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MARKETABLE SUPPLY OF HONEY: EVIDENCE FROM FARMERS HOUSEHOLDS IN ETHIOPIA

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Abstract. Identifying determinants of honey market supply in smallholder producers were the objective of the study. Both primary and secondary data were collected. A total of 150 honey producer households were selected randomly from honey producer households and data were collected by individual interviews using a pre-tested structured questionnaire and a focus group discussion. Secondary data were collected from published and unpublished sources. The data was analyzed using descriptive statistics and multiple linear regression models. The model result revealed that beekeeping experience, training participation, colony number, frequency of extension contact and types of beehive owned significantly affect the volume of the honey marketed. The study highlights the importance of providing training, arranging field days and creating a forum for experience sharing, providing of a modern hive and giving good extension services.

Keywords: Abuna Gindeberet, honey, market supply, multiple regressions, smallholder producer

INTRODUCTION

Ethiopia has a longer tradition of beekeeping than other countries in the world since the time of King Ezana, around the 3rd century AD, and as a result of its forests and woodlands (Workneh, 2011). Additionally, in 2013, the country produced 45,000 tons, which accounted for about 27% and of African and 3% of world honey production, making the country the largest producer in Africa and tenth in the world (FAOSTAT, 2015). However, beekeeping research and development activities were initiated in 1965 with the establishment of the Holeta Bee Research Center (HBRC), aiming to improve the productivity of the subsector (Desalegn and Kebede, 2005).

Beekeeping requires little land and is therefore an ideal activity for small-scale, resource-poor farmers (Arage et al., 2018) and is valued as an environmentally friendly agricultural activity. It mainly produces natural honey and its associated by-products - beeswax, royal jelly and pollen. However, according to the CSA (2017), Ethiopia's total honey production is about 47.71 million kg, of which the greater proportion of honey (90%) is harvested from traditional hives, with about 95% of hives being 'traditional'. The Ethiopian climate and the extended flowering season are favorable for apiculture, but beekeeping has been a marginalized activity in most developing countries and is widespread in most parts of Ethiopia (Adilo et al., 2005). Despite Ethiopia's huge potential, honey production has not been fully exploited in the country due to a number of factors (Awraris et al., 2012). According to Kassa et al. (2018), honey producers faced marketing problems due to the remoteness of some kebeles, low farm gate prices and long market chain, which results in a low level of marketing. Improved information and marketing enable farmers to

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plan their production and marketing more effectively. However, current knowledge on bee product marketing is poor and inadequate for overcoming the problems identified in the marketing system (Awraris et al., 2012).

According to Kassa et al. (2018) in their study on the factors affecting the market supply of honey in Chena district, which uses multiple linear regression model, beekeeping experience and distance from the nearest market have a significant positive and negative effect on market supply, respectively. However, the findings of the study by Tizazu et al. (2017) on the determinants of honey market supply using multiple linear regression models inferred that these variables have no significant effect on the market. In addition, Samuel's (2014) studies of the honey market chain, and the case of Sodo Zuria, multiple linear regression model findings indicate that the age and family size of the household head had a negative impact, while beekeeping training, the number of modern beehives used, the educational status of the household head, the previous year's price, total livestock holding and agro ecology were positively related with the volume of honey supplied to the market. From this we see that there is a gap between the studies on the determinants of the honey market supply from place to place, and even district to district. Even though both honey and honey by-products are economically and socially important, no study has been conducted to improve the sector. Therefore, this study helps to identify market supply determinants of honey producers in Abuna Gindeberet district.

METHODOLOGY

Study area

This study was conducted in Abuna Gindeberet district of West Shewa zone, Oromia regional state, Ethiopia. Abuna Gindeberet district is located about 170 km west of Addis Ababa and 128km from the zonal town Ambo. It is characterized as midland (32%) and low land (68%), which is about 13 midland and 28 low land kebeles. The district has a total of 44 kebeles, of which 41 are rural administrative kebeles with a total population of 181,853, where 49.93% were male and 50.07% were female. Beekeeping is practised with about 14,569 honey bee colonies, totalling approximately 299 Modern hives, 1114 Transitional hives and 13,156 Traditional hives in the study area (AGDLFDO, 2018). The district is suitable for honey production due to its favorable agro ecology and beekeeping activities, as it houses for bee forage. Honey production is commonly practised during two production seasons, but more intensively used in the first season that is during flowering season. The first and second season run from September to November and from April to May, respectively.

Types, source and method of data collection

The data were gathered using survey questionnaires from a sample of households of honey producers in the district in question. Enumerators who are working in the selected rural *kebeles* as development agents were selected for data collection. Before data collection, the enumerators were trained in the techniques of data collection and the questionnaires were pre-tested to evaluate the appropriateness, simplicity, understanding and relevance of the questions, as well as the time taken for an interview. Data were collected using a structured questionnaire from honey producer households.

Sampling procedures and sample size

A multi-stage sampling technique was employed for this study. Firstly, *kebeles* were classified in to midland and lowland agro ecology because the district has about 13 midland and 28 lowland *kebeles* and all *kebeles* were honey producers. Secondly, two *kebeles* among each agro ecology selected randomly, namely Goro jalate and Kolu from the lowland, and Yagot and Irjajo from the midland *kebeles*. The third stage, honey producers and non-producers identified and at the fourth stage, 150 sampled households were randomly selected from honey producers using probability proportional to sample size. The formula for sample size determination for a heterogeneous population is given by the Cochran's formula (1997).

$$n = \frac{pq(Z)^2}{e^2} = \frac{0.5 \cdot 0.5(1.96)^2}{0.08^2} = 150 \qquad (1)$$

where:

n – sample size
p – 0.5
q – 1-p and
e – 8% allowable error
Z – value of standard variant at a given confidence level and to be worked out from the table showing the area under the normal curve is 95% $z\alpha/2 = 1.96$

Methods of data analysis

Descriptive analysis: Inferential statistics such as the chi-2 test and t-test were used in the process of examining and describing the characteristics of the sampled household.

Econometric analysis: Different models could be employed to analyze the determinants of market supply, although the most commonly used are multiple linear regression, Tobit and Heckman's models. If some households prefer not to participate in a particular market in favor of another, while others may be excluded by market conditions, the Tobit or Heckman models are used to analyze the market (Komarek, 2010). However, in this study, multiple linear regression models were used to analyze the determinants of smallholder honey supply to the market. This model was selected because of the assumption that all honey producers participate in the market, and practical applicability. Following (Greene, 2003), the econometric model specification of supply function in matrix notation is as follows:

$$Y_i = X'\beta + U_i \quad (2)$$

where:

Y_i – amount of honey supplied to the market
β – vector of the estimated coefficient of the explanatory variables
X' – vector of the explanatory variables and
U_i – error term

When some of the assumptions of the Classical Linear Regression (CLR) model are violated, the parameter estimates of the above model may not be the Best Linear Unbiased Estimator (BLUE). Thus, it is important to check the presence of heteroscedasticity, omitted variable and multicollinearity among the variables that affect the supply of honey in the district.

Multicollinearity test: It is necessary to test the multicollinearity problem among the explanatory variables, which seriously affects the parameter estimates. According to Porter (2008), multicollinearity refers to a situation where it becomes difficult to identify the separate effect of independent variables on the dependent variable because of an strong relationship existing among them. The Variance Inflation Factor (VIF) was used to check multicollinearity among explanatory variables. As a rule of thumb, if the VIF is greater than 10, the variable is said to be highly collinear (Gujarati, 2009). A measure of multicollinearity associated with the variance inflation factors (VIF) is computed as:

$$\text{VIF} = \frac{1}{1 - R_i^2} \quad (3)$$

Where:

R_i^2 is the multiple correlation coefficients between explanatory variables, and the larger the value of R_i^2, the higher the value of VIF, causing higher collinearity in the explanatory variable.

There are a number of test statistics for detecting heteroscedasticity. The Breusch-Pagan / CookWeisberg test for heteroscedasticity was used to detect any linear form of heteroscedasticity in this model. Finally, Ramsey RESET test (test for omitted variables) was employed to test specification errors which may occur due to the exclusion of relevant variables and link test conducted for model specification.

Hypothesized variable

Table 1 shows the types and number of variables used, how the variables are described and also how the variables are measured while conducting this study.

Table 1. Summary of variables determining producers' honey market supply

Variable	Description	Type	Measurement	Hypotheses
1	2	3	4	5
SHH	Sex of the HH head	Dummy	1 – male, 0 – female	+
HHSz	Household size	Continuous	Adult equivalent	±
EDLHH	Education level of HH	Continuous	Years of schooling	+
AECOL	Agro ecology	Dummy	1 – midland, 0 – lowland	+

Table 1 – cont.

1	2	3	4	5
DISNM	Distance from nearest market	Continuous	Hours	–
EXPR	Beekeeping experience	Continuous	Years	+
TRAINP	Training participation	Dummy	1 – trained, 0 – not	+
COLONY	Number of colony	Continuous	Number	+
ACREDIT	Access to credit	Dummy	1 – yes, 0 – no	+
FEXTCO	Frequency of extension	Continuous	Number	+
TBH	Type of beehive used	Categorical	1 – traditional, 2 – traditional & transitional, 3 = traditional & modern and 4 – all	±

Source: own computations, 2019.

RESULT AND DISCUSSION

Characteristics of sampled households

According to Table 2, the family size of sampled household results revealed that the mean of the family size of household in adult equivalent was 7.30 in midland and 5.54 in lowland agro ecology with an aggregate of 6.47. Since honey is not labor-intensive agricultural activity, a large number for family size is not as important, because it increases the level of consumption at home. The t-test results showed that household size was statistically significant at a 10% significant level, meaning that the household size between lowland and midland agro ecology was not equal. In the terms of the distance to the nearest market in the study district, the average distance needed for the farmer to travel to the nearest market was about 1.12 (1:07) hour and 1.89 (1:53) walking hour for midland and lowland agro ecology, respectively, with an overall average of 1.49 (1:29) walking hour per trip. This creates variations among the sampled households to purchase inputs and to sell their produce at the required period of time and at affordable prices. The t- value inferred that there were significant differences in the distance traveled to the nearest market center at a 10% level of significance. This shows that there is a difference in walking hour for agro ecology in honey marketing.

Another importance attribute was the educational status attained by the household head during the years of schooling. Education also enables a person to perform basic communications for business purposes, as well as production practices. From all the sampled household heads, the average educational status was found to be 5 years of schooling approximately with an average of 6 and 4 years of schooling for midland and lowland agro ecology, respectively. In other words, some farmers did not attend formal education, while others attended formal education in the district up to 15 years of age. These results on the two-tail t-test show that education level was statistically significant at a 10% level of significance. This implies that there was a significant difference in educational status of lowland and midland agro ecology. In other cases, in terms of the number of colonies owned by a sampled household, there were on average about 6.22 and 9.37 honey bee colonies existing in midland and lowland agro ecology, respectively, with an aggregate of 7.71 numbers of hives in the study area. This implies that there were households with a large number of colonies to produce an ample amount of honey for sale as well as for economic growth. The result of the two-tail t-test shows that the number of colonies owned was statistically significant in between lowland and midland agro ecology at a 5% level of significance.

Regarding the types of honey beehives owned, 71.33 % of sampled households owned only traditional hives, with 30% from midland and 41.33% from lowland agro ecology. About 8.67% of the households had both traditional and modern hives. However, 13.33% of midland and 3.33 % of lowland with a total of 16.67% sampled households owned all types of beehives, which means traditional hives, transitional hives and modern hives. According to Table 2, the types of beehives owned were statistically significant at chi-squared results of 1%. This implies that there was a significant difference in having traditional

Table 2. Mean and proportion of household characteristics by agro ecology

Variables	Category	Midland (*N* = 79)	Lowland (*N* = 71)	Both (N=150)	t-/χ^2 value
Sex of the household head	Male	71(47.33)	65(43.33)	136(90.67)	0.1241
	Female	8(5.33)	6(4.00)	14(9.33)	
Family size (man equivalent)		7.30	5.54	6.47	–4.154*
Education of household head		5.62	4.03	4.87	–3.112*
Distance from nearest market		1.12	1.89	1.49	5.625*
Market information	Yes	50(33.33)	41(27.33)	91(60.67)	0.4818
	No	29(19.33)	30(20.00)	59(39.33)	
Experience in beekeeping		10.23	9.11	9.70	-0.9768
Training	Yes	53(35.33)	50(33.33)	103(68.67)	0.1932
	No	26(17.33)	21(14.00)	47(31.33)	
Access to credit	Yes	18(12.00)	10(4.67)	28(18.67)	1.8644
	No	61(40.67)	61(40.67)	122(81.33)	
Number of beehives owned	Traditional	338(29.24)	640(55.36)	978(84.60)	2.5678**
	Transitional	58(5.02)	12(1.02)	70(6.06)	
	Modern	91(7.87)	12(1.02)	103(8.91)	
Volume of honey supply		66.84	79.45	72.81	0.8781
Frequency of extension contact		1.98	1.66	1.84	–1.3403
Types of beehives owned	Traditional hive	45(30.00)	62(41.33)	107(71.33)	17.76***
	Traditional and transitional	3(2.00)	2(1.33)	5(3.33)	
	Traditional and modern	11(7.33)	2(1.33)	13(8.67)	
	All in one (all hive types in one)	20(13.33)	5(3.33)	25(16.67)	

Source: computed from survey data, 2019.

hives, transitional hives, modern hives and combination of all beehives in one between midland and lowland.

Determinants of honey market supply

Interpretation of OLS estimates is possible if and only if the basic assumptions of multiple linear regression models are satisfied. Thus, prior to running a regression of the OLS model, model specification error, existence of multicollinearity, heteroscedasticity and omitted variable test were detected.

To monitor the effect of the hetroscdasticity, robust standard error is used. The VIF test indicates no serious multicollinearity problem, where all VIF values were ranging between 1.08 and 3.04 with a mean value of VIF 1.72, which is less than 10 among continuous explanatory variables, and the Contingency Coefficient for dummy variables tested. The existence of omitted variables was also checked using the Ramsey Reset test. The results showed that there were no problems of omitted variables. Among the hypothesized eleven variables included in the regression model, five variables were found to significantly affect honey market supply at the household level.

Experience in beekeeping: As expected, the beekeeping experience of the sampled households significantly and positively affected the volume of honey sold at a 10% significance level. This result is in line with the findings of Kassa et al. (2018) and Ayantu (2018), who illustrated that as beekeepers experience increased, the volume of honey supplied to the market also increased.

Training participation: The model results imply that participation in beekeeping training significantly affected the volume of honey supplied at the 5% significance level. It is known that providing training to honey producers can fill the knowledge gap that constrained production, productivity and marketing. This is in line with the findings of Tizazu et al. (2017), and also those of Samuel (2014), who depicts beekeeping training significantly affects the volume of honey supplied at the HH level.

Number of beehives owned (colony): As hypothesized, this is a highly significant variable affecting the quantity of honey supplied to the market at a 1% significance level. This indicates that producers with more beehives can harvest a greater amount of honey and have the probability of supplying more honey to the market. Tizazu et al. (2017) and Kassa et al. (2018) confirmed that the use of a large number of colonies directly related to the amount supplied to the market and return earned by the beekeeper.

Frequency of extension contact: A contract extension was positively and significantly related to the volume of honey supplied at the 10% significance level. This is mostly due to the fact that beekeepers who frequently contact extension workers concerning the honey production, harvesting, transferring and handling methods contributed to increasing the amount of honey supplied to the market. The result is consistent with the findings of Kassa et al. (2018) and Tizazu et al. (2017).

Types of beehives owned: This is a categorical variable that affects the decisions of honey producers to sell a particular amount of the honey they produce. The model result shows that using both modern and traditional beehives, and having traditional, transitional and modern hives together affected the volume of honey supplied significantly and positively at a 5% and 1% level

Table 3. OLS estimated result of the determinants of honey market supply in the study area

Variables		Coefficient	RSE	t-ratio	p-value
Sex of household head		18.233	11.132	1.64	0.104
Household size		–0.626	1.104	–0.57	0.571
Education level		–0.685	0.842	–0.81	0.417
Agro ecology		9.419	6.474	1.45	0.148
Distance from market		4.133	3.873	1.07	0.288
Beekeeping experience		0.432*	0.248	1.74	0.084
Training participation		11.452**	4.958	2.31	0.022
Colony number		9.451***	1.220	7.75	0.000
Access to credit		0.163	7.183	0.02	0.982
Extension contact frequency		4.456*	2.547	1.75	0.082
Types of beehives owned	Trad. and Trans.	–2.184	12.037	–0.18	0.856
	Trad. and modern	30.139**	12.415	2.43	0.017
	Combination of all	40.83891***	12.64624	3.23	0.002
_cons		–51.3992***	17.85706	–2.88	0.005
Number of observation		150			
F (13, 136)		42.06			
Prob > F		0.0000***			
R-squared		0.9110			

Source: own computation from survey results, 2019.

of significance, respectively. This indicates that having only traditional hives in large number doesn't increase the volume of honey supplied in relation to the number of hives when compared with modern hives. The result was confirmed by Ayantu (2018) and Kassa et al. (2018).

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary and conclusion

The study focused on factors affecting the market supply of honey in the study area. The data were collected from a total of 150 producers using structured questionnaires. Inferential statistics and econometric (multivariate probit) models were used to analyze the data collected using STATA Software version 13 and excel sheet.

Abuna Gindeberet district is suitable for honey production due to its favorable agro ecology and availability of bee forage. The results revealed that the total production of honey was estimated to be 158,489 kg from 14,569 honey bee colonies, with late October to beginning of December being the peak honey production and harvesting season.

In conclusion, econometric results of the multiple regression models indicated that experience in beekeeping, participation in training, the number of colonies owned, the frequency of contact extensions and the type of beehives positively and significantly affected the volume of honey marketed as expected. All variables with a significant effect positively determined the amount of honey marketed in the study district.

Recommendation

From the study findings, the following policy recommendation can be made.

- Training significantly affects the honey marketed in the study area, because honey production and the management practices of the farmers are mostly based on traditional knowledge. Therefore, improving the honey producers' skills and knowledge, providing required materials and training producers will minimize problems and create the capacity for farmers to expand their production and increase the volume of honey supplied and assist faster delivery of the products. Therefore, all relevant bodies should pay attention to training provision.
- Improving the technical know-how of beekeepers based on using the best practices of experienced beekeepers as a point of reference would help to set targets in increasing market supply of honey. In particular, fostering positive attitudes toward partnership, networking and learning from one another by arranging field days, cross visits and creating a forum for experience sharing need to be developed among honey producers.
- Using a combination of different types of hives is critical in increasing productivity per hive (modern), and the efficient utilization of resources (input) is beneficiary. The relevant bodies should focus on increasing hive productivity through promoting and providing modern hives. In order to overcome the shortage of modern beehives, the government and NGO should pay attention to providing the required material, such as honey extractors.
- It is better to have a small number of modern beehives than having many traditional hives. This would increase productivity and marketing practices of farmers and enables them to link with honey and honey product marketing. To boost the marketed surplus across farmers, there is also a need to focus on the number of colonies owned, and especially modern hives by improving, facilitating and giving priority.
- The frequency of extension contacts is improved by the existing technology, bringing beekeepers into more extension services and referring them to the necessary advisory services can help beekeepers increase their honey market supply to the market.

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