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CHALLENGES ON DIFFERENT HONEY PRODUCTION SYSTEM IN AGRO-ECOLOGY OF TAHTAY-KORARO NORTH WESTERN TIGRAY, ETHIOPIA

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ABSTRACT
Ethiopia is having a large number of honey bee colonies and keen interest to develop the organizations to utilize beekeeping sector as a tool for poverty alleviation. In this study area, a number of modern bee hives with its maximum accessory were introduced but, the production and productivity are not as such prominent. This research was conducted to find out the major constraints of honeybee production in traditional as well as modern production systems along with different agro-ecology zones of Tahtay-Koraro Woreda. 120 beekeepers were randomly selected from both traditional and modern production system *i.e*. 20 respondents from each production systems were selected from highland, midland and lowland agro-ecologies. The major pests and predators are ants, wax moth, birds, bee lice, beetles, spiders and wasps. Respondents have identified the incidence and impact of beekeeping constraints was varies along with production system and agro- ecology. Provision of technical training on prevention and controlling methods of pest and predators as well as bringing a solution for the challenges based on a production system and agro- ecology is important to improve production in honey sector.

KEY WORDS: Agro-ecology, beekeeping, constraint, honeybee, production system, tahtay-koraro.

INTRODUCTION

Livestock is considered an important economic sector in Ethiopia, which significantly contributes to economic growth and development. In 2008-09 including plowing services, livestock production contributed 45% of agricultural GDP (Behnke, 2010). Ethiopia is having a huge natural resource which is fundamental for honey production and in almost all parts of the country beekeeping is traditionally well-established household activity (Gidey *et al.*, 2012). Traditional beekeeping was practiced for long period of time in the study area and the government focus on the rehabilitated Ex-closure areas was given to landless youths as cooperatives, trained and providing initial capital to run modern beekeeping activities as an alternative employment opportunity. In Ethiopia, it is estimated that around one million farmers are actively participating in honey production throughout the country using the traditional, intermediate and modern hives (Beyene and David, 2007). Honey produced in Ethiopia is almost exclusively used for local consumption (about 10% mainly is consumed by beekeeping households and 90% is sold for income generation; out of the amount which is sold for income generation 70% is used for the brewing of mead, also known as 'Tej'(Serda *et al*., 2015). Study indicates that both production system and agro- ecology was significantly affected honey yield per hive per year in tahatay- koraro woreda Ethiopia (Zekiros and Gangwar, 2017) and similar studies have been done previously in this area of honey production sector (Gangwar, 2016, Gangwar *et al*., 2010, Gebreagziabher Aregawi *et al*., 2014). Having a large number of honey bee colonies, diversified flora and creating a strong interest of development organizations to use beekeeping as a tool for poverty alleviation in the study area, but the production and productivity were not satisfactory and shows variation in different production system and agro-ecology. A study on challenges along beekeeping production system and agro-ecology is important for development and sustainability of the sector.

MATERIALS & METHODS

Study area description

The research was conducted in North Western zone of Tigray, in woreda tahtay-koraro, of Ethiopia which is a center for zonal administration. This research site is located at about 310 km far from Mekelle town and 1095 km north of Addis Ababa which is situated at longitudinal and latitudinal location of 13^0 88'36" to 14^0 07' 00"N and 38^0 04'30" to 38^0 17' 00" E respectively with an range elevation of 1035-2564 meters above sea level.

The study site is known for the mixed crop-livestock farming system in which cultivation of Teff, Sorghum, Maize, Finger Millet and Pulse crops are the major cropping activities (Yayneshet, 2010).

Sampling procedure and data collection

The study was conducted in Woreda tahtay-koraro, of Tigray region Ethiopia. The proposed study was conducted as cross-section study of the household survey including qualitative and quantitative approaches to data collection to get strong information of honeybee production systems. Based on agro-ecological classification made by the Tigray Agriculture and Rural Development Bureau (2002), Highland, Midland and Lowland refer to areas having an altitude of 2300-3200 meter above sea level and 600-800 mm annual rainfall, 1500-2300 (M.S.L) and >600 mm annual RF and 500-

1500 (M.S.L) and 400-600 mm annual RF, respectively. Therefore, based on the representativeness from three agro-ecological zones with respect to honeybee colonies potential, 3 Peasant associations *i.e. Beles* from midland, *Kelakil* from lowland and *Koyetsa* from highland were selected using purposive sampling technique.

120 respondents from the three agro-ecologies (40 per peasant associations and in which 20 per production system) were randomly selected from beekeepers.

Prior to the actual survey, information was gathered from secondary data, an informal survey from key informants and bee keeping experts in the Woreda. Based on that information, semi-structured questionnaire was developed and pre-tested for its consistency and applicability to the objectives of the study. The primary data was collected from the household respondents using semi -structured questionnaire and personal interviews, focus group discussion and personal observations.

Data analysis

Constraints along production systems (traditional and modern beekeeping) and along agro-ecologies (highland, midland and lowland) in the study area were ranked based on the ranking index formula employed by (Musa *et al*., 2006).

$$\text{Index} = \frac{\text{Rn} * \text{C1} + \text{Rn} - 1 * \text{C2} \ldots . + \text{R1} * \text{Cn}}{\Sigma(\text{Rn} * \text{C1} + \text{Rn} - 1 * \text{C2} \ldots . + \text{R1} * \text{Cn})} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

Rn=Value given for least ranked level (if the least rank is 11th, then Rn=11, Rn-1=10, R1 = 1).

Cn = Counts of the least ranked level (in the above example, the count of the 11th rank =Cn, and the count of the 1st rank = C1)

RESULTS & DISCUSSION

1. Involvement of sample respondents in off-farm activities

According to the survey result in Figure 1, a total of 24 (20%) of household sample respondents, in which 5 in highland, 11 in midland and 8 in lowland were involved in different off-farm activities besides beekeeping and agriculture work as a supplement to their livelihoods. Total of 15 (62.5%) beekeepers in modern production system and 9(37.5%) in traditional production system were participating in an off-farm activity in all agro-ecologies. The higher participation was observed in midland modern and the lower involvement in a highland traditional production system. Those respondents who involved in off-farm activities reflect that beekeeping can be practiced as part-time job and it can manage by any member of the family.

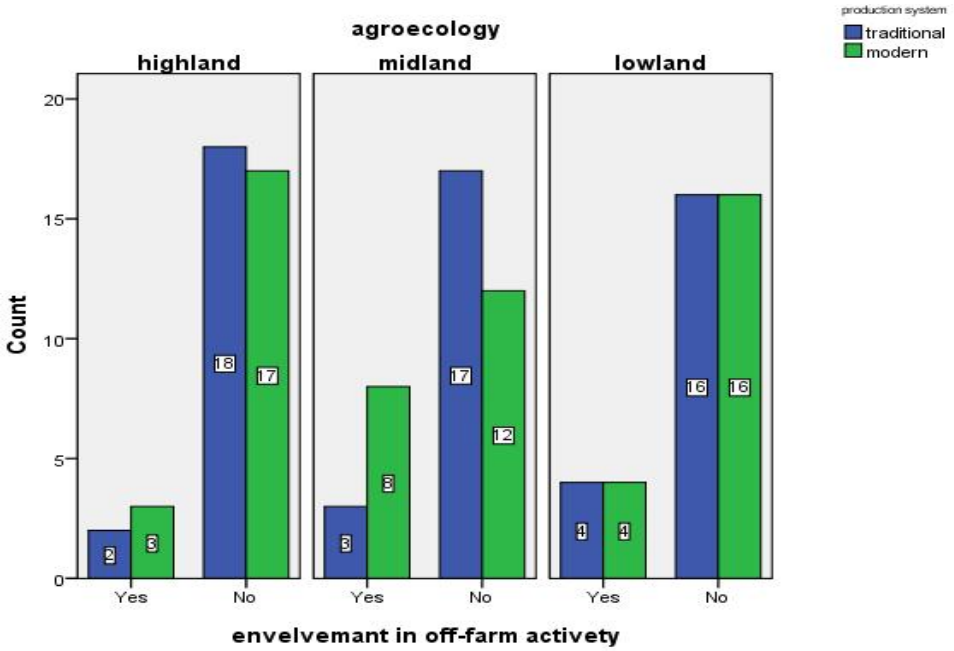

FIGURE 1. Involvement of respondents along agro-ecology and production systems

Source of bee colonies and current stock

TABLE 1. Source honeybee colony of respondents in traditional and modern production

Source	Traditional	Modern
Getting through Gift	11(18.3%)	3(5%)
Catching swarms	35(58.4%)	5(8.3%)
Purchasing	14(23.3%)	52(86.7%)
Total	60(100%)	60(100%)

Table 1: shows that source of honeybee colonies to start beekeeping. Majority of respondents in movable frame hive production 52(86.7%) obtained their colonies through purchasing. Farmers catch swarmed bee from asgede tsimbla and hrirmi water shade then they bring to sale in tahtay-koraro and other periphery woredas. However, no formal beekeepers participate in queen rearing and sealing practice in the study area. Cost of the purchasing varies based on colony strength (group discussion). Farmers also check the presence of a queen in the hive and keep the queen in locally contracted queen cage during transportation. In traditional beekeeping, the major source of initial stock is catching swarming, middle by purchasing and low through a gift. This could be due to the traditional beekeeping used small hive which good to catch swarm bee colony through hanging on the tree and long time practiced farmers used to catch swarmed bee from wild forest especially from hrimi and asgede tsimbla lowland areas.

TABLE 2. Colony holdings in traditional and modern production system in highland, midland, and lowland agro-ecology in Tahtay-Koraro (n=120)

Agro-ecology	Production system							
	Traditional				Modern			
	Maximum	Minimum	Mean	SEM	Maximum	Minimum	Mean	SEM
Highland	11	1	3.95	0.596	15	1	4.30	0.846
Midland	13	1	3.95	0.756	8	1	3.50	0.531
Lowland	18	1	5.20	0.887	12	1	3.80	0.659
Total	18	1	4.37	0.436	15	1	3.87	0.395
Production system X^2 = 82.566, P = 0.000 AEZ X^2 = .325, P = 0.850								

Where SEM = standard error of the mean

Table 2 shows an average number of colonies holding of traditional and modern beekeepers in the highland, midland and lowland agro-ecologies of tahtay-koraro. The average colony holding for traditional beekeepers were 3.95, 3.95 and 5.26 hives in the highland, midland and lowland, respectively. The average colony holding of modern beekeepers in the highland, midland and lowland was 4.30, 3.50 and 3.80 hives, respectively. There is a significant difference in colony holding along the production system i.e. traditional beekeepers have higher colony holding (4.37 hives) than modern beekeepers (3.87 hives) ($P<0.05$). This is due to the traditional beekeepers use traditional hive while could make themselves by local material and catching swarmed bee colony to start and run bee keeping and this requires no or very small startup capital comparing with movable frame hive beekeeping.

2. Honey bees pests and predators

Beekeepers were interviewed on the prevalence of bee pests and predators with their prevention and controlling methods. The respondents identified pests and predators were the major challenges in both traditional and modern production system. Based on the result they responded the pests and predators were ants, wax moth (*Galleria mellonella*), birds, bee lice (*Braula coecal*), Beetles (*Aethina tumida*), spiders, wasps, lizard and Hama gat identified in descending order according to their economical importance (Table 3). Beekeepers indicated in both traditional and modern production were used indigenous and scientific knowledge to prevent and control pests and predators.

TABLE 3. Pest and predators ranking in Tahtay-Koraro (n=120)

Pests and predators	Percentage of pest and predator by rank									
	1	2	3	4	5	6	7	8	9	Rank
Wax moth	20.5	44.3*	23.9	6.8	-	-	-	-	-	2
Birds	18.5	27.3	42.0*	8.0	3.4	1.1	-	-	-	3
Ants	52.3*	28.4	18.2	1.1	-	-	-	-	-	1
Bee lice	4.5	5.7	10.2	36.4*	36.4	5.7	1.1	-	-	4
Spiders	-	-	2.3	17.0	20.5	47.7*	9.1	3.4	-	6
Beetles	-	-	3.4	28.4	42.0*	20.5	4.5	1.1	-	5
Wasps	-	-	-	2.3	2.3	17.0	48.9*	26.1	3.4	7
Lizard	-	-	-	1.1	3.4	9.2	31.0	39.1*	16.1	8
Home got	-	-	-	-	-	-	10.3	39.1	50.6*	9

**Ranking percentage value*

TABLE 4. Constraint ranking of traditional and modern beekeeping in highland, midland and lowland AEZs

Constraints	Traditional production system								Modern production system							
	Highland		Midland		Lowland		Traditional		Highland		Midland		Lowland		Modern	
	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Cost of inputs	-	-	-	-	-	-	-	-	0.11	7	0.0893	5	0.0685	9	0.0892	7
KSG	0.118	5	0.133	5	0.10	6	0.117	6	0.09	8	0.0870	7	0.0647	10	0.0805	8
LIQ	-	-	-	-	-	-	-	-	0.20	2	0.1263	3	0.1536	2	0.1599	2
SBF	0.105	6	0.144	4	0.18	3	0.143	4	0.08	9	0.0747	9	0.1428	4	0.0991	5
Drought	0.082	8	0.104	6	0.1118	4	0.0992	7	0.06	12	0.0631	11	0.0775	7	0.0668	10
Absconding	0.186	1	0.213	2	0.22	1	0.2063	1	0.1446	3	0.1625	1	0.1857	1	0.1642	1
PAP	0.167	3	0.162	3	0.2066	2	0.1785	2	0.116	4	0.1125	4	0.1522	3	0.1269	4
Diseases	0.058	11	0.063	9	0.0557	10	0.0589	10	0.0439	13	0.0368	16	0.0576	11	0.0461	13
High temperature	0.046	13	0.040	14	0.0717	9	0.05256	11	0.0235	16	0.0383	15	0.0734	8	0.0451	14
PHA	0.164	4	0.215	1	0.1013	5	0.1601	3	0.201	1	0.13317	2	0.1098	5	0.1479	3
Lack of wax	-	-	-	-	-	-	-	-	0.1105	6	0.0589	12	0.0402	13	0.0698	9
Swarming	0.071	9	0.068	8	0.0777	8	0.0722	8	0.0416	14	0.0397	14	0.0282	14	0.0365	15
Lack of marketing	0.05	12	0.049	10	0.04	12	0.0463	12	0.018	17	0.0220	17	0.0220	17	0.0207	17
LES	0.094	7	0.049	10	0.05	11	0.0643	9	0.0349	15	0.0410	13	0.0265	16	0.0342	16
SBC	-	-	0.0476	12	0.04	12	0.0438	14	0.0672	11	0.0755	8	0.0270	15	0.0566	12
Lack of credit	0.174	2	0.100	7	0.08	7	0.1186	5	0.1116	5	0.0875	6	0.0804	6	0.0932	6
Lack of land	0.066	10	0.041	13	0.03	14	0.0459	13	0.0758	10	0.0647	10	0.0574	12	0.0659	11

Where KSG=Knowledge/skill gap, PHA=Pesticides and herbicides application, SBF=Shortage of bee forage, LIQ=Lack of inputs (accessories) and quality, LES=Lack of extension service, SBC=Shortage of bee colony and PAP=Pests and predators

(a) (b)

FIGURE 2. Ants prevention through burned oil filled beakers (a) and wax moth affected hive (b).

3. Major Constraints and economic importance in honey bee production

Among the list of significant for beekeeping production, it serves as income generation, food consumption, pollination of crops and natural resource conservation. So in order to utilize the resource in beekeeping sub-sector, it is better to identify the existing constraints and search the solutions. The occurrence and impact of constraints vary along production systems and agro-ecologies. The major challenges of the beekeepers in traditional production system absconding, pest and predators, pesticides and herbicides application, shortage of bee forage, lack of credit, knowledge and skill gap drought, swarming, lack of extension service and diseases were identified according to economic importance. However, in modern production system absconding, lack of input (accessories) and quality, pesticides and herbicides application, pests and predators shortage of bee forage, lack of credit, cost of input, knowledge and skill gap, wax adulteration and drought were identified in order of decrease order. Absconding was identified the primary constraint in both production system in the study area This is due to honeybee feed shortage, application of chemicals, the presence of pests and predators, honeybee. According to Bassa *et al*. (2016) lack of technical knowhow of small scale farmer, prevalence of honey bee enemies, lack of improved apiculture equipment's, lack of improved honeybee flora, little attention given to apiculture development and technology introduction in the sector, lack of market oriented apiculture farming system and market information problem were identified as constraints in southern nation and nationality of Ethiopia and disease, pest and predators, absconding, shortage of bee forage, lack of beekeeping materials, drought, beekeeping skills, reduction of honeybee colony, death of colony, indiscriminate application of chemicals and marketing problem were also the major constraints in sgede Tsimbl a district, Northern Ethiopia(Gidey *et al*., 2012).

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