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Honeybee colony marketing and its implications for queen rearing and beekeeping development in Tigray, Ethiopia

Teweldemedhn Gebretinsae[1]* and Yayneshet Tesfay[2]

[1]Department of Animal Science and Ecotourism, Axum University, Shire campus, Shire Tigray Ethiopia.
[2]International Livestock Research Institute (ILIRI), Mekelle, Ethiopia.

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Colony marketing is an important venture in Werieleke district of Tigray region in Ethiopia. This research was conducted in Nebelet and Maikinetal colony market centres of the district to characterize market actors, colonies, the markets and prices by interviewing 120 market actors. This was run for 6 market days at one week interval (July to September in 2010) by interviewing 5 sellers and 5 purchasers from each market daily. The price of colony in Nebelet was significantly higher than that of Maikinetal ($P < 0.0001$). The highest price was found at the 3rd week of August in Nebelet (925 ± 11.64) and at the 2nd week of August in Maikinetal (596 ± 11.64). Colony marketing had been neglected in the area. Difficulties in determining quality of queen, deserting worker bees, damaging bees by heat and suffocation, comb breakage, lack of awareness on safety, lack of protective are some of the constraints faced. Colonies are flowing from the highlands, which may result in genetic erosion and other problems. Therefore, a law should be established to standardize marketable colonies, conserve bee biodiversity and avoid disease transmission. Beekeepers should be encouraged to multiply their own colonies and rear queens at their specific sites.

Key words: Beekeeping, colony, marketing, queen rearing, price.

INTRODUCTION

The government and NGOs are trying to use beekeeping as a tool for poverty alleviation in Ethiopia through provision of equipments and trainings. This increased promotion of beekeeping is creating an increasing demand for bee colonies. In contrary, the population of domestic colonies has declined from 5.15 million in 2009 (CSA, 2009) to 4.77 million in 2012 (CAS, 2012). Hence, colony marketing is becoming an important business for some beekeepers. It is a common practice in the semi-arid areas of Northern Ethiopia such as Bure district of Amhara region (Yigzaw et al., 2010), Ahferom (Nuru, 2008) and Werieleke (Teweldemedhn and Yayneshet, 2012) districts of Tigray region. This practice is an important source of income for colony sellers, both traders and producers. It is an important source of colony for beekeepers; both for start up, expansion and replacement. Colony marketing in Tigray can be classified into two categories; namely colony marketing at

*Corresponding author. E-mail: teweldeg2008@gmail.com, Tel: +251913422164. Fax: +251344444898.

Figure 1. Nebelet colony market centre.

colony marketing at central market places. Nebelet and Maikinetal are the two major central colony market places located in Werieleke district. However, little research (Nuru, 2008) has been done so far about this unique practice of colony marketing. Therefore, the objectives of this study were to assess the origin and destination of honeybee colonies, price trends, constraints and opportunities of honeybee colony marketing.

MATERIALS AND METHODS

Description of study areas

The study was conducted in Werieleke district of Tigray (13°45' to 14°10'N latitude and 38°50' to 39°20'E longitude). Two small towns Nebelet and Maikinetal were deliberately selected, as these are the only towns in the district where the tradition of colony marketing exists. These markets are among the major colony marketing centres in the region.

Sampling and data collection

Visits were made to the markets during the weekly market days and this was repeated for six market days (from the 4th week of July to the 1st week of September) throughout the colony marketing season in 2011 at a week interval. Personal observations and semi-structured questionnaires were employed to characterize colony sellers, purchasers, the physical market, the colonies, and price trends within the season and between years (from 1999 to 2010). To get information about the past, elder colony sellers were selected and interviewed. For this reason, market actors were stratified into two as colony sellers and colony purchasers. Afterwards, five colony sellers and five colony purchasers were purposively selected based on information they had from each market centre and each data collection day. Hence, a total of 120 individuals were interviewed using pre-tested semi-structured questionnaires. Colony market day and market place were considered as independent factors.

Data analysis

Descriptive statistics such as means, percentages and frequencies were used to summarize variables such as sex and practices of colony transporting. Colony prices in relation to market day and place were tested for statistical significances using two-way ANOVA at $P < 0.05$.

Statistical significances for nominal and ordinal data were tested using chi-square test in order to characterize colony market actors. Pearson correlation was also calculated for price trends of colonies, honey and hives. All statistical analyses were carried out using JMP5 statistical package.

RESULTS

Poorly equipped markets

According to the respondents from Nebelet, colony selling started since 1980s. At the time of starting, the market was located at farmlands in the Southern vicinity of the town. However, with time, this was translocated to the wastelands in the South-East vicinity of the town. Finally, when that place was allocated for other livestock marketing in the early 2000s, the colony market area was transferred again to Eastern part of the town. This area is rocky, well drained, devoid of plants, nearer to the main entry and exit road in the East ward of the town (Figure 1). Hence, people and animals pass through the edge of this colony market area without any safety precaution.

On the other hand, it became difficult to trace back the time during which colony marketing started in Maikinetal. But one can estimate that it could have at least as equal age as that of Nebelet by analyzing the background of beekeeping practice in the area. This market is located in the periphery of the main entry and exit road in the North-West of the town. It is simply a hilly side devoid of infrastructure except naturally grown scattered *Acacia* trees used as shelters (Figure 2).

Market actors

Market actors in the central colony market places of Werieleke could be classified as colony sellers and purchasers, but labourers and mediators were also involved.

Figure 2. Maikinetal colony market centre.

Table 1. Characteristics of colony sellers in Nebelet and Maikinetal markets.

Parameter	Nebelet (N = 30)	Maikinetal (N = 30)	X^2, P-Value
Sex			
Male	100 (30)	100(30)	
Female	0 (0)	0 (0)	
Average age (years)	45.17 ± 6.86^a	34.3 ± 5.40^b	P < 0.0001
One way distance (hours) to the market	4.27 ± 1.22^a	3.45 ± 0.95^b	P = 0.0055
Number of years participated in selling bees	16.1 ± 5.01^a	8 ± 3.25^b	P < 0.0001
Number of colonies sold			
Colony/day/person	2.47 ± 0.97	2.03 ± 0.93	P = 0.0862
Colony/season/person	4.73 ± 1.62	4.37 ± 1.38	P = 0.436
Proportion of sellers by type			
Producers	86.67(26)	50 (15)	
Hunters	0 (0)	50 (15)	X^2 29.327
Traders	13.33(4)	0 (0)	P < 0.0001

N.B: -Numbers in parenthesis are frequencies; -Means with different superscripts along the rows are significantly different.

Labourers were involved in transporting colonies to and from the market centres by carrying the colonies. These labourers were male, landless youths, young family members or relatives of the colony sellers. Landless youths were paid their daily wages on cash but family members and relatives were not paid.

Colony sellers in both market centres were exclusively males. The sellers in Nebelet were significantly older (P < 0.0001), had longer experience in colony selling and travelled longer distances to reach the market than those who were selling colonies in Maikinetal. The average age was 45.17 ± 6.86 (n = 30) and 34.3 ± 5.40 (n = 30) years for sellers in Nebelet and Maikinetal, respectively. The average one way walking time to reach the market in Nebelet and Maikinetal was 4 h 16 min, and 3 h and 27 min, respectively. The sellers in Nebelet were mainly producers (88.33%) who practice colony multiplication using swarming (in Ganta-Afeshum district) and splitting (in Ahferom and Werieleke districts). The remaining were traders who purchased and collected the colonies from beekeepers' apiaries and sell them at the central market. Sellers in Maikinetal were producers (splitting, swarming) and hunters in equal ratio. Hunters were mainly landless youths from the lowlands. The average number of colonies sold was 2.5 ± 0.97 and 2.0 ± 0.93 per day per person in Nebelet and Maikinetal, respectively (Table 1). Male colony purchasers accounted for 90% in Nebelet and 93% in Maikinetal. Purchasers in Maikinetal were older than in Nebelet (43.1 ± 7.47 vs 48.3 ± 6.42). Higher numbers of colonies were purchased per person per day in Maikinetal than in Nebelet (1.27 ± 0.45 vs 1.53 ± 0.51). About 85 and 90% of the bought colonies in Nebelet and

Table 2. Characteristics of colony purchasers in Nebelet and Maikinetal markets.

Parameter	Market places		P-value
	Nebelet (N = 30)	Maikinetal (N = 30)	
Sex			
Male	90 (27)	93.33 (28)	0.639
Female	10 (3)	6.67(2)	
Average age (year)	43.07 ± 7.47 [b]	48.27 ± 6.42 [a]	0.0054
Colonies purchased/person	1.27 ± 0.45 [b]	1.53 ± 0.51 [a]	0.0366
Type of hive to be used			
Modern	83.33 (25)	90 (27)	0.221
Traditional	16.67(5)	10 (3)	
Supplier of modern hives			
Relief Society of Tigray	83.33 (25)	80 (24)	0.739
Bureau of Agriculture and rural development	16.67(5)	20 (6)	
Training			
Trained	76.67 (23)	73.33(22)	0.766
Not trained	23.33(7)	26.67(8)	
Percentages of purchasers by type			
Start up	30 (9)	36.67 (11)	
Expansion	36.67 (11)	40 (12)	0.678
Replacement	33.33 (10)	23.33 (7)	

-Numbers in parenthesis are frequencies; -Means with different superscripts along the rows are significantly different.

Maikinetal, respectively were aimed to be kept in modern frame hives (Table 2).

Nature of the colonies

Colonies supplied to the markets were nested in traditional hives ranging from conical to cylindrical in shape and made of cow dung. The number and strength of the colonies in the markets varied across the market days in the summer season. The number of colonies in both markets was the lowest in July and reached a peak in the 2nd and 3rd weeks of August in Maikinetal and Nebelet, respectively (Figure 3).

The strength of the colonies was generally increased up to mid of August starting from the beginning of colony marketing season. After this, young colonies with new queen and not well established colonies started to appear in the markets (Figure 4).

Colonies in Nebelet were generally stronger than that of Maikinetal. Moreover, a special practice of worker bee collection was observed in Maikinetal, where beekeepers went to the market with empty hive(s) but caged queen(s). These beekeepers smear their hives with aromatic plants and put their queens inside the hive then hang them on trees in the market (Figure 5). In the evening of the same day, these hives were observed to be filled with as many worker bees as a weak colony at the same market. Such false colonies are meant to be sold by cheating inexperienced purchasers some days later.

In addition to colony selling and worker bee collection, queen bee selling was a common practice in Maikinetal. The price of a queen was 15 Ethiopian Birr[1]. Farmers did not provide feed for their queens while they were caged in the market. The queens stay arrested in cages before they are taken to the market regardless of their fecundity.

Colony transport

Both honeybee colony sellers and purchasers transported their colonies to and from the markets on foot by carrying them on their shoulders. Traditional hives that contain colonies for sale were fixed on top of a forked wooden tool of greater than or equal to the length of the hive (Figure 6). This tool is supposed to assist in holding the hive and minimizing its breakage. This practice was considered essential by colony sellers in Nebelet. However, most purchasers in both markets and sellers in

[1] Birr is an Ethiopian currency. Currently (July 2013), one US $ is equal to 18.58 Birr.

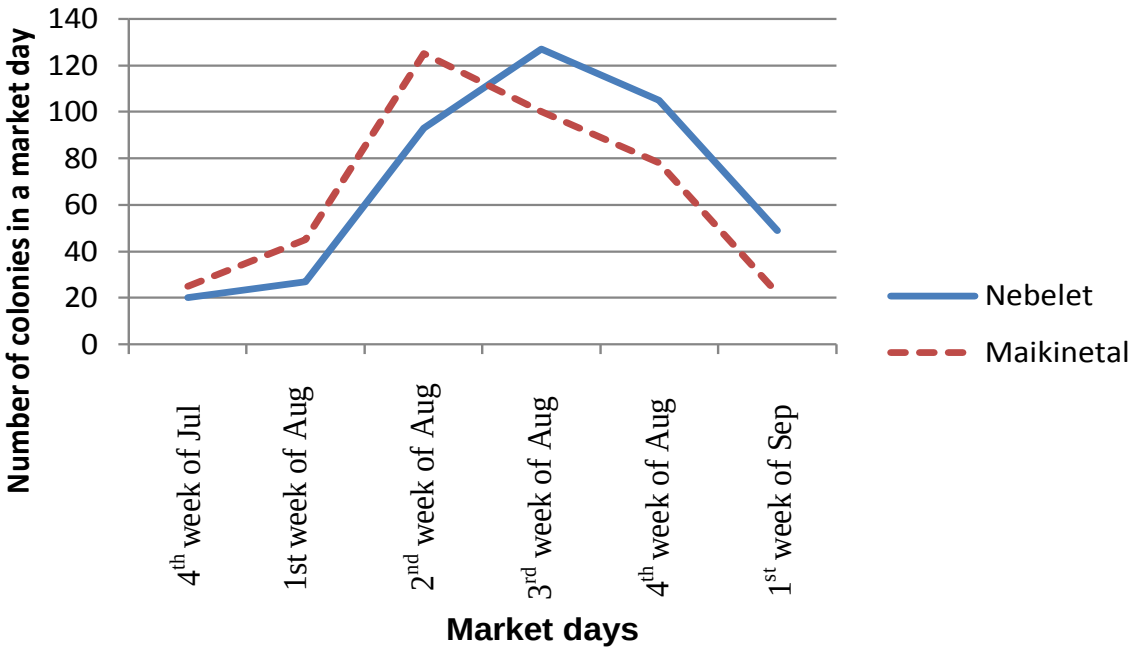

Figure 3. Number of colonies present in Nebelet and Maikinetal.

Figure 4. Varieties of colonies in the colony markets.

Figure 5. Worker bee attraction and queen selling in Maikinetal.

Figure 6. Ways of colony transporting to and from market.

Table 3. Practices used during transporting colony in Nebelet and Maikinetal markets.

Practice	Nebelet		Maikinetal		P-value
	Sellers	Purchasers	Sellers	Purchasers	(place type interaction)
Type of hive holder used					**=0.896**
Forked tool (wooden)	30(100)	5(16.67)	14(46.67)	0(0)	=0.883
Woven/'*Kefer*'	0(0)	25(83.33)	16(53.33)	30(100)	=0.993
Type of hive lid used					
Mesh	18(60)	13(43.33)	15(50)	9(30)	=0.676
Thick cloth/sack	7(23.33)	17(56.67)	9(30)	21(70)	=0.0196
Dung	3(10)	0	4(13.33)	0	=0.999
'*Sefee*'	2(6.67)	0	2(6.67)	0	
Resting of bees for ventilation					=0.999
Rest	23(76.67)	3(10)	8(26.67)	6(20)	= .999
Do not rest	7(23.33)	27(90)	22(73.33)	24(80)	=0.999
Support for combs?					=0.967
Use	25(83.33)	0(0)	0(0)	0(0)	=0.967
Do not use	5(16.67)	30(100)	30(100)	30(100)	=0.967
Caging of queen in the market					
Cage	30(100)		20(66.67)		
Do not cage	0(0)		10(33.33)		

Numbers in parenthesis are percentages.

Maikinetal transported colonies by holding them in a woven basket type of household tool called '*Kefer' (*Figure 6). Sellers in Maikinetal know about the forked tool but they preferred *Kefer* because the hives of their colonies are smaller enough to be placed inside this basket type tool. During transport, hive lid varied from home made dry dung and '*sefee*' to dark/thick cloths and thin/transparent well ventilated meshes.

To avoid heat accumulation inside the hives and damage to the bees, sellers travel early in the morning, and attentively monitor the sound of their bees. When the vibrating sound of bees is increased in an effort to maintain the temperature of the hive, colony sellers go to a shelter, any tree nearby their path, and let the colonies to rest and cool down by opening their cover. They also used a thin/transparent well ventilated meshed cloth as a cover. This was a common practice to those who sell colonies in Nebelet. Colony sellers who travelled longer distances have various mechanisms to avoid or minimize these risks (Table 3).

Figure 7. Comb breakage and prevention technique during colony transport

Figure 8. Knowledgeable beekeeper orienting colony purchasers at Maikinetal.

Breakage of combs was one of the risks in colony transporting whose frequency increased with the strength of colonies. To avoid this, supporting combs with dried cow dung was commonly practiced by colony sellers in Nebelet. However, both sellers and purchasers in Maikinetal did not know how to avoid the risk of comb breakage. Consequently, some of the stronger colonies broke their combs and the bees were damaged (Figure 7).

Colony marketing

Colony marketing system in Werieleke was an open system where price was determined through direct negotiation of purchasers and sellers. The process of pricing was determined by the strength and quality of colonies and queens. Indicative factors used for pricing include queen presence, its age and fertility, and docility of the bees. However, many purchasers did not know how to evaluate colonies and were assisted by knowledgeable people (Figure 8).

The risks that purchasers and sellers faced and the remedies they employed are summarized in Table 4. The major risk the colony sellers faced during selling was loss of some worker bees. Worker bees were deserting by some dazzling colony sellers who were skilful to attract bees from other colonies gathered in the market.

Inter-annual colony price trend

The average price of a bee colony was significantly ($P = 0.0039$) higher in Nebelet than in Maikinetal (771.33 Vs 528.67 birr). Price of bee colonies had been increasing continuously at an average rate of 11.3 and 13.1% per

Table 4. Risks and remedies of purchasers and sellers in Nebelet and Maikinetal markets.

Category	Risk	Remedies
Purchasers	Queenless colony	-Look for presence of brood
		-Look for queen if caged
		-Agreement
	Quality of queen	
	Age	-Bright colour of combs and regularly patterned larva
	Fertility/clipped wing	-Presence of larva
	Aggressive bees	-Observation
Sellers	Loss/deserting/robbing workers bees	-Isolating away from suspected colonies
		-Pushing away suspected colonies
		-Closing bees within their hive

Table 5. Pearson correlation between colony price, honey price and cost of modern hive.

	Colony price in Nebelet	Colony price in Maikinetal	Honey price (modern)	Honey price (traditional)
Colony price in Maikinetal				
R	0.956	1		
P	0.044			
Honey price (modern)				
R	0.976	0.958	1	
P	0.024	0.042		
Honey price (Traditional)				
R	0.996	0.941	0.984	1
P	0.004	0.059	0.016	
Cost of hive				
R	0.778	0.794	0.895	0.814
P	0.222	0.206	0.105	0.186

year over the period of 1999 to 2010 for Nebelet and Maikinetal, respectively (Table 5). The average price per colony was 231 ± 25.14 and 125 ± 20.14 in 1999 and grew to 925 ± 41.43 and 596 ± 35.65 in 2010 for Nebelet and Maikinetal, respectively (Figure 9). A strong positive correlation was found between colony prices in both markets, price of honey of modern and traditional hives in the district, as well as cost of modern hives (Table 5).

Intra-annual colony price trend

The prices of bee colonies significantly fluctuated between the two market places ($P < 0.0001$) as well as among the market days ($P < 0.0001$). In Maikinetal, it slowly increased from the beginning of the marketing season and reached its peak in the second week of August. On the other hand, the price of a colony in Nebelet sharply increased from the beginning of the marketing season and reached its peak in the 3rd week of August (Table 6). After the peaks, it gradually declines in both cases.

DISCUSSION

Nature of markets

The results on the nature of markets indicated that Nebelet and Maikinetal could be among the oldest

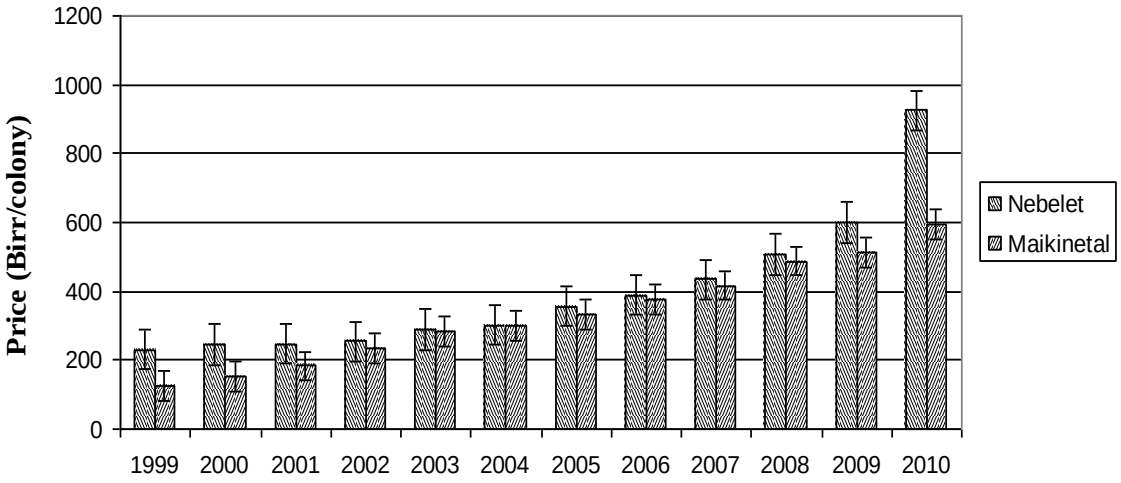

Figure 9. Bee colony price (Birr per colony) trend in Werieleke over 12 years period from 1999 to 2010.

Table 6. Colony price in Nebelet and Maikinetal during 4th week of July to 1st week of Sep (2010).

Week	Market place		P value
	Nebelet	Maikinetal	
4th July	637 ± 1.64^{de}	535 ± 11.64^{gh}	P market place < 0.0001
1st August	687 ± 11.64^{bcd}	565 ± 11.64^{fg}	P marketing week < 0.0001
2nd August	733 ± 11.64^{bc}	596 ± 11.64^{ef}	P interaction < 0.0001
3rd August	925 ± 11.64^{a}	520 ± 11.64^{ghi}	
4th August	883 ± 11.64^{a}	483 ± 11.64^{hi}	
1st September	763 ± 11.64^{b}	473 ± 11.64^{i}	

Means with different superscripts within a row and column differ significantly ($p < 0.05$).

honeybee colony marketing centres in northern Ethiopia. However, they have remained neglected from development. The locations of these colony market centres have changed several times without considering the basic requirements such as suitability and safety precautions. These could be because of less attention of local authorities and experts despite the compulsory apicultural Proclamation 660/2009 of Ethiopia (Federal Negarit Gazeta, 2009). As opposed to that of a nearby colony market called Enticho (Nuru, 2008), taxes were not collected from the sale of colonies in Werieleke, which could have contributed to infrastructural development in the colony market itself.

Nature of market actors

Bee colony multiplication and selling have remained to be a business of men from the highlands. Their clients were male and female headed households in the lowlands and midlands for both traditional and modern hive production systems. This is a reflection of the low potential for honey production (CSA, 2012) of the mountainous areas of Ganta-Afeshum and Ahferom districts which are characterized by less vegetation and climates of windy, cold and comparatively wet with bimodal rainfall patterns. In such areas bees tend to have more broody nature than collecting nectar and storing honey (Verma, 1989). The bees found in the highlands are thought to belong to *Apis mellifera monticola* (Amsalu et al., 2003) although Meixner et al. (2011) have considered the whole honeybees of Ethiopia as a single race. *A. mellifera monticola* is known for its calm behaviour, with good performances in the cool highland areas but fails to adapt in hot lowland areas despite of the availability of bee floras (Ruttner, 1988).

The abundant availability of wild honeybee colonies that are being hunted and brought back to the colony markets by landless youths harbouring in the lowland areas could be a justification for the presence of high rate of absconding among the bees sold to the lowlanders. This agrees with Teweldemedhn and Yayneshet (2012) who have stated that annual colony absconding per household in Werieleke district was the highest in the

lowlands. Furthermore, various ecotypes of bees could be developed to adapt to different agro-ecologies. Bees located in the lowlands of Tigray are classified as *Apis mellifera jementica* (Amsalu et al., 2003). Therefore, the practice of transporting colonies from the highlands to the lowlands and valleys of Werie could have a serious genetic erosion, genetic mix-up and disease transmission. The differences observed in the sources of colonies among the districts could be indications of differences in the tendency of the bee colonies towards swarming and absconding, level of skill of beekeepers and potential of the areas.

Hunting or trapping of colonies is possible in areas having suitable habitat for bees. However, in the mountain areas of Tigray having less vegetation where beekeepers are specialized on colony multiplication, the swarming colonies have less chances to escape and enter someone else bait hive (Nuru, 2008). On the other hand, the existence of significantly younger purchasers who bought fewer bee colonies in Nebelet compared to Maikinetal is an indication of the increasing involvement of landless households in the highlands and midlands in beekeeping.

Beekeeping is an important means for rural livelihood improvement because it does not require more capital, land, labour and technology (Bradbear, 2003) and hence it helps for agricultural wastelands to become productive (Jacobs et al., 2006). Unlike the selling of colonies by predominantly males, women were also purchasing bee colonies in both market centres. This agrees with Yigzaw et al. (2010) who noted that the number of women beekeepers is increasing in recent years as the extension is trying to gender mainstream beekeeping.

Nature of colonies

The variation in the number of bee colonies at the market, their strength throughout the marketing season and the market places clearly reflects the annual colony growth cycle of the areas. Both strength and number of colonies steadily increased up to the second and third weeks of August in Maikinetal and Nebelet, respectively. After this period, small colonies started to appear not only as a result of prime swarming but also after (successive) swarming, which are locally called '*elet'* to mean that weak bee colonies. Hence, the proportion of young colonies increased up to the end of the marketing season in both places. Colonies of the midland market (Nebelet) were generally stronger than that of lowland market (Maikinetal).

At the beginning of the marketing season, colonies were collected by hunting and newly transferred to hives in Maikinetal. The practice of deserting worker bees at Maikinetal market appears to have weakened the colonies. Colony sellers were also frequently quarrelling with the worker bee collectors due to the illegal action of the later. Purchasers also suspected colony sellers of the low quality bees collected in such a manner. Another serious problem investigated in the market was the selling of young queens arrested in traditional cages. The probability of fecundity of such caged queens is very low as the mating flight is generally restricted to a maximum age of 26 days (Cramp, 2008; Sammataro and Avitabile, 2011).

Experiences from Australia show that queen bee marketing is so advanced that high quality queens are sent through postmen in conditioned containers with enough attendants and feed. Unlike to the low level of local beekeepers' and experts' understanding on the biology of bees in Tigray, queen purchasers in developed countries are informed about the age of queens to be taken out of their nucleus hives (Doug, 2009). Beekeepers' and experts' knowledge and skill of bee biology should be considered as the basis for success on beekeeping. Because of this gap, unoccupied modern frame hives as high as 66% were reported in Bure district where colony marketing is recently emerging using hunting as its sole source (Yigzaw et al., 2010). These are implications for introducing appropriate queen rearing techniques in Ethiopia based on knowledge of bee biology.

Practices of colony transport

Underdeveloped transport infrastructure in association with rugged topography restricted the honeybee colony sellers and purchasers to travel on foot for transporting bee colonies to and from the markets. However, their long tradition of colony marketing seems to be enabling them to transport bee colonies safely. The efforts of the beekeepers in avoiding heat accumulation, suffocation and damage are remarkable. This practice is in line with the recommendations of Krell (1996). However, the lowlanders who were selling and purchasing colonies in Maikinetal were comparatively less aware of such requirements, which could be related to their short experience in bee colony marketing. This is because most of them are youths who trap and hunt colonies as a means of getting income without having enough experience in beekeeping and colony transporting.

Practices of colony marketing

In a marketing system where there is no standard for the bees and pricing is highly compromised, the colony purchasers are liable to many risks with regard to the quality of the colonies and queens. This was aggravated by their lack of skill on beekeeping as most of them were beginners. Hence, they were left with the options of hiring a skilled person or buying from known sellers with some kind of guarantee. This is an indication of policy and

extension gaps with respect to beekeeping and colony marketing. The extension office has tried nothing to help such farmers. Deserting worker bees to sell them as if a colony, bringing queenless colonies, and selling unfertilized queens were among the major problems observed due to poor technical backup and loose regulation.

Conflicts were arising because of the collection of worker bees by deserting from their colonies in the market. Such individuals came to the market with weak colonies and/or queen alone. They attract bees from the market using different aromatic plants such as citrus fruits and spices. The fate of such colonies might be absconding shortly after their arrival to their destination since a colony of old workers without a queen and larvae, and a colony with unfertilized queen have no chance of producing bees for the next generations. This risk was more prevalent in Maikinetal than Nebelet, which agrees with an earlier report (Teweldemedhn and Yayneshet, 2012). To avoid the risk, colony sellers attentively watch at the situations around them and immediately react whenever a suspected colony is observed. Either they force the dazzling person to go away with his bees or they close their bees. However, it was difficult to control the situation and beekeepers were complaining for a gap in law that deals with such trespassing.

Inter-annual colony price trend

The fast growth in the inter-annual price of a colony could be associated with the introduction of modern frame hives, increasing price of honey and over all decline in the purchasing power of the Ethiopian currency (Birr). A growing beekeeping industry usually creates a demand for bee colonies (Krell, 1996). Prices of colonies significantly increased in other regions too. This was due to shortage of colonies as a result of degradation, agricultural intensification and poisoning by chemicals, increased demand due to introduction of large number of hives, deprivation of natural multiplication due to introduction of modern hives and lack of skill of colony multiplication (Yigzaw et al., 2010). The strong positive correlations among colony prices in both market centres, price of honey of modern and traditional hives, as well as cost of modern hives supports the above argument.

As long as the commercialization of beekeeping increases through provision of modern beehives while beekeepers are not trained how to produce their own bee colonies, the price of colonies will continuously increase. This in turn is a reflection of the quality-supply-demand for the colonies as clearly seen in the markets. The price of colonies was generally higher in Nebelet than in Maikinetal because the colonies in Maikinetal were heterogeneous ranging from very weak, less established, hunted colony to well established. On the other hand, the demand for colonies was higher in Nebelet than that of Maikinetal. This was because new beekeepers around Nebelet were using the market as their sole source of colonies in contrast to that of new beekeepers around Maikinetal who used hunting.

Intra-annual colony price trend

Similar to the inter-annual patterns, the intra-annual and spatial patterns in price of colonies were fluctuating according to the quality-demand-supply of colonies. That is colonies at the beginning of marketing season were generally weak and they continued to be stronger through time until a new pattern came. Similarly, the supply of colonies at the beginning of marketing season was limited because the time for colony multiplication is later in the season. On the other hand, purchasers of colonies were not confident enough to buy colonies at the beginning of the season while the fate of the weak colonies and the rainfall pattern were difficult to predict. However, purchasers were eager to buy colonies as early as bees and rainfall are predictable. Their aims were to have well established productive colonies before the summer is ended up.

The price of colonies reached its peak earlier in Maikinetal than Nebelet due to the agro-ecological differences between them. Since the lowland areas were characterized by vegetations that bloom quickly after the start of the rainfall, the strength of bee colonies and the demand of beekeepers to purchase colonies grow faster.

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Conflict of interests

The authors have not declared any conflict of interests.

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