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DETERMINANTS OF ADOPTION OF IMPROVED BEEKEEPING TECHNOLOGIES IN WEST SHEWA AND OROMIA SPECIAL ZONE SURROUNDING FINFINE, OROMIA REGIONAL STATE, ETHIOPIA

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ABSTRACT

Improved technologies in beekeeping have brought over decades in Ethiopia. However, it has been observed that improving the rural household income by adopting modern beekeeping technologies is still a challenge. This is due to the relative slow adaption rates of the new technologies. Therefore, this study was, designed to find out the determinant factors of adoption of improved technologies in beekeeping and identifying the major constraints of beekeeping production in the study area. A total of 120 farmer households were randomly selected from the two zones.Semi-structured questionnaires used for gathering the primary data. The data gathered was analyzed using SPSS version 22.The study result showed that from the total sampled households, 56.7 % of the households are adopted improved Beekeeping technologies and the remaining 43.3% did not adopt yet. A logit model result revealed that adoption is positively affected by extension services, awareness, and livestock holding whereas absconding is negatively affected. So, farmers alertness on beekeeping technologies and extension advice should be strengthened. In addition, having some financial sources like livestock holding could support the adoption. So, encouraging in supplement income generating activity beside beekeeping activity is better, this make easy for input purchase for starting beekeeping business. In general, efforts should be put into empowering the farmers with knowledge and skills, ensuring availability of modern technologies, and increasing the beekeepers' awareness on the technologies. The main challenges being hindering the bee product were: Agro chemical application, pests, and lack of improved beekeeping materials among other challenges. So, special attention on solution for anti-bee chemical application, bee pests and predators, and other causes of colony deterioration should get in thoughtfulness.

KEYWORDS: *Adoption, Beekeeping, Determinants, Improved Technologies*

INTRODUCTION

One of the means by which farm level productivity can be increased is through the introduction and dissemination of improved agricultural technologies to farmers. This is possible if and only if, information on the adoption and risk-taking behavior of farmers is known in advance (Admassie & Ayale, 2010). To promote diversification in agriculture and reduce poverty in Ethiopia, beekeeping offers a great potential for income generation and poverty alleviation (FAO, 2012; &Sisay, 2015). Unlike other agricultural projects such as crop and livestock, beekeeping is relatively low investment enterprise and can be undertaken by most people irrespective of age, sex, disabled (Mujuni *etal.,* 2012).However, beekeeping has not

received sufficient attention in the past as it does presently in developing country (ibid),cited in Matanmi (2008). Despite the potentiality of beekeeping in Ethiopia, little research and development in beekeeping has been conducted yet. Agricultural research has not given due emphasis to assessment and understanding of modern methods of bee keeping especially in the country where the scholars and policy makers have not been able to adequately demonstrate the importance of these modern technologies to farmers livelihoods. But, adopting improved technologies and improved management practices would greatly improve the yields and quality of honey (Wilson, 2006). Even though considerable attention is given in reports and documents to the significance of beekeeping in Ethiopia, little research and development in beekeeping has been conducted. Efforts to increase production would require proper assessment of the factors affecting the adoption of beekeeping and associated technologies (like improved hive and other accessories, bee colonies and product management technologies). Hence, the country in general and the region in particular are not benefiting from the subsector as its potential would allow. Among the major challenges of beekeeping in Ethiopia, more than 90% of the beekeeping is practiced in traditional ways using traditional hives with low production and productivities of the subsector, lack of technical skill or poor management, the critical shortage of inputs, inadequate extension delivery system and lack of bee forage (Gezahegn, 2012). Therefore, this research gap initiates this study to identity factors influencing adoption of improved beekeeping technologies and their major constraints in beekeeping production in the study area.

RESEARCH METHODOLOGY

Description of the Study Area

The study was conducted in West ShewaZone and Oromia Special Zone Surrounding Finfine in Oromia region. West Shewa Zone is one of the administrative zones of the Oromia Regional State. The zone has located between 8°51'16" to 9°14'53"N and 38°15'2" to 38°28'45"E and about 120 km West of Addis Ababa/Finfine (ZAO, 2017).It consists of 13 districts from which the research conducted was in Dandi and Ejere districts.

Dandi district is located about 90 kilometers away from Addis Ababa to the west side at an altitude of ranging from 2140 to 2800 m above sea level with mean annual rainfall of 1140 mm and average daily temperature of 16.3°C (Belay & Azage, 2012). The capital of the district is known as Ginchi. Ejere district is located 44 km west of Addis Ababa at altitude of 2060-3085mabove sea level and, 38° -22' E longitude and 9°2'N latitude with receiving an average annual rain fall of 1075 mm (Sisay *et al.,* 2017).Special Zone of Surrounding Finfine (S/Z/O/S/F) is the zone from which Walmara and Sebata hawas were selected for the study. Some districts those are lately joined to the Special Zone Surrounding Finfine were Walmara, Sululta & Berek, Sebata hawas; those were previously found under West Shewa, North Shewa, and South West Shewa Zones of the Oromia Regional State respectively; but they have been administratively placed under the Oromia Special Zone Surrounding Finfine since 2008 (https://en.wikipedia.org). The zone is located in the central highlands of Ethiopia, in Oromia Regional state surrounding the capital city, Addis Ababa. Geographically, the zone lies between 8^0 34' – 9^0 32' North latitude and 380 25' – 390 08' East longitude. Walmara is one of the districts in the Oromia Region part of the Oromia Special Zone Surrounding Finfine; it is bordered on the south by the Sebatahawas, on the West by West Shewa zone, on the North by Mulo, on the Northeast by the Sululta, and on the East by the city of Addis Ababa.Sebata hawas is one of the district in the Oromia Special Zone Surrounding Finfine; and is bordered by Southwest Shewa zone in South, by Walmara on the Northwest, and in the North, by Burayu, on the Northeast by city of Addis Ababa, and on the East by Akaki sub city. The Awash River defines this district's boundary with Southwest Shewa Zone. The altitude of district ranges from 1700 to 3385masl. The highest point in this district is Mount Wechacha (3191 metersm.a.l), located in the Southern part of the district.

Sampling Method

For this study, Oromia region was purposively selected because the region is one of the most beekeeping production potentialities in the Country. According to CSA (2012), the major honey and beeswax producing regions in Ethiopia are Oromia (41%), SNNPR (22%), Amhara (21%) and Tigray (5%). Again, two zones from the region also selected purposively where the technology was early addressed for the reason that the area are closest to Holeta Bee Research Center and Potential area. Then stratified and simple random sampling method were conducted to select districts and kebeles. Finally, the number of households that had been drawn from each kebeles was determined by using probability proportional to size (PPS). Table 1 below illustrates the sample size generated that has been employed.

Table 1 Household Sample Size Across Adoption Status for the Study

No	Zone	Districts	Non-Adopter	Adopter	Total
1	West Shewa	Ejere	19	22	41
		Dandi	12	19	31
		Total	**31**	**41**	**72**
2	OSZSF(Oromia Special Zone Surrounding Finfine)	Walmara	17	15	32
		Sebata hawas	4	12	16
		Total	**21**	**27**	**48**
	Overall Total		**52**	**68**	**120**

Type of Data

In the study, primary data was collected for all variables those have been hypothesized to influence beekeeping technologies adoption. The sampled respondents have been interviewed with the help of semi-structured (close &open-ended questions) scheduled, and the secondary data was used checklists from zonal and district Agricultural offices for crosschecking the gathered data.

Data Analyzing

The collected data were analyzed using descriptive statistics and econometric models. A binary logit of econometric models was used to identify the determinants of improved beekeeping adoption. Following Gujarati (1995) the model is specified as:

$$\text{Ln}\,[P/(1-P)] = \beta_0 + \beta_1 X_1 + \ldots \beta_n X_n + e \qquad \ldots\ldots\ldots\ldots\ldots(1)$$

The model was estimated using the maximum likelihood method. Adoption category (whether adopted or not adopted the improved beekeeping technologies) was considered as dependent variable which is dummy.The technology is full package of improved beekeeping technology recommended in the study area includes: use of improved bee hive, bee forage planting, feeding of bee colony, seasonal colony management, inspection, colony transferring, colony splitting, queen raring, use of protective cloth, harvesting, product quality management and use of recommended container for storage. The variables presented in table 2 were used in the model.

Table 2 Dependent and Independent Variables With Expected Sign

Variables	Type	Measurement	Expected Sign
1. Dependent	Dummy	Adopter = 1 Non-adopter = 0	
2. Independents			
Age	Continuous	Number of years	- ve
Literacy Status	Categorical:	1=Unable to read &write 2= Read &Write 3= Grade 1 - 4 4= Grade 5- 8 5= High School 6= Higher Education	+ve
Sex	Dummy	0 = Female 1 = Male	+ve
Training on Beekeeping	Dummy	1 = Yes 0 = No	+ve
Household Land Size	Continues	Measured in hectares	-ve
Family Size	Continuous	Number members	+ve
Experience in Beekeeping	Continuous	Number of years	+ve
Total Livestock Unit	Continuous	TLU	+ve
Market for The Products:	Dummy	1 = Available, 0 Otherwise	+ve
Extension Contact:	Dummy	1= Advised, 0 Otherwise	+ve
Credit Use	Dummy	1 = User, 0 Otherwise	+ve
Absconding of Honeybees	Dummy	1= Absconding,0 Otherwise	-ve
Field day visit	Dummy	1 = visited,0 Other wise	+ve
Traditional hive owned	Continues	Numbers of colony	+ve

RESULTS AND DISCUSSIONS

Demographic and Socioeconomics Features

This section deals with results obtained using statistical measures based on the corresponding continuous and dummy/categorical variables. Accordingly, the household head mean age was 40.3 years where the mean age for adopters and non-adopters were 40.41 & 39.54, respectively (Table 3). From the result, no significance difference was observed across adoption category based on age. Usually, rural family was used family labor as industry to process their farm activity, and hence it is expected to support technological adoption even though beekeeping is the least labor requirement. Accordingly, the sampled households' average family size was 5.27 and 6.07 persons for non-adopters and adopters, respectively. Concurred to the assumption average family size for adopter is larger to some extent. Experience on beekeeping is one of the variables that were considered for positive impact. However, exprience was found to be insignificant in affecting the adoption of the technology but with slight difference between mean of the adopters 9.04 and non-adopters 9.93 (Table, 3). This may imply farmers of the study area had long lasting with traditional practice as usual of the developing countries' feature of agricultural production. Land is the main factor for agricultural input that obviously expected as positively correlated with technology adoption and production. But in case of beekeeping it is assumed as when farmers face shortage of land they will adopt different land saving technologies like. Concurred to the assumption, from the total mean of farm size owned by the sample respondents 1.5 hectares, adopters were accessed with 0.98 hectares while the non-adopter owned about 2.38 with significant mean difference at 1% probability level (Table 3). The result shows that the beekeepers in the study areas having more land divert their business to land product rather depending on off-farming activities like beekeeping. So, if development agents focus on land less household and youth to implement beekeeping activities, the landless

farmers and jobless youth may be benefited, and un-employment problem of the country furtherly reduced to some extent. Number of livestock is an important proxy for income generating activity in terms of dairy, poultry, ruminant, and cattle sale in the study area. Farmers with high number of livestock have an opportunity to bear the risk that may occur with lack of income from single business. It is possible to understand that the mean livestock owned by the adopter is 2.56 and 1.35 by non-adopters, respectively. The *t*- test result indicated that there is significance difference between them at 1 % significance level (Table, 3). This is due to the income generated from the sale of livestock and their products may support purchase of the technologies input and brings farmers for adopt. Number of livestock was measured in Tropical Livestock Unit (TLU). The mean traditional honeybee colony holding was 8.43 and 4.23 honeybee colonies for adopters and non-adopters, respectively. Owing more or a smaller number of colonies affect the use of improved beekeeping, as farming households decided to use the technology if they have knowhow about the product (Workneh, 2011). The study also agrees with previously research done, illustrates the significant difference among the group at $p<0.01$ probability level (Table, 3).

Most of the farmers had no education which was ranging from unable to read and write, to higher education. Accordingly, the result founds that from the sampled households, 24.2 % did not pass through formal schooling (i.e. unable to read and write). Based on adoption category, more of non-educated households were from the non-adopters of the technologies. It is about 36.5 % those were non-adopters and illiterate while 14.7 % were from adopters. Comparison was done between adopters and non-adopters in relation to their educational level, and it has statistically significant mean difference at $P<0.05$. This explains that the education level of adopters of improved beekeeping technologies is higher than non-adopters of the technology, implying the influence of the variable in making adoption decisions. Similar result was achieved by Bunde and Kibet (2015) done onSocio-economic factors Influencing adoption of modern bee keeping technologies in Baringo Country, Kenya.

Awareness about the technologies and its benefit helps the beekeeper to learn more about the technologies and used to alerts those to-wards adopting the technologies. Consequently, about 94.1 % and 32.7 % of adopters and non-adopters had got an opportunity to aware/hear about the technology respectively (Table 4). It is statistically significantly different at $P<0.01$. This shows that the beekeepers that got a chance of having information on the technologies, are adopt more. Similarly, among the respondents, 95.6 % and 23.1 % of adopters and non-adopters respectively, had got an opportunity to contact with extension. It is significantly different at $P<0.01$, showing that farmer those advised and supported by extension workers on beekeeping activity, adopt more. Again, the study identified that, farmers' characteristics such as participation in field days and visiting different demonstrations on apiary sites enhance adoption of farm technology. In other explanation the more participated on field day are from adopter category which is supported by $\chi 2 = 71.59$ indicates significant difference (Table, 4). So, extension support with full awareness and motivation/invitation to different field days and advices are more important for technology adoption and expansion.

Regarding to credit, it makes possible, farmers to acquire inputs for technology adoption since it helps to start the business that could help poor beekeepers accessing with necessary equipment, which the farmers perceive the technology to be costly to engage in. The study confirms the idea by founding the adopters have more accessed and used credit, with high significant different at $P<0.01$(Table, 4). So, if promotion of the technology is accompanied by credit, as the fact the beekeepers who decide to adopt the technology can get credit.Concerning market access, as shown in Table 4, 100 % of the adopters supplied their product to the available market and they had responded that the availability of market, while lesser (68%) of the respondent positively respond concerning market availability from non-adopters. This assists the beekeepers to

know more about the market and motivated to produce more, which in turn help them to adopt the technology to produce more products and supply more. The difference is statistically significant at P<0.01 and indicates significant factor of market availability for the technology adoption. Beekeeping training develops the beekeepers' self-confidence in the use of the technology. As summarized in Table 4, it is significantly different at P<0.01, which implies developing the skill of beekeeper through beekeeping training especially, practical participation improved adoption of improved beekeeping technologies.

Table 3 Demographic and Socio-Economic Characteristics for Continues Variable

Variables	Adoption category	Group Statistics					
		N	Mean	Std. D	Mean D/ce	(Std.E)	t- test
Age	NAD	52	39.54	11.43	-0.873	2.089	-0.42
	AD	68	40.41	11.27			
Family size	NAD	52	5.27	2.96	-0.804	0.516	-1.56
	AD	68	6.07	2.67			
Land holding	NAD	52	2.377	1.67	1.39531	0.2334	5.98***
	AD	68	0.98	0.84			
Experience	NAD	44	9.93	7.44	0.888	1.307	0.68
	AD	68	9.04	6.28			
TLU	NAD	52	1.35	0.97	1.2	0.3	-3.95***
	AD	67	2.56	2.02			
Traditional hive Owned	NAD	52	4.23	3.94	-4.196	0.98	-4.28***
	AD	68	8.43	6.18			

*** Significant at P<0.01, ** Significant at P<0.05; NAD = Non-Adopter; AD = Adopter

Source: own survey result, 2016

Table 4: Demographic and Socio-Economic Characteristics for Categorical Variables

Variables	Category	Adopters N (%)	Non-Adopters N (%)	Total (%)	$\chi 2$
Sex	Female	2(2.9)	1(1.9)	3(2.7)	0.125
	Male	66(97.1)	51(98.1)	117(97.5)	
Marital status	Single	5(7.4)	6(11.5)	11(9.2)	3.669
	Married	62(91.2)	42(80.8)	104(86.7)	
	Divorced	1(1.5)	4(7.7)	5(4.2)	
Education status	Illiterate	10(14.7)	19(36.5)	29(24.2)	14.349**
	Read and write	5(7.4)	8(15.4)	13(10.8)	
	Grade 1-4	12(17.6)	8(15.4)	20(16.7)	
	Grade 5 – 8	17(25.0)	8(15.4)	25(20.8)	
	Junior Secondary School	15(22.1)	8(15.4)	23(19.2)	
	High school	6(8.8)	1(1.9)	7(5.8)	
	Higher education	3(4.4)	0(0)	3(2.5)	
Awareness	No	4(4.4)	35(67.3)	39(31.7)	54.046***
	Yes	64(94.1)	17(32.7)	81(68.3)	
Extension Contact	No	1(4.4)	40(76.9)	41(34.2)	74.58***
	yes	67(95.6)	12(23.1)	79(65.8)	
Field day	No	10(14.7)	48(92.3)	58(48.3)	71.59***
	yes	58(85.3)	4(7.7)	62(51.7)	
Use credit	No	10(14.7	35(68.6)	45(37.8)	36.04***
	yes	58(85.3)	16(31.4)	74(62.2)	
Market available	No	0(0)	16(31.4)	16(13.4)	24.65***
	yes	68(100)	35(68.6)	103(86.6)	
Training	No	8(11.8)	46(88.5)	54(45)	70.03***
	yes	60(88.2)	6(11.5)	66(55)	

*** Significant at P<0.01, ** Significant at P<0.05

Sources: Own survey result, 2016

Logistic Regression for Factors Influencing Adoption

The variables subjected to econometric logit model and the results are as shown in table 5. From the study result, the total variation for the adoption of improved beekeeping technologies that explained by binary logit model was about 92.2 %. The model properly predicted sample size of 96.8 % for adopters, and 85% for non-adopters. The variables that were incorporated in the logistic and significantly affect adoption of improved beekeeping technologies were discussed as the following.

Education increases acquiring information and there by capable beekeepers with possible knowledge regarding improved beekeeping technologies. It also increases understanding of the technologies and facilitates its application. As hypothesized, education affects adoption of improved beekeeping technologies positively and significantly at P<0.1. The result is also supported by earlier studies of Workneh (2011) that dealt with factors associated with the adoption of improved beehive. Bunde and Kibet (2016) had reported, education level of the household head was found to have positive and significant relationship with the intensity of adoption of modern bee keeping technologies**.** So, farmer who are educated are more likely to adopt modern bee keeping, and suggested prioritizing basic education expansion before technology dissemination to farmers or new technology should focus on educated farmers for fast adoption. Regarding extension contact, the coefficient of the variable was statistically significant with a positive sign. This means that farmers who had an opportunity to contact with extension agent are strongly motivated to adopt the technologies. The extension contact helps the smallholders to raise their awareness about the characterization and attributes of the technology and use. The result is concurred with research done by Assefa and Gezahegn (2010) on Adoption of Improved Technology in Ethiopia. Improved beekeeping technology requires awareness on the benefits and practical aspects. The odds in favor of adopting improved beekeeping technologies increased by a factor of 94.391 for beekeepers who acquired information on improved beekeeping practices. The finding is concurred with the study of Renaud *et al.* (2018). Their findings suggest that to increase the uptake of beekeeping, increasing awareness and knowledge is import. Livestock holding as measured Tropical Livestock Unit (TLU) had a positive and significant influence on the technologies adoption. As expected, as farmers have other financial supplement, the more they likely to diversify their income sources and adopt new technologies. Unlike other agricultural activities beekeeping does not compete with other enterprises on resources, like land, feed, labor, and other required inputs. Absconding is the total movement of honeybee colony by leaving the hive. Absconding can happen due to different reasons. Lack of feed, harm of honeybee pests and insects, and drought. As hypothesized, absconding influences adoption of improved beekeeping negatively and significantly at P<0.1, the odds in favor of adopting improved beekeeping increased by a factor of 0.029 for beekeepers who had suffered by absconding (Table,5). So, attention to identify factors for absconding and possible solution to reduce absconding is demanded from research and development workers.

Table 5: Logistic Regression Factors Influencing Adoption the Technologies

Variables	B	S.E.	Wald	Sig.	Exp(B)	Test
Sex	-19.46	40193	0.000	1.000	0.000	-2 Log likelihood = 34.869[a]
Age	-0.042	0.088	0.224	0.636	0.959	
Family size	0.154	0.278	0.309	0.578	1.167	$\chi 2 = 102.739$***
Education	0.607	0.338	3.225	0.073*	1.835	
Land size (ha)	-0.334	0.527	0.402	0.526	0.716	Predicted adopter = 96.8 %
Experience	-0.034	0.115	0.086	0.769	0.967	
Traditional hive possessed	0.190	0.127	2.256	0.133	1.210	

Awareness	4.547	1.617	7.907	0.005***	94.391	Predicted non-adopter = 85 %.
Absconding	-3.541	1.868	3.594	0.058*	0.029	
Extension contact	4.157	1.375	9.145	0.002***	63.874	
Training	0.986	1.021	0.934	0.334	2.681	
Market	17.165	12234	0.000	0.999	28474377.7	Overall = 92.2 %
Use of Credit	0.081	1.090	0.006	0.941	1.085	
TLU	0.267	0.162	2.725	0.099*	1.306	
Constant	-4.106	42014	.000	1.000	0.016	

*, *** significant at p<0.1, and p<0.01, respectively

Sources: Own survey result, 2016

Constraints

In order to utilize the beekeeping sub sector, identifying the existing constraints and searching for solutions are of paramount importance. Accordingly, the respondents identified nine major constraints. All problems cannot be solved at once because of time and capital shortage and so; prioritization of the problems was made to identify the most important constraints that hinder the development of beekeeping sub sector in the study area. As indicated in Table 6, agro chemical application is the chief constraining beekeeping success in the study area. It affects their feed sources (bee forage) and leads death of colonies. As a consequence, the honeybee colony declined and deteriorates bee production in the areas. The existence of honeybees' disease and pests are prioritized as core problem that could affect the honeybees' life and couse absconding. The remaining constraints prioritized above affect the hive products of the study area, though their degree of influence is different.

Table 6: Ranking of beekeeping constraints in the study area

Constraints	Frequency	Percent
Agro chemicals	35	31.3
Diseases, pest, and predators	29	25.9
lack of bee keeping material	20	17.9
Absconding	10	8.9
Lack of skill	7	6.3
High cost of improved bee keeping material	5	4.5
Declining of Bee colony	4	3.6
Shortage of bee forage	1	0.9
Lack of extension support	1	0.9
Total	112	100.0
Missing System	8	
Total	**120**	

Sources: Own survey result, 2016

CONCLUSIONS AND RECOMMENDATIONS

For the study descriptive statistics and econometric model were employed for analysis. From descriptive result, demographic factors like education, awareness/information, extension contact, field day, use of credit, training, and market available are the variables comes with significant difference among the groups on adoption of improved beekeeping technologies. In addition, total mean farm size, number of livestock owned (TLU), and number of bee colony are considerable factor in advancing adoption of the technologies. The binary logit model also clearly shows that educational level, extension contact, number of livestock owned, awareness and absconding are the main determinants factors of probability of adoption in the study area. Even though the government of Ethiopia gives great

attention to the beekeeping sub-sector to promote modern beekeeping technologies the probability of adoption of the technologies is found to be minimal and affected by different factors. Agro chemical application is ranked as a first; diseases, pests and predators are ranked as the second major constraints of beekeepers. Similarly, shortage of bee equipment and accessories, with high costs of the material is the considered factors in hindering beekeeping development in the area.

Based on the Conclusions the Following Recommendations are Drawn:

- Education is an important factor for any new hi-tech adoption. So, future researchers can explore how to promote beekeeping among educated farmers and pay attention to advancing education to rural farmers as prioritizing to any technology advancement. This is because presently, beekeeping is mainly practiced by uneducated farmers and resulted as its adoption is low.
- Lack of extension support was found to be the major factor influencing to modern bee keeping practices in the area. So, Agricultural extension services have to be provided for farm households regardless of distance of farmer home from offices of development agents.
- Having other supplement income is also important factor to purchase the required beekeeping improved inputs. This may reduce beekeepers' constraints in purchasing improved beekeeping equipment to start the activity. So, running other agricultural activities beside beekeeping is recommended since the activity is never competing any rural enterprises.
- In order to support beekeeping adoption, efforts should be focused on continuing and intensifying initiatives that increase awareness and knowledge, particularly in improved beekeeping activities. Early awareness may be effective in raising motivation and reducing inequalities or negative perceptions and feelings based on false information. So, adequate information has to be provided for farm households about the technologies, benefits, usages.
- Similarly, attention to the wise way of using different chemicals, specifically herbicides to minimize the death of honeybees is required.
- Appropriate interventions in disease, pest and predator control should be strengthened to reduce colony disturbance and improve overall bee production and productivity.
- Beekeeping equipment and accessories have wished to be supplied /accessible/ to the farmers/beekeepers at affordable price.
- Generally, government bodies and development partners are strongly demanded to pay standard attention to beekeeping sectors through investing it on educated farmers (especially, the available human resources like unemployed youth in the country). Awareness and extension follow-up are very important since the community perceive beekeeping as traditional and expect as nothing is new regarding the activity. Financial support and minimizing cost of beekeeping equipment is necessary to attract everybody to the enterprises. Finally, highest attention is required in the side of agro-chemical since it diminishes the bees rases and honey production the study area and Ethiopia in general.

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APPENDIXES

Variables Test

Table 7: Results of Multicollinearity Test: Contingency Coefficient for Dummy Variables

	Aware	Abscond	Extension	Field Day	Training	Market	Credit	Sex	Education
Aware	1								
Abscond	0.1058	1							
Extension	0.4027	0.0715	1						
Field day	0.5219	0.0630	0.7120	1					
Training	0.4950	0.0038	0.6206	0.6668	1				
Market	0.4632	0.0503	0.4158	0.388	0.3912				
Credit	0.1321	-0.0737	0.2439	0.2432	0.2329	0.0699	1		
Sex	-0.057	-0.0358	-0.0627	-0.088	-0.076	-0.034	-0.067	1	
Education	0.2172	0.0495	0.2586	0.3373	0.2964	0.1150	0.0544	0.1305	1

Table 8: Results of Multicollinearity Test: Variance Inflation Factor for the Continuous Explanatory Variables

	Tolerance	VIF
Family size	0.786	1.273
Hectare of land	0.846	1.183
Traditional honeybee colony owned	0.974	1.027
TLU	0.790	1.266
age of household head	0.729	1.371