Analyzing market participation, market surplus and market outlet choice among small scale honey producers

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Journal of Livestock Science (ISSN online 2277-6214) 16: 28-43
Received on 26/9/24; Accepted on 5/12/24; Published on 2/1/25
doi. 10.33259/JLivestSci.2025. 28-43

Abstract

This study aimed to analyze honey producers' market participation, market surplus, and market outlet preferences in the Legehida district of the Amhara National Regional State, Ethiopia. To achieve the study objectives, both primary and secondary data sources were employed, and 205 honey producers were selected using simple random sampling procedures. The collected data were analyzed using the Heckman two-stage estimation and multivariate probit model to identify the factors that determine honey market participation decisions and their intensity (level) as well as honey producers' market outlet preferences. The results from the first stage of the Heckman model (Probit regression) indicated that the sex of the household head, educational level, distance to the nearest market, amount of credit used, frequency of extension contact, and lagged market price significantly affected honey producers' decisions to participate in the honey market. The second stage of the Heckman model (OLS) revealed that the sex of the household head, income from sources other than beekeeping, beekeeping experience, total number of hives owned, frequency of extension contact, and cooperative membership significantly determined honey market surplus (level of participation in the honey market). The results from the multivariate probit model indicated that the age of the household head, sex of the household head, distance to the nearest market, frequency of extension contact, beekeeping experience, cash income from sources other than beekeeping, volume supplied to the market, access to credit, access to market information, and cooperative membership of honey producers significantly influenced their choice of market outlets for their produce.

Key Words: Honey, Heckman two stages, Market Outlet, Multivariate probit

Introduction

Agriculture, a key driver of economic growth in Ethiopia, contributes approximately 31.2% to the GDP, provides 65.33% of employment, and supports about 79.24% of the population living in rural areas, where agriculture serves as their primary source of income. The Ethiopian government has committed to allocating 38.8% of its budget for the 2019–20 fiscal years to the overall economy, with 15.5% earmarked for agricultural and rural development programs (Chamiso et al., 2024).

Apiculture is a promising off-farm enterprise that significantly contributes to smallholder incomes, both directly and indirectly, accounting for approximately 2.5% of Ethiopia's agricultural GDP (FAO, 2023). According to the Central Statistical Agency (CSA, 2023), Ethiopia's total honey production reached approximately 65,000 tons. The honey industry also generates substantial revenue, with annual honey sales averaging 550 million Ethiopian Birr (FAO & ILRI, 2023). Moreover, the subsector provides employment opportunities in both rural and urban areas, involving unemployed urban youth and landless rural women in beekeeping and the production of beekeeping equipment (FAO, 2023).

Despite high honey production potential in the region, market supply remains low. Various socioeconomic, production, market, and institutional challenges contribute to this low productivity. According to Kassa et al. (2017), honey farmers face marketing difficulties due to limited market access, poor farm-gate prices, and lengthy marketing chains, which hinder effective market participation.

Although the district is believed to have a diverse array of plants and cultivated crops suitable for beekeeping, there has been no research on honey market participation decisions regarding market surplus and producers' preferred market outlets in the study area. A study by Desalegn (2021) sought to identify factors influencing honey market surplus in the Gera district of Jimma Zone, Oromia National Regional State, Ethiopia. However, it did not categorize honey producers as participants or non-participants in the market and employed an ineffective two-limit Tobit model for analysis. This study aims to fill that methodological gap using Heckman's two-stage models.

Furthermore, a study conducted by Emana (2015) utilized a multinomial logit model to identify factors affecting producers' choices of market outlets in Ahferom Woreda, Tigray, Ethiopia. However, this model restricted producers from selecting multiple outlets simultaneously if they aimed to optimize their profit share based on farm-gate pricing. To address this methodological limitation, the current study employs a multivariate probit model to identify factors influencing producers' choice of market outlets, allowing them to select multiple options from a list of available channels to maximize their profit share.

Consequently, this study primarily focuses on analyzing the factors affecting participation decisions and levels of participation while investigating the influences on market outlet choice decisions in Legehida Woreda, Ethiopia.

Conceptual Framework

The conceptual framework for this study was developed based on a review of various literature sources. Figure 1 illustrates the framework. The dependent variables include market participation, marketed surplus, and market outlet choice. Socio-economic factors encompass age, education, gender, and transportation. Institutional factors consist of extension services and cooperative membership. Marketing factors involve market distance and access to market information, while production factors include beekeeping experience and the types of beehives utilized.

Research methods

Study area

The study area is situated in the South Wollo region of Ethiopia's Amhara National Regional State. Legehida Woreda lies approximately 104 kilometers southwest of Dessie, the capital of South Wollo, 578 kilometers east of Bahirdar, and 540 kilometers north of Addis Ababa. It is bordered by Woreillu Woreda to the east, Jama Woreda to the south, Kelala Woreda to the west, and Legambo Woreda to the north. According to a bulletin from the Legehida Woreda Government Communication Affairs Office (2011), the total land area of the Woreda is 42,935 hectares, which encompasses 16 kebele administrations (4 lowland, 9 midland, and 3 highland).

Legehida Woreda has significant potential for honey production, primarily due to its diverse plant and cultivated crop species that provide abundant pollen and nectar for foraging bees. To enhance overall output in this sector, both NGOs and government organizations in the area have offered training on honey production systems, marketing, and storage (LDLFDO, 2020).

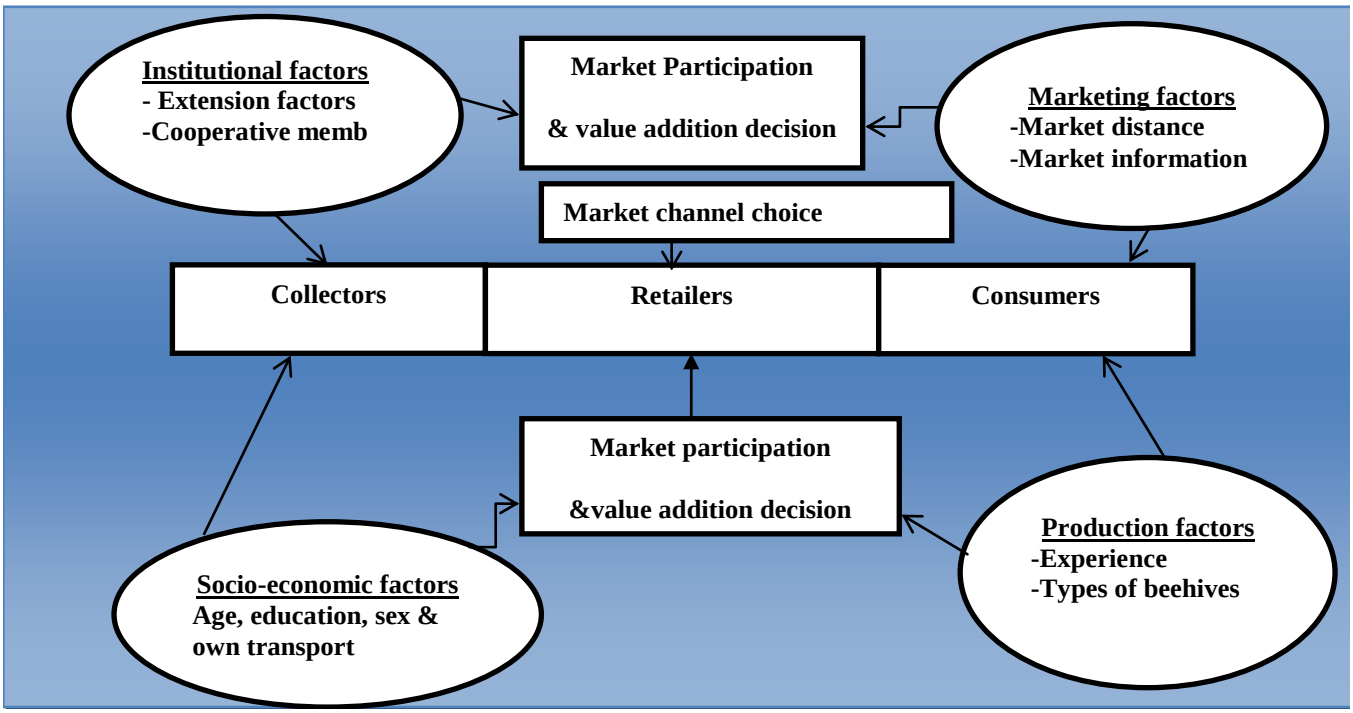

Fig 1: Conceptual framework of the Study

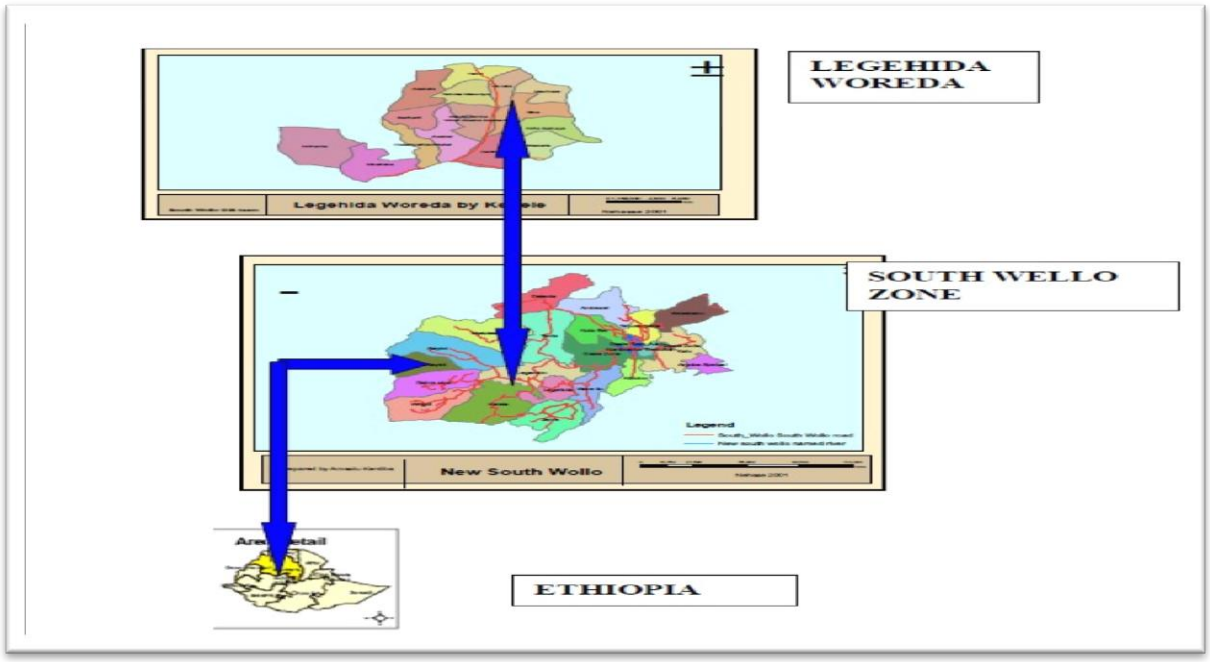

Figure 2: Map of the study area

(Source: South Wollo Zone DoFED, 2024)

Data type, Source and Method of data collection

This study utilized both qualitative and quantitative data gathered from primary and secondary sources. Primary data were collected through a structured questionnaire administered to honey producers. This data focused on factors influencing the volume of honey supplied, including both the decision to participate and the intensity of participation, as well as market outlet choices and the demographic and socio-economic characteristics of the households. Additionally, secondary data were obtained from various publications, articles, books, figures, and reports to inform the study on the honey value chain. Information such as sales volume, pricing, input supply, and the number of hives in the study area was sourced from the Woreda Agricultural Development Office.

Sampling Procedure and Sample Size

Producer Sampling: This investigation employed a multi-stage sampling technique. Initially, the district was purposefully selected based on the interests of the funding organization, as it was within their intervention area. **In the second stage,** three kebeles were randomly chosen from the district's 16 high-potential honey-producing kebeles. The use of probability sampling, specifically simple random sampling, ensured that each element in the population had an equal and independent chance of being selected (Kumar, 2011). The kebeles were categorized into three strata: Dega, Woyina Dega, and Kola. Subsequently, one kebele was selected from each stratum: Siba (04), Denbiya Afafa (013), and Luguama (016). The number of honey producers in these kebeles were 108 (97 men and 11 women), 131 (124 men and 7 women), and 183 (178 men and 5 women), respectively. **In the third stage,** households engaged in honey production within the selected kebeles were stratified into honey market participants and non-participants. The total sample size of honey producer households for this study was determined using a formula provided by Yamane (1967) at a 5% precision level. The researcher calculated a representative sample size from the total number of households in the three kebeles, with the sample size being proportionately allocated among the honey-producing households.

n= N/1+N (e^2)……. ***(1)*** Where n=sample size

N= total number of household

e is degree of precision at 95% confidence interval (Yemane, 1967). In this study i.e. e= 5%.

$$\textbf{Then, } n = \frac{422}{1+422*(0.0025)} = \underline{\mathbf{205}}$$

Data Analysis

In this study, descriptive, inferential statistics and econometric analyses were employed to data analysis. Descriptive statistics such as frequencies, percentages, means and standard deviations were used to analyze the collected data. Inferential statistics such as *t*-test and χ2-test were employed.

Econometric Model Analysis

The factors influencing honey market supply (decision to participation and level of participation) and honey producers market outlet choices were analyzed using the Hackman two-stage model and multivariate probit models, respectively.

Determinants of honey market supply (Decision + intensity of market participation)

Heckman's sample selection model was utilized to identify the variables that influence market participation and the marketable surplus of honey in the study area. The model first captures participation decisions. In this initial step, the "inverse Mills ratio," a selectivity term derived from the model, is incorporated into the second-stage outcome equation to account for variables affecting the amount of marketed surplus. This ratio serves as a control for bias arising from sample selection (Heckman, 1979).

In the second stage, the equation is estimated using ordinary least squares (OLS), incorporating the Mills ratio into the equation for marketable surplus. A significant Mills ratio in the model suggests the presence of unobserved variables in the participation equation. After including this additional term (lambda), the coefficient in the second-stage equation remains unbiased, adjusted for selectivity (Bellemare, 2018). The Heckman two-stage model is structured to assess the likelihood that a honey producer will participate in the market (Y1i) and sell surplus (Y2i). Below is the specification for the binary probit/participation model: $Y1i = X1i\beta 1i + u1iu \sim N(0, 1)$…… ***(2)***

$HMP = 1 \; if \; Y > 0$…… ***(3)***

$HMP = 0 \; if \; Y \leq 0$…… ***(4)***

In this context, u1i represents residuals that are independently and normally distributed with a mean of zero and constant variance. The vectors X1i are considered independent variables that influence the likelihood of sampled

households participating in the honey market, while Y1i denotes the latent dependent variable, which remains unobserved.

Marketed surplus/intensity of participation equation (Heckman Second Stage equation)

$Y_2i = X_2i\beta_2i + \mu i\lambda i + \eta i$…… ***(5)***

In this context, Y2i signifies the quantity of honey marketed in the second stage, while X2i represents the explanatory variables that affect this quantity. The term β2i refers to an unknown parameter associated with the estimation of the marketed quantity. Additionally, μi reflects the impact of selectivity bias on the marketed quantity, and ηi denotes the error term.

Mill ratios $(\lambda_i) = \frac{\Phi(h(xi,\tilde{\alpha}))}{\phi(\tilde{\alpha},xi)}/1$…… ***(6)***

Determinants of honey producers' market outlets choice

In the study area, honey producers were more inclined to utilize multiple market outlets simultaneously. Consequently, a multivariate probit model was employed to estimate the determinants of these choices, rather than a multinomial logit model. This approach allows for an assessment of how various explanatory variables influence the selection of each distinct outlet while also accounting for correlations between unobserved disturbances and the interrelationships among market outlet choices (Arinloye et al., 2014).

As noted by Djalalou et al. (2015), each producer aims to make rational decisions that maximize their utility or profit from available options. It is assumed that when a producer i evaluates non-exclusive options within the choice set of honey marketing outlets, the available choices may differ based on the decision-maker's circumstances. Consider the i^{th} farm household (where i = 1, 2, …, N), which faces the decision of whether to engage with available market channels. Let U0 represent the benefits a farmer gains from selecting a retailer, while Uk denotes the benefits associated with choosing the K^{th} market outlet, where K corresponds to collectors (Y1), retailers (Y2), and consumers (Y3). If Y^*ik = U^*k U0 > 0, the farmer will opt for the K^{th} market outlet. The farmer's net benefit (Y^*ik) from selecting a market outlet is treated as a latent variable, influenced by observed explanatory variables (Xi) and an error term (Ui).

$Y^*_{ik} = X_i\beta_k + U_i$ k= (Y_1, Y_2, Y_3)..... ***(7)***

Using the indicator function, the unobserved preferences in the above equation translated into the observed binary outcome equation for each choice as follows:

$$\boldsymbol{\Omega} = \begin{matrix} \mathbf{1} & \mathbf{px1x2} & \mathbf{px1x3} \\ \mathbf{Px2x1} & \mathbf{1} & \mathbf{px2x3} \\ \mathbf{Px3x1} & \mathbf{px3x2} & \mathbf{1} \end{matrix} \text{.....} \quad \textit{(8)}$$

Off-diagonal elements in the covariance matrix, which capture the unobserved correlations among the stochastic components of different types of outlets, were particularly noteworthy. This assumption led to the formulation of a Multivariate Probit (MVP) model that illustrated the decision-making process involved in selecting a specific market outlet. This model allowed for correlations among the error terms of various latent equations, reflecting unobserved factors that influence the choice of alternative outlets.

The log-likelihood function corresponding to a sample outcome was then expressed in the format utilized by Cappellarri and Jenkins (2003).

$\ln L = \sum_{i=1}^{N}(t)_i \ln \Phi(\mu_i . \Omega)$…… ***(9)***

Where ***(t)*** is an optional weight for observation ***i,*** and $\boldsymbol{\Phi_i}$ is the multivariate standard normal distribution with, argument $\boldsymbol{\mu_i}$ and $\boldsymbol{\Omega}$, where $\boldsymbol{\mu_i}$ can be denoted as:-

$\mu_i = (k_{i1}\beta_1 X_{i1}, k_{i2}\beta_2, k_{i3}\beta_3 x_{i3}), While\ \Omega_{ik} = 1\ for\ j = k$ …… ***(10)***

$\Omega_{jk} = \Omega_{kj} = k_{ij}k_{ik}\rho_{jk}\ for\ j \neq k, k = 1,2,3 \ldots\ with\ k_{ik} = 2y_{ik}$… ***(11)***

Definition of variables and their expected sign (hypothesis) for the volume of honey supply (both the decision to and level of market participation)

The various factors anticipated to influence the volume of honey supplied to the market, including producers' market participation and the extent of that participation, were discussed. Consequently, the primary explanatory variables expected to impact the two dependent variables were identified as follows in tabl1 2:

Summary of Independent variables for honey market outlets preferences

The explanatory variables that were expected to influence honey producers choice of market outlets are the following a in table 3:

Table 1: Proportional sample distribution for each Kebeles

N	Kebeles	Population	Total partici	Total non-partici	Sample from partici	Sample from non-partici	Total sampled HHs
1	Siba (04)	108	101	7	46	7	53
2	Denbiya Afafa (013)	131	123	8	56	8	64
3	Luguama (016)	183	173	10	78	10	88
	Total	422	397	25	180	25	205

Source: Districts Trade and Industry office report and Own computation, 2024

Table 2: Definition, measurement and hypothesis of variables for volume of honey supplied to the markets (decision to and level of participation)

List of independent variables and their types		Dependent variables, their type and relationship with the independent variables	
		Decision to participation	Level of participation
Lists	Variable type	Dummy	Continuous
Sex	Dummy	-	+
Educational level	Continuous	+	+
Family size	Continuous	+	-
Total non-beekeeping revenue in ln (CINBK)	Continuous	+	+
Beekeeping experience	Continuous	+	+
Types of hive used	Categorical	+	+
Total number of hive	Continuous	+	+
Distance to the nearest Market	Continuous	-	-
Access to credit	Dummy	+	+
Frequency of extension Contact	Categorical	+	+
Cooperatives Membership	Dummy	+	+
Predicted quantity of honey produced	Continuous	+	
Access to market Information	Dummy	+	+
Lagged price	Continuous	+	+

Source: From empirical reviews and own hypothesis (2024)

Table 3: Definition, measurement and hypothesis of variables for honey producers' choice of market outlets decision

Description	Measurement	Expected effect on outcome/ hypothesis		
		Retailer	**Consumer**	**Collector**
Market outlet Choice	Multiple			
Volume of honey sold	Continuous (Kg)	-ve	+ve	-ve
Sex of the Household Head	Dummy (1=male, 0=female)	+ve	-ve	-ve
Family Size	Continuous (numbe) of families member)	-ve	+ve	+ve
Education status of the Household Head	Continuous (Grade level)	-ve	-ve	-ve
Distance to Nearest Market	Continuous (Km)	+ve	-ve	+ve
Market Information	Dummy (0=no 1=yes)	-ve	+ve	-ve
Credit Access to Honey Production	Dummy(0=no 1=yes)	+ve	+ve	-ve
Frequency of extension contact	Continuous (Number of contact)	+ve	-ve	-ve
Cash Income other than Beekeeping	Continuous(number in Birr)	-ve	-ve	-ve
Years in Bee keeping	Continuous (number of years)	-ve	-ve	-ve
Age of the household head	Continuous (numberYear)	-ve	-ve	+ve
Trust in buyers	Dummy (0=no, 1=yes)	-ve	+ve	-ve
Cooperatives membership	Dummy (0=no, 1=yes)	-ve	+ve	-ve

Results and Discussion

Socio-economic and Demographic characteristics of the Sample Households

As shown in Table 4, out of 205 sampled honey-producing households, 180 were both producers and market participants, while the remaining 25 households were solely honey producers, using their yield exclusively for household consumption.

The survey results considered several continuous variables, including the age of the household head, educational attainment, distance to the nearest market, family size, total number of hives owned, and the amount of honey produced. With the exception of the age of the respondents, all other variables demonstrated a statistically significant mean difference between market participants and nonparticipants. The only variable that exhibited a positive correlation was the distance to the market.

Table 5 presents the results of the χ^2 test, which indicated a statistically significant difference in the proportion of household heads by sex between market participants and nonparticipants. Additionally, factors such as cooperative membership, lagged market price, access to extension services, credit utilization, market information, chemical application, and colony absconding also showed significant differences between the two groups.

Econometric Results

The selected explanatory variables were utilized in this section of the study to identify the determinants of market participation decisions, levels of participation, and the market outlet choices of beekeepers. The predicted explanatory variables were tested for multicollinearity and heteroscedasticity.

Test for Heteroscedasticity: The analysis indicated no issues with heteroscedasticity in the dataset, allowing us to conclude that the parameter estimates of the coefficients for the independent variables are Best Linear Unbiased Estimators (BLUE). The null hypothesis (H0) suggests a constant variance, with a chi-squared value of 0.70 and a probability of 0.4019.

Test for Multicollinearity: All Variance Inflation Factor (VIF) values were below 10, with a mean of 1.42. This suggests that there is no significant multicollinearity among the independent variables. When multicollinearity exists, it becomes challenging to isolate the effects of each parameter estimate on the dependent variables. Therefore, testing for multicollinearity among explanatory variables is essential.

Determinants of honey market participation decision and level of participation

Determinants of honey market participation (Decision to market participation)

The households first decided whether or not to become honey sellers, which was analyzed using the first stage of the Heckman model. An effective first-stage Heckman estimator was employed to assess the decision to participate in the honey market. In this model, 14 potential predictor variables were selected for analysis. The findings indicated that at the 5% significance level, the Wald test rejected the null hypothesis that all regression coefficients were jointly equal to zero. This outcome demonstrated that the independent variables in the probit regression model collectively influenced a household's likelihood of selling honey.

Six explanatory variables significantly affected the decision to participate in the honey market: the sex of the household head, the educational level of the household head, distance to the nearest market, frequency of extension contact, amount of credit used, and lagged market price.

Sex of Household Head: At a 5% significance level, the sex of the household head had a negative and significant impact on the decision to participate in the honey market. The results suggested that, holding all other factors constant, having a male household head decreased the likelihood of engaging in the honey market by 0.0044 compared to having a female household head. Although both male and female heads of households had financial responsibilities, male heads were more likely to secure additional income than their female counterparts. Consequently, female heads participated in the market at a higher rate. This finding aligns with Nuri et al. (2016), who noted that having a male household head negatively affected producers' decisions to engage in the Koch and Bulla markets.

Educational Level of Household Head: The educational level of the household head positively and significantly influenced participation in the honey market. At a 5% significance level, having an educated household head increased the likelihood of market participation by 0.0073 when all other factors were held constant. This may be attributed to households with higher education levels being better equipped to assess costs and benefits based on market price trends. As honey prices in the study area occasionally rose, more educated household heads were likely to participate in the market. This finding is consistent with Ahmed et al. (2016), who reported that educational attainment positively impacted market participation in potato farming.

Distance to Nearest Market: As anticipated, distance to the nearest market was statistically significant at the 5% probability level and negatively correlated with household head participation in the honey market. The survey

findings indicated that each additional kilometer from the nearest market reduced the likelihood of participation by 0.0101, holding all other factors constant. Increased transportation costs, walking distances, and other marketing expenses deterred households from participating in the honey market, making access to facilities and market information more challenging. This finding corroborates Regasa (2018), who found that Ethiopian smallholders' ability to deliver wheat to the market was adversely affected by their distance from it.

Frequency of Extension Contact: At a 5% significance level, the frequency of extension contact had a positive and significant impact on the household head's decision to participate in the producers' market. The survey findings indicated that, while holding all other explanatory variables constant, an increase in the frequency of extension contact by one day raised the likelihood of participating in the honey market by 0.0859. This can be attributed to the fact that more extension visits provided up-to-date knowledge on agricultural technologies that enhanced productivity, thereby increasing the likelihood that producers would engage in the honey market. This aligns with findings from Christopher et al. (2014), which demonstrated that the number of extension visits by government workers positively and significantly influenced market participation.

Amount of Credit Used: At a 5% significance level, the amount of credit used by farm household heads had a positive and substantial effect on the likelihood of market participation. The analysis revealed that, while holding all other variables constant, an increase in credit usage by 1,000 ETB raised the probability of participating in the honey market by 0.0788. This is likely because access to credit reduces transaction costs in both input and output markets, thereby positively influencing producers' chances of participating in the honey market. Similar results were reported by Abduselam et al. (2018), who found that access to credit significantly enhanced producers' likelihood of participating in the potato market due to reduced transaction costs.

Lagged Market Price: At a 5% significance level, lagged market prices positively and significantly impacted decisions regarding market participation. Farm household heads often anticipated increased honey market participation in the current year if last year's prices for honey products were favorable. Holding all other variables constant, a satisfactory price for honey from the previous year increased the likelihood of participating in the honey market by 0.1071. This suggests that farmers were more likely to allocate additional resources for honey production if last year's prices were favorable. This finding is consistent with Tadie and Lemma (2018), who noted that lagged market prices had a positive and significant effect on teff market participation.

Determinants of honey market supply /volume/level of market participation

Heckman's second-stage estimation identified key factors influencing honey market surplus through a selection model that incorporated the inverse Mills ratio derived from a maximum likelihood probit estimation of honey market participation decisions. At the 5% significance level, the coefficient for the inverse Mills ratio (Lambda) in the Heckman two-stage estimation was significant (see Table 7). This indicates the presence of sample selection bias or certain unobservable factors affecting a farmer's likelihood of participating in the honey market, which in turn impacts the amount of marketable surplus. Additionally, the positive sign of the inverse Mills ratio suggests that unobserved factors positively influence both the volume of marketed honey and participation decisions.

Rho represents the correlation between the error terms in the selection and substantive models, with a possible range from -1 to +1. This correlation can provide insights into the extent of selection bias. If the regression coefficients for both models are calculated using consistent procedures, a correlation of 1 would indicate potential selection bias. The overall goodness of fit for the model parameter estimations was evaluated using the Wald-Ch^2 test. The null hypothesis for this test posited that all coefficients collectively equal zero. The results from the chi-square test confirmed the overall goodness of fit for the model.

Significant positive impacts on the quantity supplied of honey were found for several factors, including the sex of the household head, income from sources other than beekeeping, beekeeping experience, total number of beehives owned, frequency of extension contact, and lagged market price (see Table 7).

At a 5% significance level, the sex of the household head was found to have a positive and significant influence on honey supply to the market. Specifically, being a male head of household significantly increased the quantity of honey supplied by 45.46 kilograms compared to female-headed households, while keeping other variables constant. This difference may be attributed to the tendency of female-headed households to prioritize household consumption by reserving more honey for family use, thereby reducing the amount available for sale. Male-headed households tend to supply more honey to markets than female-headed households, often due to gendered roles and resource access. Men typically have better access to market information and transportation, while women often prioritize family needs, reserving more honey for household consumption. This pattern is well-documented in studies by Aguilar et al. (2015) and Mutua et al. (2017).

Table 4: Mean Comparisons for the continuous variables

Variables	Mean Comparisons			
	Participant (N=180)	Non-participant (N=25)	Total (N=205)	t-value
Age of the household head	44.79	44.72	44.76	0.996
Family size of the household	5.14	5.16	5.15	-7.34
Volume of honey produced	100.61	41.88	71.25	-2.523
Total number of hive owned	7.74	4.96	6.35	-10.96
Distance to the nearest market	10.28	9.68	9.98	-3.04

Source: Survey result, 2024

Table 5: Descriptive statistics for the categorical variables

Variable	**Categories**	**Participant (N=180)**	**Non-participant (N=25)**	**X^2**
Sex of the household head	Female	12(6.7%)	1(4%)	8.42***
	Male	168 (93.3%)	24 (96%)	
Cooperative membership	Yes	139 (77.2%)	9 (37%)	15.69***
	No	41 (27.8%)	16(63%)	
Lagged market price	Good	74 (41.03%)	1 (4.17%)	14.13***
	Bad	106 (58.97%)	24 (95.83%)	
Access to Extension service	Yes	117 (65%)	10 (37.8%)	47.16***
	No	63 (35%)	15 (62.6%)	
Credit Utilization	Yes	82 (45.7%)	12 (46.66%)	26.57***
	No	98 (54.3%)	13 (53.33%)	
Market Information	Yes	103(57.14%)	22 (88.89%)	80.45***
	No	77 (42.86%)	3 (11.11%)	
Chemical application	Yes	180 (100%)	25 (100%)	9.32***
	No	0 (0%)	0 (0%)	
Colony Absconding	Yes	143 (79.5%)	20 (78.7%)	7.38***
	No	37 (20.5%)	5 (21.3%)	

Source: Survey result, 2024

Note. *** shows statistically significant level at 1%.

Table 6: First-stage probit estimation for the determinants of honey market participation

Variables	Coefficient	Robust standard Error	Z	Marginal effect
Lagged market price	1.474	.5466	2.37	.1071**
Sex of the HH	-.4960	.2344	1.64	.0044**
Educational level	.1777	.2207	.00	.0073**
Family size	0.0324	.1254	.90	.0083
Income other than beekeeping	-0.0009	.0002	.57	-.0011
Beekeeping Experience	-3.7919	.8042	-.20	.0603
Types of hive used	-1.0971	.1900	-1.96	.0381
Total number hive owned	-5.591	.4335	-1.50	.0234
Distance to the nearest market	-.0243	.1051	-2.13	.0101**
Amount of credit used	.3622	1.296	.00	.0788**
Frequency of extension contact	1.9454	.6631	-2.09	.0859**
Cooperative membership	-18.68	2012	-0.23	-.0383
Predicted quantity of honey produced	-.0268	.0272	-.99	5.5585
Access to market information	16.884	.4498	.000	.0775
Constant	-.1777	.7650	-3.65	-
Lambda	60.8680	26.0043	-2.34	-
Rho	1.0000	-	-	-
Number of Obs = 205, censored Obs= 25 Uncensored Obs= 180 Prob > chi2 = 0.000**				
R-squared = 0.86, Waldchi2 (11) = 154.14** Note:-**, denote variable significant at 5% significance level				
Note: Dependent variable was honey market participation decision				

Source: Own computation from the survey result, 2024

Additionally, other sources of income, aside from beekeeping, positively and significantly affected honey marketing surplus at a 5% significance level. This result indicates that for every increase of 1,000 ETB in a producer's average income, the amount of honey supplied to the market increased by 0.8%, holding other factors constant. In essence, producers with higher average incomes found it easier to bring honey to market than those with lower or no income. This suggests that increased income facilitates and boosts honey production, resulting in a greater quantity supplied.

Household beekeeping experience also had a positive and significant impact on honey marketing surplus at the 5% significance level. Specifically, for each additional year of beekeeping experience, the amount of honey supplied to the market increased by 21.05 kilograms, assuming other factors remained constant. Producers with more experience in honey production and marketing were more likely to sell larger quantities due to their broader marketing networks and greater knowledge. Studies show that experienced beekeepers supply more honey to markets due to better production practices, quality management, and marketing networks. Kumar et al. (2018) found that longer experience led to higher honey sales, while Birhanu and Kebede (2019) noted that experienced Ethiopian beekeepers were more efficient, increasing marketable surplus.

The number of beehives owned (NBHO) positively influenced the volume of honey supplied to the market at a 5% significance level. The model indicated that for each additional hive owned, the volume of honey marketed increased by 19.66 kilograms, while other factors remained constant. This suggests that producers with more beehives harvested larger volumes of honey, leading to greater market supply. Tessema and Gemechu (2016) found that Ethiopian beekeepers with more hives significantly boosted their honey sales volume, aligning with the idea that higher production capacity translates to greater market supply. Similarly, Gebremedhin et al. (2018) observed that each additional hive increased honey output, thus enabling beekeepers to sell larger quantities and improve their income.

At the 5% significance level, the **frequency of extension contact** had a positive and significant impact on honey supply. For each additional day of extension contact, honey sales increased by 24.6 kilograms, holding other factors constant. This positive effect can be attributed to beekeepers gaining valuable knowledge during their interactions with extension agents, particularly regarding modern production, harvesting, storage, and handling methods. Research shows that extension contact positively impacts honey supply by providing beekeepers with knowledge of modern techniques. Gizaw et al. (2017) and Mulugeta and Fufa (2018) found that regular extension services improved honey production and marketing in Ethiopia, helping beekeepers adopt better harvesting, handling, and storage methods, leading to higher sales.

Lagged Market Price: As anticipated, lagged market prices had a positive and significant impact on the surplus honey sold, with a significance level of 5%. The robust findings from Heckman's second stage indicated that the market surplus for honey products increased by 3.645 kilograms, assuming other factors remained constant. This suggests that when the previous year's market price for honey was favorable, farmers were more likely to allocate additional resources towards honey production, resulting in a higher quantity supplied to the market. Research shows that lagged market prices significantly influence honey supply. Gemedo et al. (2017) and Tefera et al. (2016) found that higher honey prices in the previous year encouraged Ethiopian farmers to increase production and supply in response to favorable price trends, leading to greater market availability. However, a comparison of honey supplied to the market between the lagged year and the survey year revealed a decrease in supply within the study area. This observation aligns with the research conducted by Tadie and Lemma (2018), which found that lagged market prices positively and significantly influenced market participation in teff.

Determinants of producers' market outlet choice

Market Outlet Choices for Beekeeping Farmers

In the district, beekeeping farmers utilized three market outlets: collectors, retailers, and consumer outlets. The model results (Table 8) indicated that these three options formed the choice set in the Multivariate Probit (MVP) model. The model demonstrated a good fit to the data, as evidenced by the Wald test statistic (39) = 108.36, which was statistically significant at the 5% level. This finding confirmed that the subset of coefficients in the model was significant and that the components included had adequate predictive ability.

Moreover, the p-value (prov = 0.0000) was statistically significant at the 5% level, indicating that the independence of disturbance terms reflecting the independence of multiple market outlets was rejected. This suggests significant joint correlations among the estimated coefficients across the equations in the model.

The likelihood ratio test for the null hypothesis of independence between market channel decisions (rho21 = rho31 = rho32 = 0) was also significant at the 5% level. Consequently, we reject the null hypothesis that all rho values are jointly equal to zero, confirming the model's goodness-of-fit. This indicates that there were notable differences in market outlet selection behavior among beekeepers, as reflected in the likelihood ratio statistics.

Table 1: Results of the robust second-stage Heckman selection model for the level of honey market surplus (intensity of participation).

Variables	Coefficient	Standard error	P value
Sex	45.4654**	21.987	.039
Educational level	6.1521	4.8152	.201
Family size	0.634	2.5868	.806
Income other than beekeeping	0.0080**	0.0035	.023
Beekeeping experience	21.051**	7.851	.007
Types of hives used	-7.134	11.025	.518
Total number of hives owned	19.668**	2.358	.000
Distance to the nearest market	-1.6766	1.353	.215
Access to credit	4.5162	12.336	.714
Frequency of extension contact	24.604**	7.243	.001
Cooperatives membership	11.754	14.92	.431
Lagged price	13.110**	4.127	.002
Access to market information	-3.890	3.565	-1.09
Constant	-96.5674	48.2782	.041
Mills lambda	27.967**	10.895	2.57
Rho		1.0000	
Sigma	60.8680	19.38	
Lambda	60.8680	26.0043	-2.34

Note: Dependent variable was honey marketed surplus in Kgs Source: own computation, 2024

The correlations rho21 (between retailer and collector outlets), rho31 (between consumer and collector outlets), and rho32 (between consumer and retailer outlets) were negatively related at a statistically significant level of 5%. This suggests a competitive relationship among these outlets, indicating that in honey marketing within Legehida District, producers tended to use consumers and retailers as substitutes for collector outlets.

As shown in Table 8, out of the 13 explanatory variables included in the multivariate probit model, five significantly affected collector market outlets, eight influenced retailer outlets, and eight impacted consumer outlets at a 5% probability level.

Analysis of Factors Influencing Market Channel Choices among Beekeepers

Age of Respondents (Age): This variable was anticipated to have either a positive or negative influence on producers' market channel selection. The analysis revealed a positive and significant relationship with the consumer marketing channel at the 5% significance level. Specifically, as the age of beekeepers increased, their preference for consumer market channels rose by 7.3% compared to other channels, holding other variables constant. This trend suggests that buyers' confidence in honey quality tends to increase with the age of beekeepers, attracting consumers who prefer purchasing from more experienced producers at reasonable prices. Additionally, older beekeepers often develop long-term relationships with consumers, fostering goodwill. This finding aligns with Chamiso et al. (2024), who noted that the age of the farm household head positively and significantly influenced the choice of consumer outlets at a 10% probability level.

Sex of Respondents (SEX): At the 5% significance level, this variable exhibited a negative correlation with retailer outlets and a positive correlation with consumer outlets. The positive relationship indicates that male-headed households were significantly more likely to choose the consumer market channel over the retailer channel by 6.08%, holding other factors constant. This suggests that male-headed households may have more time and resources to transport their products to distant markets for direct sales to consumers, whereas female-headed households might spend more time on family responsibilities, increasing their likelihood of selling to retailers by 1.91%. This finding is consistent with Nuri et al. (2016), who found that male-headed households tend to select optimal market outlets for selling their produce.

Beekeeping Experience (BKExp): At the 5% significance level, beekeeping experience was negatively and significantly related to the use of collector channels. Specifically, for each additional year of experience, the likelihood of choosing a collector market outlet decreased by 82%, as experienced beekeepers became aware of more profitable alternatives. Conversely, beekeeping experience was positively associated with consumer channel choices. As expected, this variable was positively and significantly related to the use of consumer channels at a 5% significance level. Increased experience in beekeeping enhances efficiency in honey production and processing. If consumers trust the quality of the honey, they are more likely to purchase it in larger quantities for future use. The results indicated that as beekeepers' experience increased, the probability of selecting the consumer market channel

rose by 76% compared to the collector market channel, holding other variables constant. This finding aligns with Tura and Hamo (2018), who discovered that farming experience positively influences the choice of optimal market outlets among available options.

Income Other Than Beekeeping (AMIOBk): This variable was expected to positively influence producers' channel choice decisions. However, at a 5% significance level, it was found to be negatively and significantly related to the use of collector channels. Beekeepers with a strong economic status were more likely to sell their products at fair prices or store them until market prices improved. Consequently, as beekeepers' income increased, the probability of choosing the collector market channel decreased by 0.02%, while holding other variables constant. This suggests that beekeepers were not compelled to sell their produce at lower prices to repay debts. Those with additional sources of income were less likely to select rural collector outlets compared to their counterparts with fewer alternative income sources. This indicates that producers with supplementary cash income had the means to transport their products to nearby markets and sell them through various outlets.

In line with the above finding Gizaw and Teshome (2015) showed that beekeepers with higher non-beekeeping income were less reliant on collector channels, as they had the financial flexibility to wait for better prices or transport their products to higher-value markets. Similarly, Mulugeta et al. (2019) found that farmers with diverse income sources were more likely to bypass low-paying collectors and sell their honey directly to wholesalers or through cooperative networks, as they were not pressured to sell at lower prices. This evidence aligns with the finding that higher income decreases the likelihood of using collector channels.

Volume of Honey Supplied to the Market: This variable negatively and significantly influenced the choice of collector and retailer outlets, while positively and significantly affecting the choice of consumer outlets at the 5% significance level. Specifically, for every 1 kg increase in the volume of honey supplied to the market, the likelihood of choosing collector and retailer channels decreased by 1.5% and 3.0%, respectively, while the likelihood of selecting consumer channels increased by 9.8%, holding other factors constant. As producers supplied more honey to the market, their likelihood of selling directly to consumers increased, leading to a corresponding decrease in the choice of other outlets. This finding contrast with Chamiso et al. (2024), who revealed that market supply quantity positively and significantly, influenced the choice of wholesaler market outlets at a 1% significance level.

Access to Credit Services: This variable negatively and significantly influenced the choice of collector and consumer outlets while positively and significantly affecting retailer outlet choices at the 5% significance level. The availability of credit services for honey producers reduced their likelihood of selecting collector and consumer outlets. Producers often make outlet choices before harvest time to repay their creditors (traders) either in kind or by selling their honey. In other words, farmers with access to credit could cover both production and marketing costs associated with seeking better outlets. However, access to credit increased the probability of choosing retailer outlets, as these retailers often provided credit, which was repaid in cash or kind as part of production. The results indicated that access to credit decreased the likelihood of choosing both collector and consumer outlets while increasing the probability of selecting a retailer's outlet by 88.7%, 239.4%, and 148.3%, respectively. Studies show that access to credit significantly influences market outlet choices in honey production. Abdulai and Huffman (2014) found that credit access encouraged farmers to sell through higher-value channels like retailers, while Getachew et al. (2017) noted that it reduced reliance on low-paying outlets. Similarly, Bekele and Mekonnen (2019) found that credit access led to more strategic sales decisions, as farmers could engage with retailers offering better terms.

Market Information (MI): Market information was anticipated to positively influence producers' choices of market outlets. However, at a 5% significance level, the findings revealed a negative association with the choice of retailer marketing channels. Access to current market information allowed producers to evaluate price differences between their local area and the nearest major market, leading them to prefer transporting their products directly rather than relying on retailers. The results indicated that having up-to-date market information decreased the probability of choosing the retailer channel by 141.3%, as shown in Table 8. This outcome contrasts with studies by Biruk (2020) which found that market information positively and significantly influenced beekeepers' decisions to sell honey directly to retailers at a 5% significance level. Studies show that access to market information reduces producers' reliance on retailers and influences their choice of marketing channels. Alemu et al. (2015) and Kassie et al. (2016) found that with up-to-date market information, farmers preferred direct sales to wholesalers or consumers, bypassing intermediaries. Tadesse et al. (2018) similarly observed that producers with market information could better assess price differences and opt for more profitable outlets.

Distance from the Nearest Market (DSTM): This variable positively and significantly affected access to collector market outlets at the 5% significance level. The positive relationship suggests that beekeepers in remote areas faced higher transaction costs, leading them to supply collectors in their villages. This finding aligns with Kassa (2017), who reported a similar positive relationship between distance from the nearest market and the use of collector outlets, supporting earlier findings by Berhanu et al. (2013) and Xaba and Masuku (2013). Conversely, distance

from the market was negatively associated with the likelihood of producers selling to retailers at the same significance level. Households situated far from market centers experienced challenges in delivering honey to retail outlets due to inadequate road infrastructure. Consequently, they opted to sell to more accessible market outlets in their vicinity. Delivering honey to retailers typically requires transporting the product to urban markets, where retailers operate. Studies show that distance from the market affects producers' outlet choices. Alemu and Gubre (2015) found that farmers farther from urban centers preferred local outlets due to high transportation costs. Tadesse et al. (2017) and Gebremedhin and Birhanu (2018) also found that poor infrastructure made it difficult for producers to reach retailers, leading them to sell to more accessible markets.

Furthermore, the positive relationship between distance and the likelihood of choosing collector outlets suggests that collectors often purchase honey directly from beekeepers at their farms during the harvesting season. As distance to the market increases, beekeepers tend to prefer selling to honey collectors rather than incurring higher transportation costs associated with other market outlets. This finding is similarly supported by Bardhan et al. (2012).

Additionally, the relationship between distance and the likelihood of choosing consumer outlets was also positive and significant at the 5% level. This indicates that as the distance to the market increases, beekeepers are more inclined to sell honey directly to local consumers instead of opting for other outlets that involve greater transportation expenses. Specifically, when the distance to the market increased, beekeepers preferred selling through consumer channels by 11.3%, holding other variables constant.

Frequency of Extension Contact (EXTCONT): The frequency of extension contact had a positive and significant influence on the choice of retailer outlets at the 5% significance level. Extension services enhanced farmers' access to critical market information and improved their production methods, resulting in increased output. This improvement enabled producers to select the most suitable market outlet for their products. Consequently, households that received more visits from extension agents were more likely to sell honey through retailer outlets. This finding aligns with Bardhan et al. (2012), who reported that regular interaction with extension officials positively impacted milk producers' likelihood of choosing retailer outlets in Uttarakhand. However, this result contrasts with the findings of Chamiso et al. (2024), who indicated that, at the 5% significance level, the choice of consumer outlets had a more positive and significant impact than that of retailer outlets.

Cooperative Membership (COOPM): The model results indicated that membership in a honey cooperative positively and significantly influenced the likelihood of producers choosing both retailer and consumer outlets at the 5% significance level. Specifically, being a member of a cooperative increased the probability of selecting retailer and consumer outlets by 86% and 115.8%, respectively. It was evident that members of honey production and marketing cooperatives had an obligation to supply their cooperative as part of its norms. Additionally, cooperatives provided technical assistance and training to their members and distributed dividends at the end of each year. This result is consistent with the findings of Tarekegn et al. (2017).

Table 8: Determinant of market outlet choice (multivariate probit model result)

Independent variables	Collectors		Retailers		Consumers	
	Coeff.	Std.Err	Coeff	Std.Err	Coeff	Std.Err
Age	-.0226	.0152	.0233	.0179	.0734**	.0281
Sex	-.2023	.5114	-1.9096**	.6534	6.0871**	1.876
EDR	-.1289	.1269	.0884	.1438	.2871	.1932
FamSize	-.1014	.0795	-.0852	.0874	.1449	.1277
DNM	.1092**	.0326	-.3473**	.0711	.1134**	.0508
Freq.ext.con	-.1883	.1732	1.1856**	.2995	-.6506	.3806
Bke.Exp.	-.8260**	.2279	.7631**	.2993	.8239**	.3553
AMIOBk	-.0002**	.0001	-.00001	.0001	.0002	.0002
Vol.honsup	-.0150**	.0043	-.0304**	.0064	.0987**	.0292
CredAcc	-.8871**	.3200	1.4836**	.5027	-2.395**	.8493
MarkinfoAcc	-.5764	.5985	-1.4130**	.6775	2.504**	1.224
TRUST	-.1419	.3599	-.1871	.4040	.3521	.4324
COOP	.3862	.3963	.8602**	.3876	1.1584**	.5809
_cons	4.675	1.291	3.1054	1.5966	-21.275	5.103
Wald test ((39) 108.36** Prov>..... 0.000**						
N=180, Wald chi2 (39) =108.36**, Log likelihood= -173.50, number of draws= 3 rho21=rho31=rho32= 0, where1, 2, 3, stands for collector, retailer and consumer. Likelihood ratio test chi2(3)= 23.694** Prob>chi2=0.0000** Note: **statistically significant at 5%.						

Source: Own computation from survey, 2024

Conclusion

The analysis utilizing the Heckman two-stage model revealed critical insights into honey market participation among producers. In the first stage, several factors significantly influenced the decision to engage in market activities, including the sex and education level of the household head, proximity to markets, frequency of extension contact, credit utilization, and lagged market prices. In the second stage, the volume of honey supplied was notably affected by similar variables, along with additional factors such as alternative income sources, beekeeping experience, the number of hives, and again, the frequency of extension contact and lagged market price. The presence of an inverse Mills ratio indicates that unobserved factors may also play a role in influencing market participation decisions. Producers primarily sold their honey through local collectors, retailers, and direct to consumers. To enhance the effectiveness of the honey value chain and improve producers' profit margins, it is essential to focus on the identified variables that influence outlet choice. Targeted interventions aimed at increasing access to education, extension services, credit, and market information could significantly bolster honey producers' market engagement and profitability.

Recommendations

Based on the study's findings, several strategic recommendations are suggested to improve honey producers' market participation and overall profitability. These include implement adult education on beekeeping, market trends, and financial literacy; support diversified cooperatives for better bargaining and shared resources; provide tailored training for credit institutions to better support beekeepers; empower women in beekeeping through targeted programs and equal access to resources; supply improved beekeeping equipment; strengthen extension services with ongoing support; establish market information systems for real-time data; promote sustainable beekeeping practices; and invest in research and development to improve bee health and productivity. These steps aim to improve farmers' knowledge, market access, and overall livelihoods.

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