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Analysis of the Economy of Beekeeping and Honey Supply in Horo Guduru Wollega Zone, Oromia, Ethiopia

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ABSTRACT

The study focused analyzing the determinants of honey supply, to analyze the economy of beekeeping, honey marketing and income generating activities undertaken in Horo Guduru wollega zone of Oromia Region, Ethiopia. About 121 honey producers (110 male & 11 female) were selected randomly from a list of 536 honey producers found in 5 purposively selected 'kebeles'. The data were generated by individual interview and group discussions using pre-tested semi structured questionnaires and checklists. Secondary data were collected from different published and unpublished sources. The data collected were analyzed with the help of descriptive statistics and econometric model (multiple linear regression model). The results obtained from econometric analysis indicates that colony size, type of beehives used, beekeeping equipment, market information, current honey price, frequency of extension contact per year and trainings were positively and significantly affected honey supply. Of course, some opportunities have also been indicated like availability of bee colony, favorable environment, and annual flora and farmers' experiences. To boost the economy of beekeeping and honey marketing which in turn increase producers income from honey supply, all concerned bodies need to focus on building farmers capacity via training on improving honey production and supply, increasing access to improved beehives and its accessories, availing extension facilities, improving road facility, organizing honey producers to increase the volume, access to marketing and price setting, and establishing honey market center are recommended for policy intervention.

Keywords: Economy of Beekeeping, Honey Marketing, Determinants, Smallholder Farmers, Multiple Linear Regression Model

1. INTRODUCTION

Beekeeping competitive advantage for on-farm integration is attributed to the low start-up costs, labor requirements, land, technology and reliance on traditional knowledge and skills. It provides complementary services to other on-farm enterprises like crop pollination. It has significant role in generating and diversifying income of subsistent smallholder farmers mainly the small land holders and landless, among marginalized and small income earners such as women, orphans and other vulnerable groups within the society (Tolera, 2014). Oromia region contributes 46% and 54.8% of the national honey production and of the hive number respectively. The honey sector is one of the few sectors that had the most inclusive ability to achieve transformation and growth across all categories of rural households. The situation is similar in Horro Guduru wollega zone which contributes 2.3% of the Oromia honey production (Central Statistical Agency, 2013)

Horro Guduru Wollega zone is one of the 20 administrative zones found in Oromia and comprising 12 districts. Guduru district considered in this assessment is grouped under high potential for beekeeping development and covered with natural vegetation, shrubs, annual and perennial crops. Moreover, it has adequate water resources and large bee colonies, which create conducive environment for honey production (CSA, 2017). Thus, honey production and marketing has the role and contribution to ensuring food security and nutrition, poverty reduction, income diversification, and ecosystem safeguarding and it is believed that can improve living standards of the smallholder farmers. Yet, honey marketing remains low among the farmers. The determinants of honey supply has not yet been studied and analyzed for the target study area, where great potential of its production exists. Therefore, this study will be conducted to identify factors affecting honey supply in Guduru district, Horro Guduru Wollega zone.

1.2 Statement of the problem: Honey production and marketing in Ethiopia is reliable revenue generating activity and traditionally practiced both by farmers and landless rural smallholders. Conversely, the existing situations to exploit the potential regarding honey production and marketing is not encouraging (Samuel, 2017). Beekeeping by its nature doesn't need huge investment (financial asset), large size of land and complicated technical knowledge for honey production and supply to market. It is an off-farm income source engagement with specific importance to all those who do not have access to land and additional income for who do have

access land. In this way honey supply to the market was expected to play a significant social and economic role in many households, it serves as a source of additional income and cover household expense, including: purchase grains, home consumption, clothes, fertilizer, improved seeds, school fee, health care, pay for taxes, loan and other social obligations.

The major constraint to increase the welfare of smallholders is their inability to access markets. Enhancing the ability of poor smallholder farmers to reach markets and actively engage in them is one of the most pressing development challenges. Without having convenient marketing conditions, the possible increment in output, rural incomes, and foreign exchange resulting from the introduction of improved production technologies could not be effective (MoA and ILRI, 2013) . According to (Mulugeta, 2014) study result, 4,526 quintals (452 ton) of honey is produced in Gudru district annually. His study result shows that, more than 70% (316.5 ton) of produced honey is supplied to the market, without seeing the factors which affect the quantity supply.

The government offices and NGOs has been trying to give trainings and beekeeping equipment's in the area to increase the production and productivity without considering and notifying the income-generating activities undertaken by smallholder farmers to know the level of beekeeping contribution in household income, marketing, opportunity and challenges in honey production and supply in the area. Hence, this study attempted to analyze the economy of beekeeping, honey marketing, income-generating activities undertaken, and determinants of honey supply in the area.

2. REVIEW OF EMPIRICAL STUDIES ON DETERMINANTS OF HONEY SUPPLY BY SMALLHOLDER FARMERS

A number of studies are conducted on factors affecting supply of honey to the market. For instance, (Assefa, 2009) employed multiple linear regression models to analyze factors affecting market supply of honey. He investigated 10 factors that affect market supply of honey in the study area namely, sex of the household, age of the household, education level of household, experience in beekeeping, extension access, quantity of honey of produced, price of honey, access to credit, distance to the nearest market and market information. A Multiple linear regression model was employed by (Samuel, 2017) to analyze factors that determine volume of

honey marketed by the sample households. He found eight variables being significant determinants of the level of honey volume marketed. These variables were age of household, previous year price, family size, beekeeping training, agro-ecology, literacy status of household, size of livestock holding and total number of modern hives used in production by household heads.

According to (Kassa *et al*, 2017) investigation by using multiple linear regression models, six variables were found to be significantly affected the market supply of honey at household level. These are experience in beekeeping, frequency of extension contact, number of beehives owned, type of beehives used, cooperative membership and distance to the nearest market. They argued that the honey producers in the study area faced marketing problem due to remoteness of some PAs, low farm-gate prices and long market chain which results to low level of market participation. By using the same model (Tizazu *et al*, 2017), identified the four variables:- number of modern hives, credit use, training participation and number of days of extension contact which are affecting market supply significantly and positively.

Quantity supply of honey computed to different explanatory variables by employing the econometric analysis i.e. multiple linear regression analysis and the regression result revealed out of 13 explanatory variables, 10 of the variables: - household age, household family size, education, price, distance from market, year of experience, credit access, land size, modern hives and annual income have a significant effect on quantity supply of honey (Zegeye, 2018).

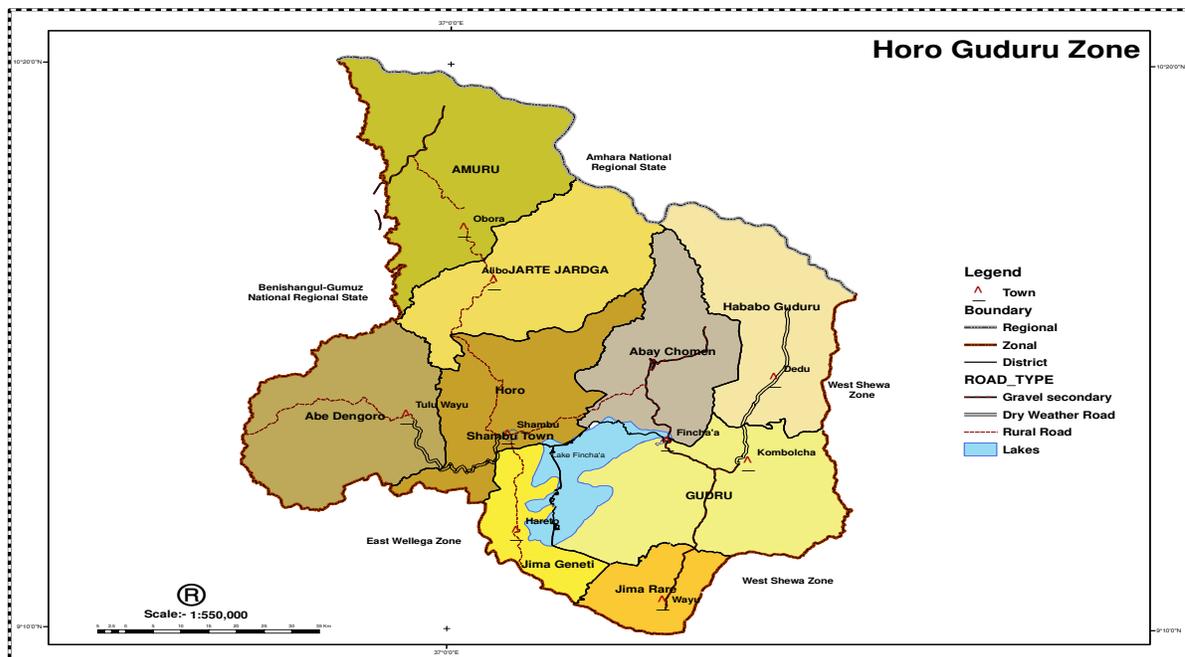
Regarding to the production different studies reported beekeeping equipment such as the number and type of beehives, ownership of protective clothing, hand gloves, knives and baiting materials to influence honey yield (Chali, 2018 & Elizabeth Ahikiriza, 2016). According to (Chali, 2018), study in Guduru district was that, the amount of honey product from traditional, transitional and modern hives for beekeepers accessing extension services is 6,246kg (62.8%), 1,079kg (92.5%) and 397kg (100%) respectively, while the honey harvest from traditional, transitional and modern hives for those beekeepers who do not have access to the beekeeping extension service is 3,695kg (37.2%), 87kg (7.5%) and 0kg (0%) respectively.

3. RESEARCH METHODOLOGY

This section presents the detail of the methodology that the research used. Description of the study area, Study population, Sampling Design and Methods of data analysis are explained.

3.1. Description of the Study Area

This study will be under taken in Horoguduru Wollega Zone; it is one of the Zones found in West Oromia. Today this Zone is sub-divided in to 12 District for its administrative purpose. Shambu is the capital town of this zone located about 314 km away from the capital town of Oromia called Finfinne. Horo Guduru Wollega zone is bounded by Amahara National Regional state in the North, west shoaw zone in the East, in the West East wollega, in the South West shoaw and West Wellega zone. Based on figures from the Central Statistical Agency (CSA) in 2007, the total population of Horoguduru Wollega zone is projected to be 576,567 of which 65,063 was urban population and 511,504 was rural population in 2007. According Regional Statistics and information from Agricultural office, the total area of the zone is 7867.6 km². The areas of the districts vary from study to study. However, the following table shows us the areas of each district.



Source: (GRLALUO, 2020)

3.2 Study population: Based on the census carried out recently the total population of the district is estimated to 113,123 (55,433 male and 57,690 Female). The total number of the rural population is 78,664 (38,548 male and 40,116 female). The total number of urban population is 34,459 (16,885 male and 17,574 Female). The total number of rural household head is 10,033 (9,473 male and 560 female) (GDANRO, 2019)

3.3 Sampling Design: A cross-sectional survey was adopted for conducting the study. The information were collected at one shot and then organized and analyzed. To increase the reliability of the study, identification and selection of sampling kebeles, where beekeeping activities are practicing, were carried out by employing purposive sampling method.

In the district, currently there are 25 kebeles (20 rural and 5 urban). For the study a two stage sampling procedure was employed to select a specific honey producer household. First, purposive sampling was employed to identify kebeles in which more beekeeping activity is undertaken. Based upon their beekeeping potential and number of involved farmers, socio-economic homogeneity of the community, researcher's operational area and some factors like financial resources and time, the researcher fixed the number of sample kebeles to be 5. These are: Dilalo Baro, Gamane Gudane, Gudane Kobo, Gobbu and Yeron Ama Tole. Among selected 5 kebeles, the smallholder farmers of honey producers were selected purposively. According to (Storck *et al.*, 1991), cited by (Chali, 2018), the size of the sample depends on the available fund, time and other reasons and not necessarily on the total population. In the second stage, using the population list of honey producer farmers from sample kebeles, the intended sample size was determined proportionally to population size of honey producer farmers. So, by using a simple random sampling a total of 121 sample household head of honey producers were selected.

3.4 Sample Size Determination: The study was used the following formula to calculate sample size. This study applied a simplified formula provided by (Yamane, 1967), cited by (Kassa *et al.*, 2017) to determine the required sample size at 95% confidence level degree of variability = 0.5 and level of precision = 8% (0.08)

$$n = \frac{N}{1+N(e)^2}$$

Where; n =designates the sample size the research uses;

N= designates total number of households

e =designates maximum variability or margin of error 8 %

1=designates the probability of the event occurring.

The following steps were used to determine sample size derived from the above formula to collect quantitative data using questionnaire.

$$\text{Therefore; } n = \frac{536}{1+536 \times 0.08^2} = \underline{121}$$

Therefore, the total sample size was 121 out of this: 27 from Gamane Gudane, 25 from Yeron Ama Tole, 21 from Dilalo Baro, 24 from Gobbu and 32 from Gudane Kobo kebeles proportionally to population size as shown on the following Table 1.

Table 1: Sample distribution of farmers (honey producers)

NO.	Name of Kebeles	Total farmers Household Head	Honey producer Households	Sample households	%
1	Yeron Ama Tole	345	112	25	21%
2	Gobbu	402	107	24	20%
3	Dilalo Baro	356	94	21	18%
4	Gudane Kobo	329	105	24	20%
5	Gamane Gudane	547	118	27	22%
	Total	1,577	536	121	100%

Source: - Own Survey result, 2020

3.5 Method of Data Collection: Both primary and secondary data were used for this study which is qualitative and quantitative in nature. Primary data were collected from sample households using semi-structured questionnaire and checklist. The data were collected by enumerators (DAs) and the researchers. The enumerators (DAs) were trained on how to conduct the interview schedule and how to approach farmers during the interview. So as to revise and modify the questionnaire for the final survey, a pre-test of the interview schedule was conducted on selected respondents who are assumed to be representative of the households living in the sample Kebeles. Based on the feedback obtained from the pre-test, the interview schedule was customized. In addition to this, Focus Group Discussion and key informant interview were employed to supplement the research finding with qualitative information. Secondary data were gathered from various sources such as records, documents, reports etc. of both governmental and non-governmental organizations such as Guduru district office of livestock and fish, Gurmuu Development Association, Agricultural and Natural Resource Offices, rural land administration & land use office and others office.

3.6 Method of Data Analysis

Data Processing: Quantitative data entry was started after all actual data compilation and summary were carefully organized and manual editing was completed. Filled questionnaires

were coded and keyed into STATA software of version 14.2. Once the process of data entry was accomplished, polishing and cleaning of the data were started. Data cleaning and editing focuses on checking whether the assigned value for each case is legitimate, on the logical consistency and structure of cases.

Descriptive Statistics: Descriptive statistics such as mean, minimum, & maximum values or scores, percentage, standard deviations and frequency was used along with econometric model to analyze the determinants of honey supply by smallholder farmers. Primary data that were collected through focus group discussions and key informant interviews was analyzed using qualitative technique of data analysis. Identification and then ranking was used for income-generating activities practiced by smallholder farmers, opportunity and challenges intended for honey production and honey supply in the study area. On the other hand, data collected through interview were analyzed through narration and interpretation.

Econometric Analysis: Different models can be employed to analyze the determinants of market supply. The commonly used ones are Multiple Linear Regression, Tobit and Heckman's sample selection models. If participation of all beekeepers in marketing of the honey is not expected, using OLS model by excluding non-participants from the analysis introduces selectivity bias to the model. Tobit, Double Hurdle and Heckman two stage procedures have been suggested to overcome such problems. If only probability of selling is to be analyzed, probit and logit models can adequately address the issue. If some households may not prefer to participate in a particular market in favor of another, while others may be excluded by market conditions Tobit or Heckman models are used to analyze market supply. By using Tobit model, the market supply can be analyzed by clustering the respondents' into supplier and non-suppliers. If censored regression is applied, the model estimates are biased because of there is no clustering honey producers as all of households supply their product to market (Wooldridge, 2010).

Like Tobit model, sample selection model (Heckman) is used in some cases when sample selection biased occurred in addition to clustering of respondents. The first stage of the Heckman model a 'participation equation', used to construct a selectivity term known as the 'inverse Mills ratio' which is added to the second stage 'outcome' equation that explains factors affecting volume of product marketed and estimated by using ordinary least square (Wooldridge, 2010).

However, in the study area all honey producers participate in the market by supplying their produce and therefore there is no clustering of honey producers in honey market participant and non-participant. Thus, for this study, multiple linear regression model and its estimation using ordinary least squares (OLS) was used to identify determinants of honey supply.

3.7 Econometrics Model Specification

The econometric model specification of the variables is as follows.

$Y = f(\text{Age, Gender, Family size, education, Farm Land size, Colony size, types of beehives, beekeeping equipment, non-bee farm income, credit, Market information, honey price, Frequency of extension contact per year, training, etc.})$

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_{14} X_{14i} + U_i \quad (1)$$

Econometric model specification of supply function in matrix notation is the following.

$$Y = \beta X + U \quad (2)$$

Where Y_i = honey supplied to the market

β = a vector of estimated coefficient of the explanatory variables

X = a vector of explanatory variables

U_i = disturbance term

3.8 Variables Specification and Working Hypotheses

Hypotheses

- H_0 = There is no statistically significance on honey supply by smallholder farmers due to personal attributes, socio-economic factors and institutional factors.
- H_A = There is statistically significance on honey supply by smallholder farmers due to personal attributes, socio-economic factors and institutional factors.

Dependent Variable: The main objective of this research is to analyze the determinants of honey supply by smallholder farmers. Honey is produced mainly for market and is one of the most beekeeping product and cash commodities for in the study area. For this, the honey marketed or supplied is dependent variable and it is continuous variable measured in Kg.

Independent variables

Variables	Unit	Description	Effect
Independent Variables			
X ₁	Continuous variable (Years)	Age of beekeeper	+
X ₂	Dummy: (1=male, 0=female)	Gender of beekeepers	+
X ₃	Continuous variable (number)	Family of beekeeper in number.	-
X ₄	Continuous variable (years in schooling)	Education level	+
X ₅	Continuous (hectare)	Land size owned by smallholder farmers	+
X ₆	Continuous variable (number of bee colony)	Colony size or total number of beehives with bee colony	+
X ₇	Dummy (improved (Transitional & Framed) = 1, Traditional = 0)	types of beehive smallholder farmers do have	+
X ₈	Dummy variable (yes = 1, no = 0)	Access to beekeeping equipment	+
X ₉	Continuous variable (birr/year)	Smallholders' non-beekeeping income	+/-
X ₁₀	Dummy variable (yes = 1, no = 0)	Access to credit from MFIs	+
X ₁₁	Dummy variable (yes = 1, no = 0)	Market information	+
X ₁₂	Continuous variable. birr/kg (2019 value)	price of honey	+
X ₁₃	Continuous variable (Frequency of extension contact days/year)	Number of days by which the beekeepers contacted by Extension workers	+
X ₁₄	Dummy variable (yes = 1, no = 0)	Smallholder farmers training on beekeeping	+

Source: Own hypothesis, 2020

4. RESULTS AND DISSCUSSIONS

This section presents the results of descriptive and econometric analysis. The descriptive analysis describes the general characteristics of the sampled beekeepers, income-generating activities undertaken, opportunity and challenges on honey production and market supply. The econometric analysis is used to identify factors that affect supply of honey in Guduru district

4.1 Socio-economic Characteristics of the respondent

Land Size of the respondents: In agriculture, landholding size plays a significant role in the rural farmers' household livelihood situation. Respondent beekeepers in the study area have access and use of land for their various agricultural activities; they have land for crop farming, livestock keeping and beekeeping activities as well (Chali, 2018). The average land holding of the respondents is 2.9 hectares, whereas the minimum and maximum land holding size of the

respondents are 0.25 and 8.53 hectares respectively with standard deviation of 1.59 refer to table 3 below.

Table 2 Land holdings of the respondents in hectares

Variable category	N	Minimum	Maximum	Mean	Std. Deviation
Land size owned by smallholder farmers	121	0.250	8.531	2.91441	1.591488

Source: Own survey data, 2020

Hive types and colony size used by the respondents: According to the information from the office of livestock and fishery offices of Guduru district, there are 445 modern hives, 51,114 traditional hives and 2,375 Kenya Top-bar or ‘chefeka’ hives in the district. The result of the survey showed that, the most common bee hive used by smallholder beekeepers was traditional hives (85%), the second one was KTB (4%) and framed hive ranked third (1%) as per shown on the following Figure 5.

Table 3 Honey bee colony holding size and hives types the of respondents

Variable category	N	Minimum	Maximum	Mean	Std. Deviation
Bee Colony size	121	5	166	38.62	27.419
Traditional hive	121	5	150	33.35	24.433
Transitional hive	121	0	30	4.09	6.008
Framed hive	121	0	16	1.45	2.895

Source: Own survey data, 2020

The entire 121 sample farmer’s honeybee colony holding size in the study area ranges from 0 to 16 framed beehives, 0 to 30 KTB and 5 to 150 traditional hives shown on table 5. From the survey result, the beekeepers who do have only traditional beehives was 38% while 62% of them have both traditional, transitional and framed hives. The result showed that minimum number of honey bee colony owned by a household is 5, maximum is 166 its mean is 39 with the standard deviation of 27.4.

The source of traditional and transitional bee hives of the respondents was from own construction. They are very familiar with how to construct different types of traditional and transitional bee hives from locally available materials. This result is consistent with the result

reported by (Chali, 2018) that found that, the main areas of indigenous beekeeping knowledge are hive construction from locally available materials, swarm catching; hive fumigation and plastering. It was found that all Framed (improved box) beehives were prepared in private small and micro enterprise manufacturing centers found in the area. At the time of survey, the price of one framed (improved box) beehives was Birr 1,800.00. But others accessories mentioned above are not found in the study area.

4.1 Marketing of Honey in the area

Share of honey for sell and home consumption: According to the study result shown on the figure 6 below, sampled beekeepers were taking the majority of their product to the market 26,205.45kg (95%); they only used a small amount of honey for home consumption 1,363.6 (5%), mainly during the holiday and for their cultural ceremony, medicinal purposes, as food and gifts for relatives from the total production of 27,569.05kg (20,724.05kg crude & 6,845.00kg pure honey of 2018/2019). It is nearly similar with (Tizazuet *al*, 2017) study result revealed, that of 96.7% the total production of honey by sample respondents was marketed. According to (Mulubrihan, 2014) also, the beekeepers were taking the majority of their product to the market; they only used a small amount of honey for home consumption, mainly during the holiday and for their cultural ceremony.

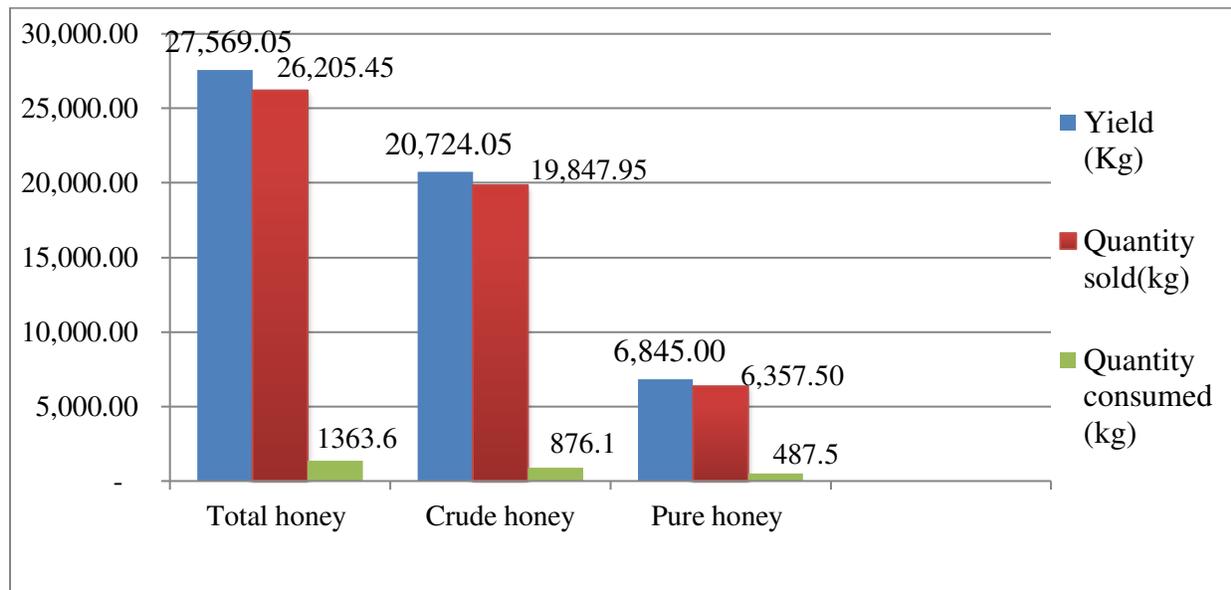


Figure 1 Proportion of 2018/2019 honey yield sold and consumed by respondents

Source: Own survey data, 2020

Pricing of honey in the study area: According to the study result, the majority of beekeepers were price takers. Despite the high honey, production in the district there is no ready market which attracts farmers. During harvesting period the price of honey is lower. Therefore, the farmers do not want to sell when the market is flooded by honey supply unless they have no urgent problems. They store the honey until the price of honey increase. About 72% (f=82) of sample respondent said, price is determined by buyers and they are price takers. The rest 24% (f=29) sample respondents replied that the price is determined by negotiation and 4 % (f=5) of sample respondent determined the price by their own as of table 11. It is similar with (Mulubrihan, 2014) study that, smallholder beekeepers are small price takers & have low bargaining power. The price of honey was determined by buyers, only few beekeepers were making pricing by negotiation. The price of honey has been fluctuating depending on the demand and the supply of honey. During harvesting period the honey price goes down and later it will rise.

Table 4 The way in which the price of beekeepers honey determined

Variable	Frequency	Percent
Buyers	87	72.0
Myself	5	4.0
Negotiation	29	24.0
Total	121	100.0

Source: Own survey data, 2020

The result of this study indicates that, the majority of buyers determine the price of the honey depending on the quality of beekeepers honey. The honey with white color and purified (semi-processed) honey by local materials has got a higher price than the red color and crude honey in the area respectively. As shown on the table 12 below, the average selling price of sample respondents were 48.38 ETB and 142.86ETB for crude and pure honey respectively. The minimum and the maximum selling price were 38 and 80 ETB for crude honey respectively. And the minimum and the maximum selling price of pure honey were 100 and 200 ETB respectively for 2018/2019 year of production. Additionally, the prices trend of both pure honey and crude honey is increasing from the past three years (2016/2017 to 2018/2019) as per shown in the following Table 12.

Table 5 Honey price trend of the past three years

Yield	Year	N	Minimum	Maximum	Mean	Std. Deviation
Pure	2016/2017	51	35.00	130.00	81.6667	23.48759
Honey	2017/2018	74	50.00	150.00	108.7162	20.54165
	2018/2019	85	100.00	200.00	142.8588	25.62186
Crude Honey	2016/2017	121	23.00	45.00	31.8595	5.51408
	2017/2018	121	28.00	50.00	38.1901	5.37481
	2018/2019	121	35.00	80.00	48.3802	10.16059

Source: Own survey data, 2020

This is also might be the same case with the reason for trends of honey yield increment that is due to favorable weather condition, increment of beekeeping participants, introduction of improved (KTB & Modern) bee hives, a slight improvement of extension serves, the demand for the honey is raised throughout the country and out of the country and newly starting initiation honey producers on honey purification and providing for consumers of local and town in the study area. The rise of demand for the honey in turn raises the price of honey in the district. The availability of different non-governmental organizations that support beekeepers in different aspects like product quality and handling improvements in the study area was another cause for the increment honey prices.

4.2 Access to Services

Access to different services could be essential to improve production and productivity of smallholder's farmers. More specifically, access to credit, training, extension contact and market information, are the most important factors that promote production and marketing of honey and thereby increase income of the producer are displayed below in table 13.

Table 6 Beekeepers' access to credit, extension service, training & market information

Services	Response	Frequency	Percent
Credit access	Yes	54	44.6
	No	67	55.4
Market information	Yes	55	45.5
	No	66	54.5
Training	Yes	79	65.3
	No	42	34.7
beekeeping equipment	Yes	68	56.2
	No	53	43.8

	Yes	108	89.3
Extension contact	No	13	10.7

Extension contacting frequency (days/year)	N	Minimum	Maximum	Mean	Std. Deviation
Number of days contacted per year	121	0	139	45.59	43.845

Source: Own survey data, 2020

Access to and Availability of Credit: Credit is important to facilitate the introduction of innovative technologies and for input and output marketing arrangements. From the total of 121 sample households, only 44.6 percent (f=54) of them had received a minimum of 1,200 and maximum of 12,000 Birr and its mean was 4993.3019 with 3378.94569 standard deviation. However, the result showed that the mentioned credit was not for beekeeping purpose rather it was for farm inputs purchase 79.25% (f=43), livestock purchase 3.70% (f=2) and household consumption 16.67% (f=9) as per displayed on table 13 above.

It is similar with (Chali, 2018) study result that, all interviewed respondents reported that there are no any credit facilities. Similarly, (Mulugeta, 2014) study shows that, regarding to financial service in Gudruu district, OCSCO and WASASA have given agricultural loan and there is no loan distributed to beekeeping activity. And also (Aseffa, 2009) study result showed that, even though farmers need credit to purchase different inputs to enhance the quantity and quality of the honey production, the short repayment period as well as the high interest rate of the service was not suitable to the individual respondents.

Table 7 share of credit for different activities' of the respondents

Variable	Frequency	Percent
Farm input purchase	43	79.63
Livestock purchase	2	3.70
Invest on honey production	0	0.00
Household consumption	9	16.67

Source: Own survey data, 2020

Access to Extension Contact: Beekeeping extension service is provided by the district livestock & fishery Office and NGOs. Each sampled kebeles has DAs of animal production and two other professionals. As a result, about 89.3 percent (f=108) of the sample respondents had access to

extension service to promote the apiculture sector and thereby increase the quantity and quality of the commodity at farm level. About 10.7 percent (f=13) were not get extension service at all. Thus, according to the information gathered from the study, minimum number of days that the respondent contacted by extension agent is 0, maximum is 139 days its mean is 45.59 days with the standard deviation of 43.845 as per shown on table 13.

Access to Beekeeping Training: Among 121 respondents 65.3 percent (f=79) of the respondents took training on Improved Beekeeping Approach which have been provided by DAs, NGOs and district livestock and fishery offices while 34.7 (f=42) were not took these trainings as shown on table 13.

Access to Beekeeping Accessories: The beekeeping equipment's like smokers, gloves, bee veils, overall, boots, water sprayer, bee brush, queen excluder, fork, knife, honey container, honey presser, honey sieve, honey extractors and other accessories was accessed for 68 respondents (56.2%) and 53 respondents (43.8%) replied not accessed to as shown on table 13. According to Table 14, the share of the resources for those who were replied yes on access of beekeeping equipment, was 12.4% donation from NGOs and AGP, 43.8% own purchase in collaboration with Gurmoo Development Association and district livestock and fishery offices facilitation.

Table 8 Share of equipment sources

Equipment Accessed from	Frequency	Percent
Donation	15	12.4
Own	53	43.8
Not accessed	53	43.8

Source: Own survey data, 2020

Access to market information: With regard to access to the market information, 45.5 % (f=55) of the sampled respondents had access to the nearby market price information as table able 13. The survey result presented in table 12 also shows that, 54.5% (f=66) honey producers were limited to some source of market information. Accordingly, 45.5% of the total sampled households respond that, they obtain price information from NGOs (Gurmoo Development Association), extension agent and personal observation on market.

4.4 Results of Econometric Analysis

The econometric analysis was planned to analyze factors affecting volume of honey supply to market in the area.

Determinants of Honey Market Supply:

Fourteen explanatory variables were hypothesized to determine the household level marketable supply of honey. Among the hypothesized seven variables were found to be significantly affected the market supply of honey at household level. These are colony size (number of beehives owned), type of beehives used (improved and traditional), beekeeping equipment, market information, honey price of 2019, frequency of extension contact per year and training as per presented on table 20. The remaining seven variables (age, gender, family size, education, farm land size, non-bee farm income and credit) were found to have insignificant effect on honey market supply.

Table 20: OLS Logarithmic Estimation of Factors Affecting Honey Supply

Variables	Coefficient	Standard Error	t	P>/t/
Age of honey producers	-0.1178084	0.2339897	-0.50	0.616
Family size	-0.1338359	0.1065191	-1.26	0.212
Educational level	0.0276318	0.0676864	0.41	0.684
Land size holding	0.075816	0.0864102	0.88	0.382
Colony size holding	0.5867068	0.100082	5.86	0.000***
Non beekeeping income	-0.1233739	0.1301633	-0.95	0.345
Honey price of 2019	0.9020927	0.3069513	2.94	0.004***
Frequency of extension contact/year	0.329542	0.0468153	7.04	0.000***
Gender	0.030105	0.1577284	0.19	0.849
Hive type (improved & traditional)	0.4467838	0.0800878	5.58	0.000***
Beekeeping equipment	0.2398899	0.1131643	2.12	0.036**
Credit access from MFIs	0.0503588	0.093183	0.54	0.590
Market information	0.2844809	0.1062403	2.68	0.009***
Beekeeping training	0.3202609	0.1238973	2.58	0.011**
_cons	-2.323031	1.738594	-1.34	0.184
Number of obs				121
F(14, 106)				55.37
Prob> F				0.0000
R-squared				0.8797
Adj R-squared				0.8638
Root MSE				0.452

Note: “***”, “**” shows the significance level of variables at 1%, and 5% respectively. Dependent variable is volume of honey marketed (in natural logarithm).

Source: Own computation from survey result, 2020

Total number of honeybee colonies (COLONYSIZ): It is proxy variable for quantity of honey produced and positively influence the volume of honey supplied to market at 1 percent significance level. This indicates that producer with more number of beehives with bee colony can harvest more volume of honey and not only having of better market surplus but will able to sell more. The model result indicated that as the number of hives with bee colony used increased by one, the volume of honey marketed increased by 58.67 percent. It is confirmed that the use of large number of hives directly related with the amount supplied to the market and return earned by beekeeper (Kerealem et al, 2009). This result is also in line with finding of (Tizazu et al, 2017; Getachew, 2009 & Kassaa et al, 2017).

Types of beehives (HIVETYP): As it was expected improved hive use is positively related with quantity supply of honey and the coefficient is statistically significant at 1 percent significance level. The model result shows that using both improved (Transitional and Framed hive) and traditional beehives affected quantity of honey supplied significantly and positively. Keeping a unit increase in improved hive leads to increase in quantity supplied of honey by 44.68 percent. The possible reason for this result is the use of improved hive is directly related with the amount of honey produced, supplied to the market and return earned by beekeepers. Improved beehives allow honey bee colony management and use of a higher-level technology with larger colonies and can give higher yield and quality of honey thus in turn increase market supply. This result is also coincides with finding of (Zegeye, 2018 & Kassaa *et al*, 2017) Case of Damot Gale district of Wolaita Zone and Chena district of Kaffa zone in Southern Ethiopia respectively.

Equipment Beekeeping (EQPMNT): It was expected that possessing beekeeping equipment (accessories) affect quantity of honey produced and positively influence the volume of honey supplied to market at 5 percent significance level. This indicates that producer with beekeeping accessories can harvest more volume of honey and abled to supply more honey to the market by 23.99 percent. This is in line with (Chali, 2018), who found that, the positively relationships between access to beekeeping accessories and honey production, which in turn with the quantity of honey supply to the market.

Access to market information (MARKTIFO) : Access to market information significantly and positively influences quantity honey market supply at 1 percent significance level. The model result confirms that as compared to households who have no access to market information, households who have access of market information increases quantity of honey supply to the market by 28.45 percent, all other factors held constant. Market information is vital instrument during marketing because it informs the farmers about marketing conditions. Farmers who have price information prior to marketing tend to sell more of their produce than those without. The finding is consistent with the results of (Nugusa, 2018) who found the existence of positive relationship between the market information and market participation decision of maize at Guduru district.

Price of honey in kg (PRICE): In this study it was hypothesized that price of honey in 2019 G.C. was one of the major determinants of quantity supply. The finding shows price of honey is positively related to quantity supply and statistically significant at 1 percent significance level. Producers checked the price of honey for their best benefit. Other variables remain constant at their mean value, as price of honey increase, quantity supply of honey increase by 90.21 percent. Similarly, previous studies conducted by (Asseffa, 2009 & Zegeye, 2018) found that, current honey prices affected marketable supply of honey significantly and positively. This is in line with (Nugusa, 2018), who find out that there is positive relationship between maize sold and current price.

Frequency of extension contact per year (EXCOFRQ): It was positively and significantly related to the volume of honey supplied to the market at 1 percent significance level. The positive and significant effect was mostly due to the reality that beekeepers who frequently contact extension worker concerning beekeeping particularly about modern honey production, harvesting and handling methods contributed to increase the amount of honey supplied to market. The model result predicts that increase in number of extension contacts per year by one in relation to honey production, increases the amount of honey marketed by 32.95 percent. This suggests that frequent extension contact avails information regarding improved technology which improves production that in turn affects the marketed supply. The result is consistent with earlier results of (Getachawu 2009; Kassaa *et al*, 2017 & Samuel, 2017).

Beekeeping training (TRAIN) : The model result in table 21 also showed that participation in beekeeping training was significantly affecting the volume of honey supplied at households' level in Guduru district. It was a dummy variable and significant at 5 percent significance level. It is known that giving trainings for producers on beekeeping can fill the knowledge gap that constrained production and productivity. The model result predicted that as compared to those households who did not participate in beekeeping trainings, the marketed supply of honey for those households who participated in beekeeping trainings increases by 32.03 percent. The result is consistent with previous results of (Samuel, 2017 & Tizazu *et al*, 2017).

4.6 Major Sources of Income generating activities undertaken in the area: Although the entire household heads in Guduru district are primarily engaged in agricultural production or mixed farming (crop production and animal rearing), most of them are also making living out of off farm and non-farm activities. Non-farm activities refers to both self-employment in non-farm sectors such as beekeeping, petty trade and craft work/carpentry and off-farm employment such as daily labor works, masonry and guard (Chali, 2018).

Accordingly, in the study area rural households earn income from different sources. The major sources of income in the area were classified in to three categories as farm income, off-farm income and non-farm income during this study. Farm income is the income that households earn from their direct engagement in different farming activities. According to the information gathered from agricultural and natural resources office of Guduru District and shown on the figure 7, the major farming activities in the area are Crop production includes maize (27%), sorghum (4%), wheat (14%), barley (1%), *teff* (20%), sesame (5%), Niger seed (19%), Beans (4%), peas (3%), and others (3%). The rest 1% is accounted for fruit and vegetables farming activities. Major fruits production includes avocado, banana, mango, papaya, orange and lemon. Vegetables like potato, tomato, pepper, onion, garlic and cabbage are means of livelihood and income generation.

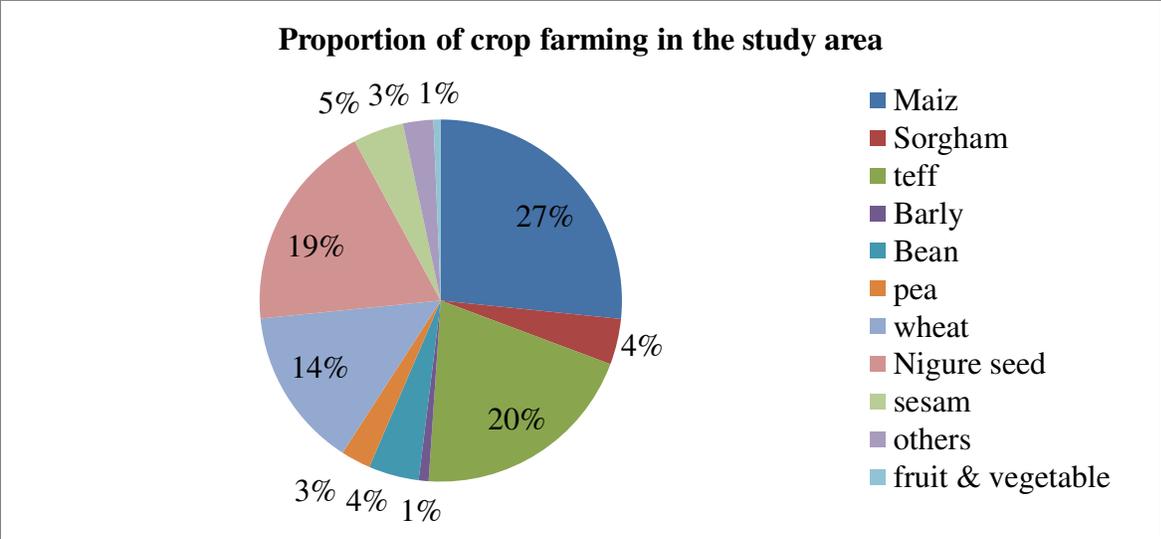


Figure 2 Crop farming system of the study area

Source: Own survey data, 2020

According to the information gathered from livestock and fishery offices, Livestock activities: such as cattle rearing (51%), equines (6%), Shoat (Goat and sheep production (14%) and poultry production (26%) are the important one in the study area as per shown in the following figure 8.

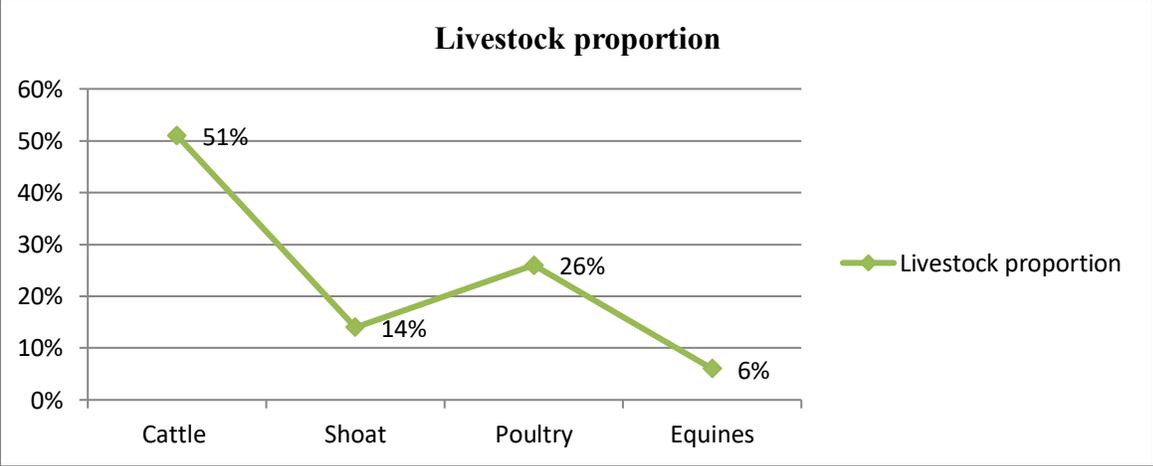


Figure 3 Livestock production system of the study area

Source: Own survey data, 2020

Regarding to off-farm activities, it is the income that is earned from farmers' engagement in income generating activities during off-farm period. The major source of off-farm income in the area is daily labor. Whereas, non-farm income is defined as the income earned from non-farm activities like beekeeping, petty trade, handicraft, and other non-farm sources.

According to (Chali, 2018) study result, Guduru farmers are engaged in beekeeping activity for year as a sideline activity. Crop production and livestock rearing are their mainstay livelihood source while other off-farm activities, tree and fruit tree planting are additional means of cash income for the respondent households. Their main annual income is generated from the five sources; crop, livestock, off-farm, forest product and beekeeping. Similarly, (Mulugeta, 2014) study shows that, for those who practice beekeeping, it is the third important household economic activity following crop and livestock production. The result also coincides with the findings of (Mulubrihan, 2014) revealed that, honey is the main source of income for smallholder beekeepers of Anderacha district, Sheka Zone of South Nation Nationalities and People Regional State of Ethiopia. According to his result of the study, most sample beekeepers ranked beekeeping as it is the first main source of their income, which is followed by livestock production and crop production. This is in line with finding of (Kassa et al, 2017) who illustrated beekeepers of the study area practice various livelihood strategies and income generating activities mainly crop production in addition to animal husbandry, honey production, petty trade and daily labor.

The table 16 below shows that, the total annual income that was earned by interviewed households from farm, off-farm, and non-farm income sources, which is totally 5,444,733.00 Ethiopian birr. Out of the total household income, honey accounted for 1,173,429.00ETB, minimum income earned by a household is 320, maximum is 29,500.00ETB its mean is 9,697.7603ETB with the standard deviation of 8,065.20340. Beekeeping by-products accounted for 22,840.00ETB, minimum income earned by a household is 0, maximum is 3,250.00ETB its mean is 188.760ETB with the standard deviation of 602.00.

Crops accounted for 2,489,488.00 ETB, minimum income earned by a household is 0, maximum is 114,600.00ETB its mean is 20,574.28 with the standard deviation of 14,796.96. Fruits & vegetables accounted for 50,134.00ETB, minimum income earned by a household is 0, maximum is 3,500.00ETB its mean is 414.3306ETB with the standard deviation of 613.63375. Livestock rearing accounted for 1,502,135.00ETB with minimum income earned by a household is 0, maximum is 35,300.00ETB its mean is 12,414.338ETB with the standard deviation of 8,163.86817 and off-farm accounted 145,201.00ETB with minimum income earned by a

household is 0, maximum is 20,000.00ETB its mean is 1,200.0083 ETB with the standard deviation of 3,334.55402.

Table 9 Annual incomes of the respondents

Annual income category	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Crop	121	0.00	114,600.00	2,489,488.00	20,574.281	14,796.9617
Livestock	121	0.00	35,300.00	1,502,135.00	12,414.338	8,163.86817
Trees	121	0.00	6,000.00	61,506.00	508.3140	1,052.55105
Fruit & vegetables	121	0.00	3,500.00	50,134.00	414.3306	613.63375
Off-farm	121	0.00	20,000.00	145,201.00	1,200.0083	3,334.55402
Honey	121	320.00	29,500.00	1,173,429.00	9,697.7603	8,065.20340
Beekeeping by-product	121	0.00	3,250.0	22,840.0	188.760	602.0058
Total				5,444,733.00		

Source: Own survey data, 2020

The pie chart of figure 9 shows that, the largest contributor to household income of the area is crop production, which accounted for 45.72% of the total annual household income. The production of animal husbandry ranked second and accounted for 27.59% of the total annual household income. Honey is the third important components of household income, which accounted for 21.55%. Off-farm activities contributed 2.67% to households' income. Trees accounted for 1.13%, fruits and vegetables accounted for 0.92% and the remaining 0.42% of household income is accounted from beekeeping by-product (ex. wax) income sources.

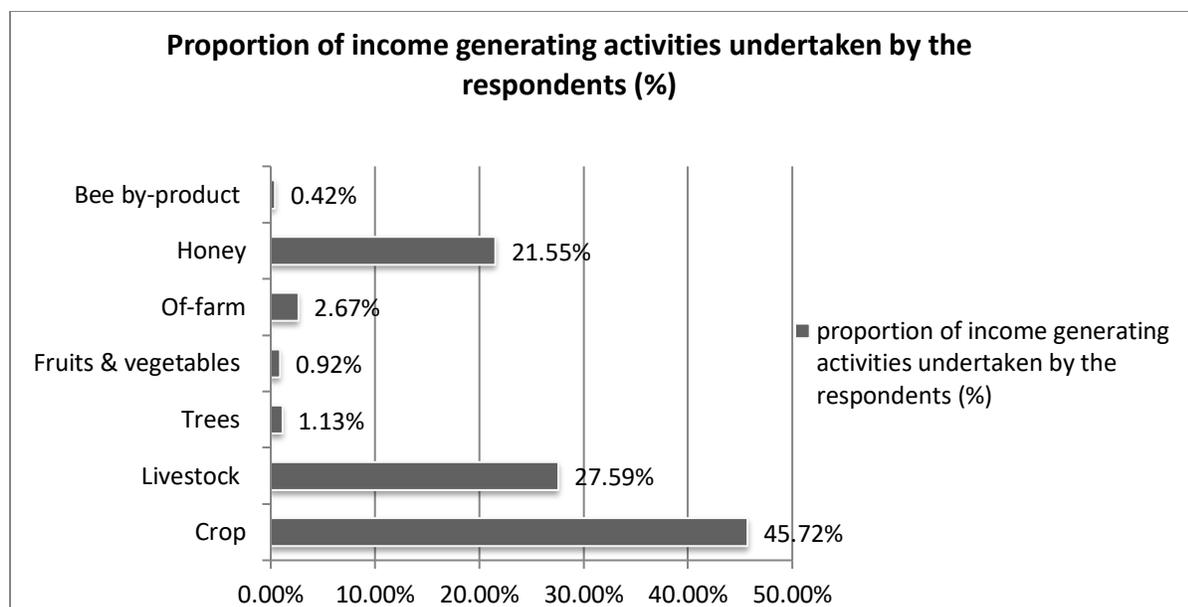


Figure 4 Contribution of honey for respondent household income

Source: Own survey data, 2020.

5. CONCLUSION

The study was conducted with the objective of analyzing the determinants of honey supply by smallholder farmers in Horro Guduru Wollega Zone in Oromia Regional state. The specific objectives include analyzing the determinants of honey supply, identifying the types of income-generating activities undertaken by smallholder farmers, analyze factors influencing honey supply by smallholder farmers; assess the opportunity and challenges in honey production and supply activity the study area. Both primary and secondary data were used for this study which is qualitative and quantitative in nature. The primary data were collected from sample households using pre-tested semi-structured questionnaire and checklist. The primary data were collected from 121 sampled households. In addition to this, Focus Group Discussion and key informant interview were employed to supplement the research finding with qualitative information. Secondary data were gathered from various sources such as records, documents, reports etc. of both governmental and non-governmental organizations such as office of livestock and fishery, Gurmoo Development Association, Agricultural and Natural Resource Offices, rural land administration & land use office and DAs at Kebeles level.

A total of 121 beekeeper farmer respondent's, 91% (110) males and 9 % (11) females were selected randomly from a list of 536 beekeepers from 5 kebel in the district. The average age of the sample respondents were 37 years with the minimum and the maximum age of 22 and 62 years respectively. The family size of the sample respondents were ranged from 2 to 14 that means farmers with different family size were practicing beekeeping activities and the average family sizes were 6. Educationally, the respondents of 37.2%) attended secondary school (from grade 5-8), 33% attended first cycle (grade 1-4), 13.2% are illiterate, 11.6% of the respondents can read and write and the rest 5% attended high school (grade 9-12). Therefore, the majority of sampled household heads were can read and write. The average land holding of the respondents is 2.9 hectares, whereas the minimum and maximum land holding sizes of the respondents are 0.25 and 8.53 hectares respectively.

There are 445 (1%) modern hives, 51,114 (85%) traditional hives and 2,375 (4%) Kenya Top-bar or 'chefeka' hives in the district. The entire 121 sample farmer's honeybee colony holding size ranges from 0 to 16 framed beehives, 0 to 30 KTB and 5 to 150 traditional hives. The minimum number of honey bee colony owned by a household was 5, maximum was 166 its mean was 39. The total production of sampled beekeepers was 27,569.05kg (20,724.05kg crude & 6,845.00kg pure honey of 2018/2019). From this, the sampled beekeepers were taking the majority of their product to the market 26,205.45kg (95%) and used for home consumption 1,363.6 (5%). The minimum and maximum amount of honey produced per household in the district was 5Kg & 630Kg for crude and 0Kg & 523Kg for pure honey in year of 2018/2019 G.C production period respectively. The average selling price of sample respondents were 48.38 ETB and 142.86ETB for crude and pure honey respectively. The minimum and the maximum selling price were 38 & 80 ETB for crude and 100 & 200 ETB for pure honey respectively for 2018/2019 year of product.

The trend of honey production and its prices was increasing in the past three production periods (2016/2017-2018/2019) which were estimated to 85.1kg & 19.1kg with price of 31.86ETB & 81.67 ETB in 2016/2017; 107.5kg & 36.3kg with price of 38.19 ETB & 108.72ETB in 2017/2018 and 107.1kg & 56.6kg with price of 48.38ETB & 142.86ETB in 2018/2019 for crud honey and pure honey respectively.

Honey production is the third important components among the smallholder farmer's income-generating activities in the area, which accounted for 21.55 percent and beekeeping by-product like wax accounted 0.42 percent. The largest contributor to household is crop production which, accounted for 45.72 percent of the total annual household income in the area. The production of animal husbandry ranked second and accounted for 27.59 percent of the total annual household income. Off-farm (daily labor) income contributed 2.67 percent to households' income. Trees accounted for 1.13 percent of the total annual household income, fruits and vegetables accounted for 0.92 percent of income sources.

Estimation of determinants of marketable supply of honey with the help of multiple regression models (OLS estimator) analysis was employed with fourteen hypothesized variables. The result of the model analysis pointed out that, among the hypothesized seven variables were found to be significantly and positively affected the market supply of honey at household level as expected. These are colony size (number of beehives owned), type of beehives used (improved and traditional), beekeeping equipment, market information, honey price of 2019, frequency of extension contact per year and training. The remaining seven variables (age, gender, family size, education, farm land size, non-bee farm income and credit) were found to have insignificant effect on honey market supply.

5.1. Recommendation

Possible recommendations that could be given on the basis of the study so as to be considered in the future intervention strategies which are amid at the promotion of honey production and marketing of the study area were as follows:

- ❖ The colony size (number of beehives owned), type of beehives used (improved and traditional), beekeeping equipment, market information, honey price of 2019 G.C, frequency of extension contact per year and training was found to influence the quantity supply significant positively during the survey time. The positive significant effects of the variable propose that by the all mentioned above for smallholder farmers, sale volume of the honey can be expanded.
- ❖ Therefore, increasing the number of hives with colony, distribution of improved (both transitional and framed) hives accompanied by safety protective materials and other

accessories for farmers of the district would bring additional marketable supply of the produce.

- ❖ Availing the strategies to support farmers with beekeeping business through facilitating access serves like credit availability, extension contact, trainings on improved beekeeping approach, cooperative formation, input supply and market facilitation/linkage also bring additional marketable supply of honey product,
- ❖ Additionally, addressing the identified problems like designing effective honeybee pests and predators controlling methods; planting different flora especially, considering for dry period; improving pre- and post-harvest handling of bee products and make ready for market, ;
- ❖ Accordingly, the district Livestock and Fishery offices, NGO, and other development partners should give weight on adequate practical skill training, facilitate on credit access for beekeeping purpose, implementing new technology, continuous follow up and technical support on honey production and marketing, design ways to collect and disseminate business information timely for beekeepers,.
- ❖ District and Zonal cooperative office and farmers union should give attention for honey producers and increase ability of smallholder producers to organize themselves into effective commercial entities (honey producers group) and encourage their participation in local and global trade
- ❖ Farmers' cooperative Union should have to construct standardized honey collection center and create enabling environment for processors and exports make smallholder farmers beneficial;
- ❖ All development agents of apicultural activities in the area should develop branding strategy and ensure traceability.

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List of Abbreviations

AGP: Agricultural Growth program, CSA: Central Statistical Agency, DA: Development Agent, ETB: Ethiopian Birr, GDANRO: Guduru District Agricultural and Natural Resource Offices, GRLALUO: Guduru Rural Land Administration and Land Use Office, HA: Alternative hypothesis, HO: Null Hypothesis, ILRI: International Livestock Research Institute, Kg: Kilogram, KTB: Kenya Top-bar, MFIs: Micro-financial Institutions, MoA: Ministry of Agriculture, NGO: Non-Government Organization, OCSSC: Oromia Credit and Saving Share Company, OLS: Ordinary Least Squares

Declarations

Conflict of interest: We disclose that there are no conflicts of interests related to financial and non-financial for this article.

Ethics approval: Final approval of this paper is contingent following the manuscript submission of its final copy to Wollega University.

Consent of participation: We declare and affirm that this work and the overall process of the research were completed without any difficulty to authors. Any scholarly issue that is incorporated in the paper has been given recognition through citation of the source.

Consent for publication: We confirm that this paper has neither published nor submitted anywhere for publication. It is our original work and findings for the area under consideration.

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Authors' Contributions: Corresponding author (problem identification, analysis and writing or developing the manuscript) and the Co-authors (collecting data, entry, coding and discussion).

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Figures

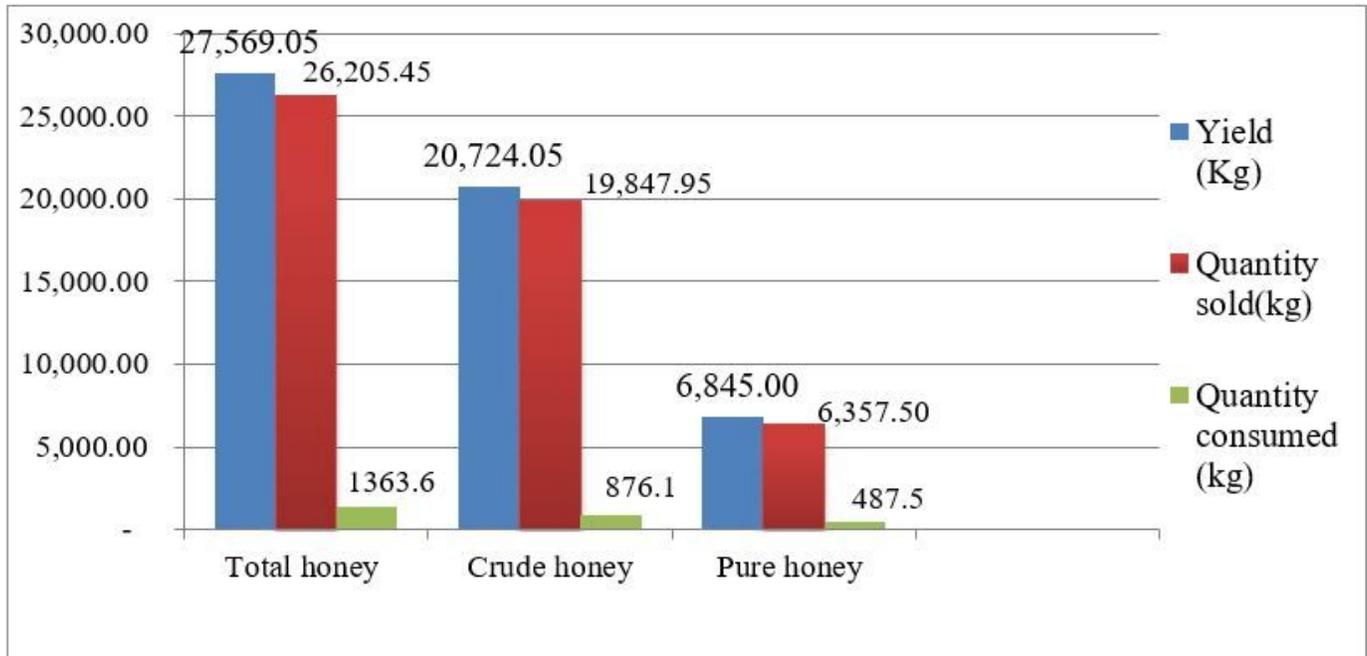


Figure 1

Proportion of 2018/2019 honey yield sold and consumed by respondents Source: Own survey data, 2020

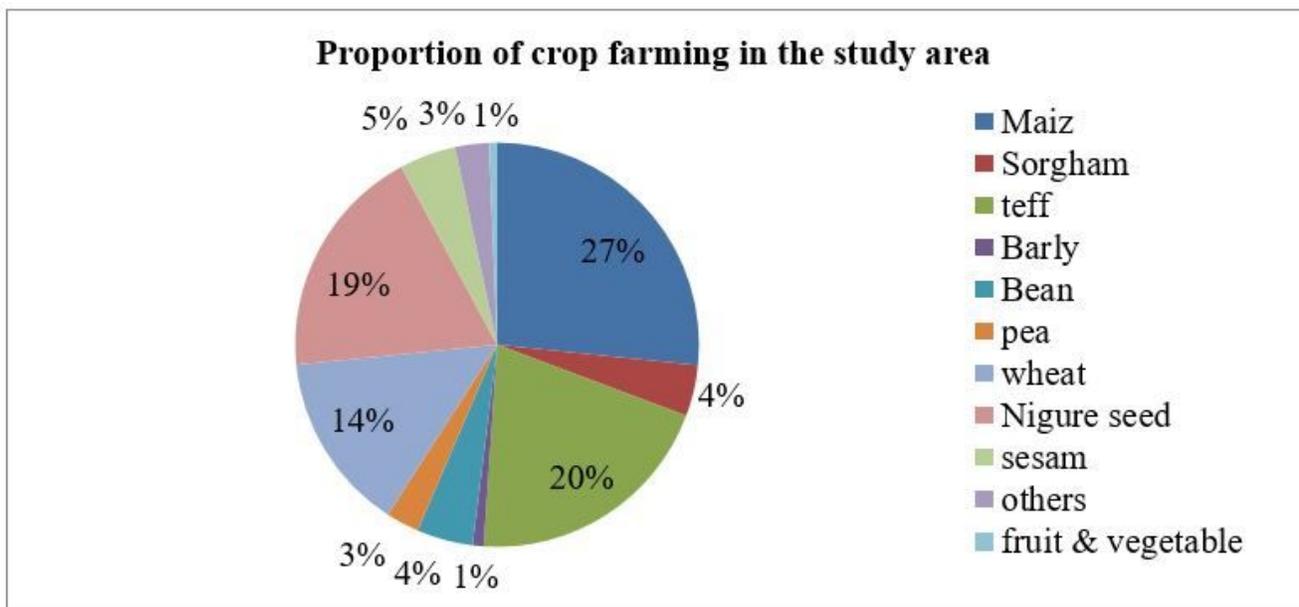


Figure 2

Crop farming system of the study area Source: Own survey data, 2020

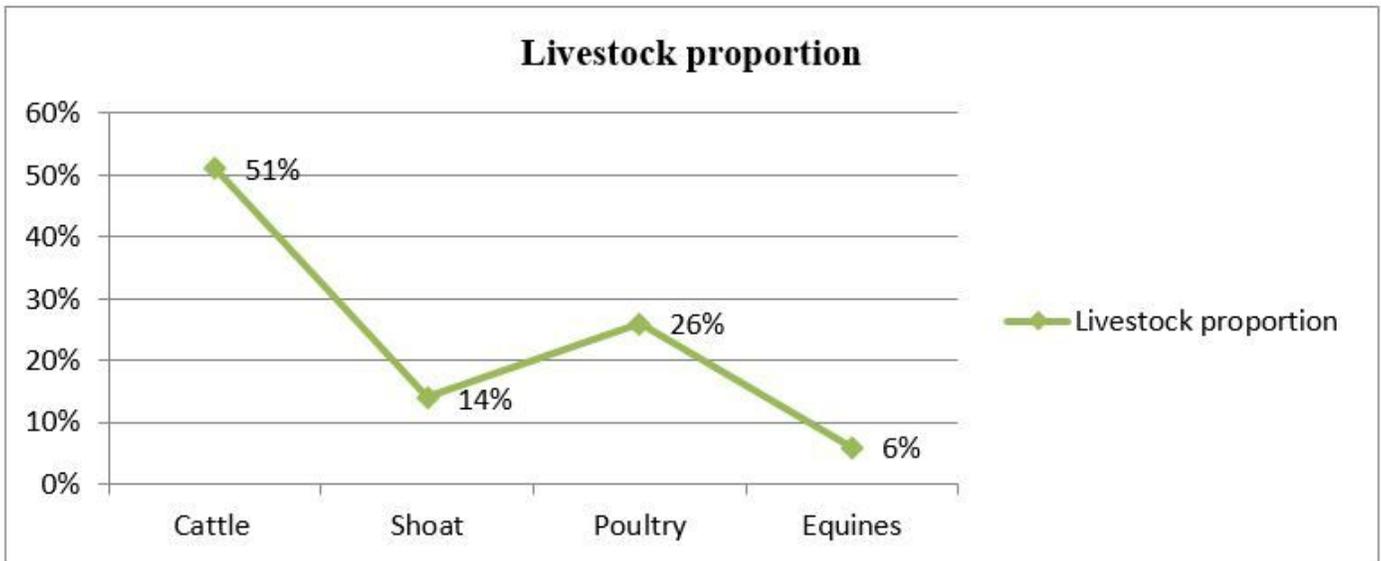


Figure 3

Livestock production system of the study area Source: Own survey data, 2020

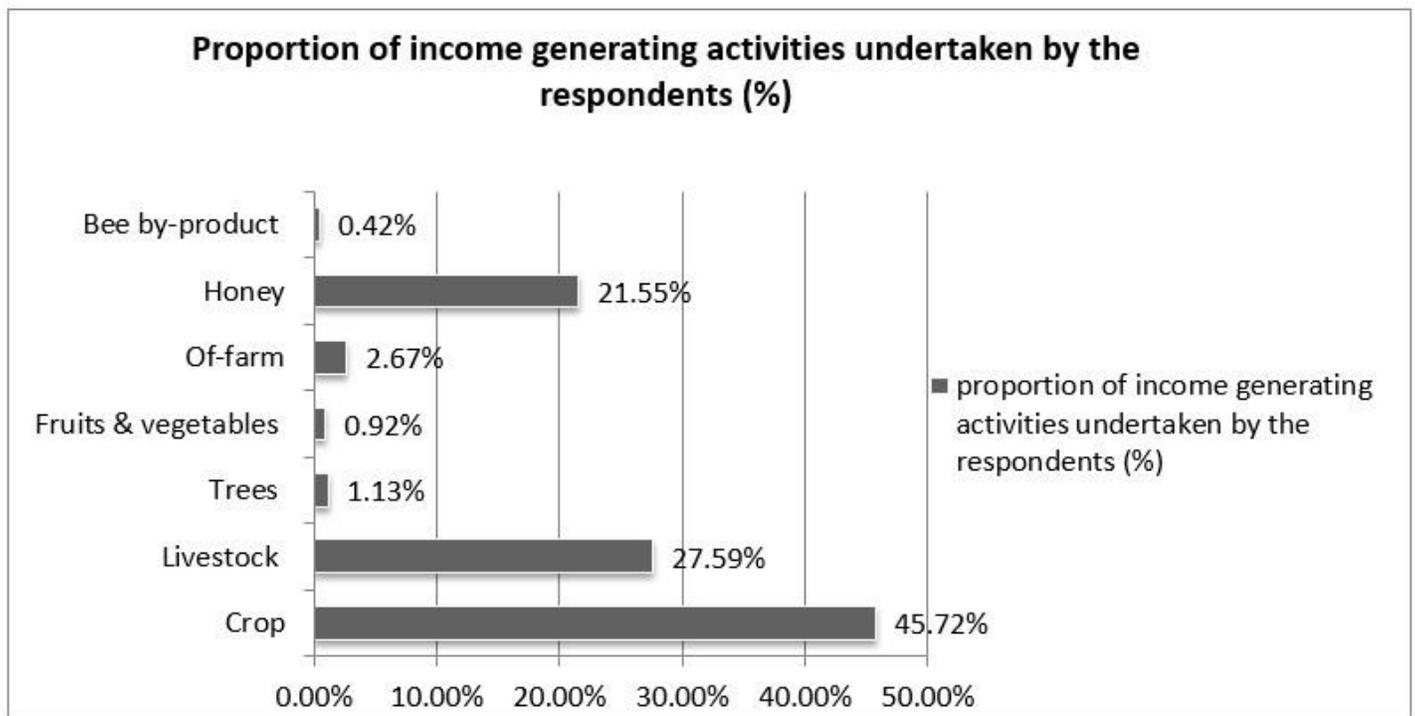


Figure 4

Contribution of honey for respondent household income Source: Own survey data, 2020.

Supplementary Files

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- S1.jpg