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

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ABSTRACT
The research was conducted in Tahtay-Koraro, Woreda to determine and document socioeconomics, honey yield, harvesting frequency and suggest possible solution for existing problems in traditional and modern production systems in different AEZs of Tahtay-Koraro Woreda of Tigray. 120 beekeepers were randomly selected from both traditional and modern production system *i.e.* twenty respondents from each production systems were selected from highland, midland and lowland agro-ecologies. Traditional beekeepers was significantly highest age (51.08 years) than modern beekeepers (41.82 years) $P<0.001$ and agro-ecology was significantly affected age of respondents *i.e.* age of beekeepers was significantly higher in lowland (49.93 years), middle in highland (45.58 years) and lower in midland (43.85 years). Relatively more women were practicing in modern bee production in the highland and lowland. Average family size of beekeepers in Tahaty-Koraro was 6.09 persons per households. Production system was significantly affected beekeeping experience (20.95 years) at $p<0.01$. Majority of the hive in traditional production system was placed at inside or outside wall of the house while, in modern were at home compounds. Honey yield was significantly affected by production system, agro-ecology and their interaction ($P<0.01$) Honey yield/hive/year was significantly highest (21.37 Kg/year/hive) in the modern beekeeping than traditional (10.5 Kg/year/hive). Similarly, harvesting frequency per year was highest in modern production system (1.22) than traditional (1.03). Generally, socio-economic characteristics of beekeepers, honey yield and harvesting frequency was significantly varied. However, production systems should be supported and integrated, promotion of beekeeping should be based on AEZs, and training to beekeepers should give to maximize production and productivity.

KEY WORDS: Beekeeping, honeybee, agro-ecology, production system, tahtay-koraro.

INTRODUCTION

Livestock is considered an important economic sector in Ethiopia, which significantly contributes to economic growth and development. Ethiopia is generally considered to have the largest population of livestock in Africa (Hartmann, 2004). Livestock production contributes about 20% to Ethiopia's GDP and livelihood of 60-70% of the total population (Aklilu, 2002). Ethiopia has a huge natural resource in which base for honey production and beekeeping is traditionally well established household activity in almost all parts of the country (Gangwar, 2016, Gidey *et al*., 2012). However, the benefits obtained from this sector to the nation and individual beekeeper is not as such satisfactory (Beyene and David, 2007). Owing to its varied ecological and climatic conditions with production of unifloral honey (Gangwar *et al*., 2010). Ethiopia is home for some of the most diverse flora and fauna in Africa. Beekeeping in Ethiopia plays an important role in income generation for beekeeper farmers with an average of 420 million Ethiopian Birr is obtained annually from the sale of honey, both in local and world markets (Workneh *et al.,* 2008).

Majority of the honey production was used for local consumption, mainly for the brewing of mead, also known as *Tej* (Hartmann, 2004). For the sustainable honeybee production system, it is better to assess and evaluate the existing production system in different agro ecology. Because this helps as a base line for intervention in development, it should be applied in different production systems (Gebreagziabher *et al*., 2014).

MATERIAL & METHODS

Study area description

The research was conducted in North Western zone of Tigray, in Woreda Tahtay-Koraro, of Ethiopia which is 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).

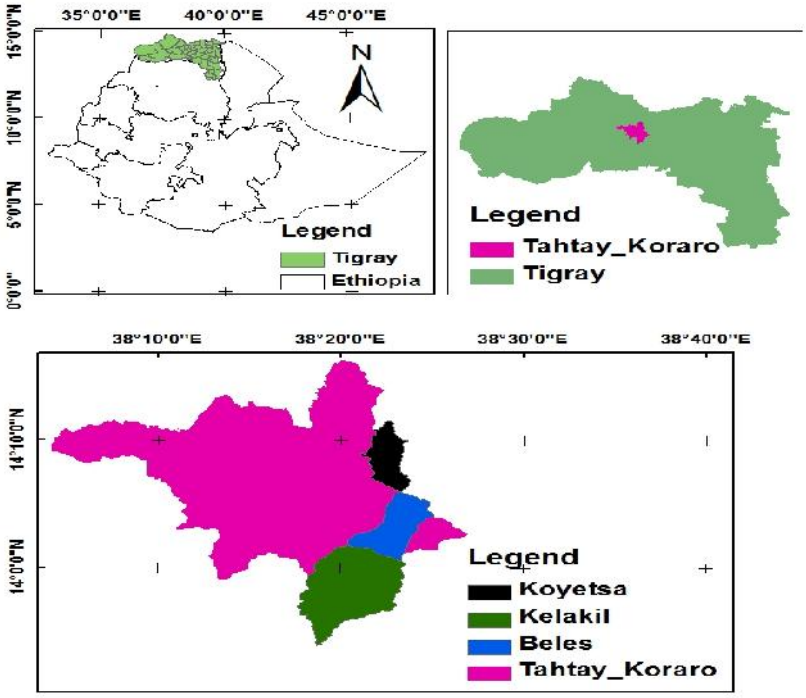

FIGURE 1: Map of study areas

Sampling procedure and data collection

The study was conducted in Woreda Tahtay-Koraro, of Tigray region. The proposed study is conducted as cross section study of household survey including qualitative and quantitative approaches of 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 that is *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, 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

Data were analyzed quantitatively using descriptive statistics such as ratio, percentage, mean and standard deviation. SPSS version 16 software and in all comparison, level of significance ($P<0.05$) were used. Statistical significances were tested for the means of different quantitative variables using F-test, both one-way and two-way ANOVA. Quantitative variables that show significant interactions between the two independent factors (production system and agro-ecology) were testing for statistical significances using two-way ANOVA.

RESULTS & DISCUSSION

Socio-economic characteristics of respondents

Sex

There was a significant difference in age between the productions systems and agro-ecology ($P<0.001$). Traditional beekeepers have more age (51.08±1.38) than modern beekeepers (41.82 ±1.44) and the age of respondents was higher in lowland (49.93 ±2.23), middle in highland (45.58 ±2.83) and lower in midland (43.85 ±2.07) respectively. The difference in age along production could be because of traditional beekeeping was deep rooted farming practiced in the woreda and the government focus on the rehabilitated closure areas was given to landless youths through organizing them as cooperatives, trained and providing initial capital to run modern beekeeping activities as alternative employment opportunity. Age difference along agro-ecology could be due to beekeeping was practiced for long time in lowland area through catching swarmed bee and rugged topography in highland influence farmers to participate in beekeeping for long time.

TABLE 1. Age of respondents based on agro-ecology and production system (n=120)

Production systems	Agro- ecology	Age of respondents		
		Maximum	Minimum	Mean± SEM
Traditional	Highland	81	26	49.95±2.95
	Midland	63	29	47.7±51.93
	Lowland	72	40	55.55±1.88
	Total	81	26	51.08±1.38
Modern	Highland	68	21	41.20±2.70
	Midland	58	22	39.95±2.22
	Lowland	68	24	44.30±2.57
	Total	68	21	41.82±1.44
Total		81	21	46.45±1.08

From the total sampled beekeepers, majority of the respondents are male-headed household (90%) and few female-headed households (10 %) beekeepers were participating in beekeeping activity. This is in line with Meaza (2010) who noted that participation of females in beekeeping is lower than males.

Family size

The average family size of the sampled respondents was 6.09, which ranges from 1-11 persons. A weak positive correlation (r = .258 and P = 0.04) was observed between family size and annual honey yield per hive. This indicates that honey yield could not strongly affect by family size because the sector needs low labor and as family size needs to more income to sustain than smaller family size.

TABLE 2. Beekeeping experience (years/household) of traditional and modern beekeepers in highland, midland and lowland AEZs of Tahtay-Koraro (n=120)

Agro-ecologies	Production					
	Traditional			Modern		
	Maximum	Minimum	Mean ± SEM	Maximum	Minimum	Mean ± SEM
Highland	41	6	20.70 ± 2.00	13	2	5.45 ± 0.55
Midland	35	10	22.35 ± 1.65	9	1	5.35 ± 0.51
Lowland	40	6	19.80 ± 1.95	11	1	5.45 ± 0.55
Total	41	6	20.95 ± 1.07	13	1	5.47 ± 0.31

In traditional way of beekeeping was practiced for long period of time in the study area. Table 2 shows average beekeeping experience in traditional production was 20.95 year and 5.47 year for the modern bee production. Beekeeping experience of traditional beekeepers was significantly higher than modern beekeepers (P<0.05). This is due to traditional beekeeping was practiced for long time as an indigenous farming practice by catching of swarmed bee from forest tree. The average bee keeping experience in Tahtay-Koraro was 13.21 years. A strong negative correlation (r= -.833 and P = 0.000) was observed between beekeeping experience and production system. This indicates that, as the production is changing to modern production system, the beekeeping experience was decreasing strongly. There is also 36 a strong positive correlation between beekeeping experience and honey yield per hive (r = .645 and P = 0.000). This indicates that as the beekeepers were increasing their beekeeping experience they are more familiar with honeybee management as a result the yield becomes increasing.

Placement of the hives

Table 3, shows majority of the respondents 32 (53%) in traditional production were placing their colony inside or/ and outside the wall of the home and in frame hive production 17(28%) of the 43 respondents were keeping through housing. This is similar with Nebiyu and Messele (2013); Gidey *et al.* (2012) who stated that majority of traditional beekeepers in Gamo Gofa zone and Asgade Tsimbla district were place at their hives backyard near to their home. The placement of hives inside and outside the wall in the house indicates the sector needs small land, which was feasible for smallholders and landless people.

TABLE 3. Placement of hives in traditional and modern production system (n=120)

Site or placement of hives	Traditional	Modern
Backyard	5 (9)	14 (23)
Irrigation	0 (0)	6 (11)
Inside the house/outside walls of houses	32 (53)	11 (18)
Hanging on trees near homestead/forest	11 (18)	0 (0)
Home compound	12 (20)	17 (28)
Area Closure	0 (0)	12 (20)

Where number in bracket is percentage

A. Modern backyard with shelter B. Traditional outside wall with human cloth

C. Traditional hive inside the house D. Modern hive in irrigation area

FIGURE 2: Placement of the hives in traditional and modern production

Honey production, harvesting frequency and harvesting season

Honeybee were collected nectar from flowering bee forage then they deposit in the comb cell after it is ripened they sealed by wax to utilize at dearth period. Majority of the respondents harvested once at the time of flowering season. However, some beekeepers also harvested twice per year. The major honey harvesting time starts from October to December while the minor harvesting season was from mid May to mid of July. This is similar with Haftom *et al.* (2013) who reported that, major honey harvesting time in Debrekidan water shade was from September to November. This could be due to following the rain season there is high availability of honey bee flowering plant.

TABLE 4. Two way ANOVA for honey yield by traditional and modern in the different AEZs.

Source	df	Mean Square	F	Sig.
AEZs	2	127.240	7.074	.001
Production system	1	3569.752	198.476	.000
Interaction	2	155.190	8.628	.000

Agro-ecology, production system and their interaction was significantly affected ($P<0.05$) for production of honey (Table 4). There was higher honey production in modern (21.37 ±0.79 kg/hive per year) than traditional system (10.5 ±0.337 kg/hive per year). The difference in honey yield among the production system was due to the suitability of modern hives for the bees because of the comb foundation was constructed by beekeeper and the bees do not loss their time and energy in constructing of comb like in traditional hive and it is suitable for management. Higher average honey productivity in modern hives was 24.4 in highland, middle 22.45 in midland and lower 17.27 kg/hive/year in lowland this could be due to abundance of nectar and pollen in highland.

TABLE 5: Honey production and harvesting frequency in relation to agro-ecology and production systems

Agro-ecologies	Production systems							
	Traditional			Modern			HFRT	HFRM
	Max	Min	Mean ± SE	Max	Min	Mean ± SE	Mean ± SE	Mean ± SE
Highland	15.00	6.00	10.9±.575	32.00	17.00	24.4±1.012	1.05±.050	1.35±.109
Midland	13.00	6.00	9.6±.387	38.00	12.00	22.45±1.387	1.05±.050	1.20±.092
Lowland	15.00	4.00	10.9±.721	28.00	8.00	17.27±1.203	1.00±0.00	1.10±.69
Total	15.00	4.00	10.5±.337	38.00	8.00	21.37±0.79	1.03±0.23	1.22±.054

Where SE=standard error of the mean, max=maximum, min= minimum, HFRT=harvesting frequency of traditional production and HFRM=harvesting frequency of modern production system.

Majority of the respondents (97% traditional and 78.4% of modern beekeeper) were harvest ones in a year but few (3% traditional and 21.6% modern beekeepers) were harvest two times in a year. Production system (X^2 9.142, P=0.002) was significantly affected the harvesting frequency. Average harvesting frequency was higher in modern production (1.22) than traditional production (1.03).This may be due to in modern hive the comb

foundation are constructed by beekeepers this makes the bees to get time to produce honey than they loss time and energy in comb construction in traditional hive. There is positive correlation between honey yields and harvesting frequency (r =48.4%, P = 0.000). This indicates as harvesting frequency increases the honey yield also moderately increases.

CONCLUSIONS

- Beekeeping is run for long time integrating with other agricultural activities in Tahtay-Koraro.
- Age of respondents ware significantly varied by agro-ecology and production system, but beekeeping experience and harvesting frequency per annum was significantly affected by production system.
- Honey production was affected by agro-ecologies, production systems and their interaction.
- There are two honey-harvesting seasons major one is from October to December this is also related with main flowering season while the minor harvesting season is from May to June.
- Production systems should be supported and integrated, promotion of beekeeping should be based on agro-ecology zones, and training to beekeepers should give to maximize production and productivity.

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