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Research Article

Assessment of Function of Beekeepers Farmers Research Group in Selected Oromia Zones

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Abstract

Assessment of the function of beekeepers Farmers' Research Extension Group (FREG) was conducted in Oromia Special Zone Surrounding Finfine, West shewa and Southwest shewa Zones of Oromia Regional State, Ethiopia from February to May, 2021 with the specific objectives to assess the main functions of FREGs and to explore challenges faced beekeepers FREGs in the areas. The interview was conducted using pre-tested semi-structured questionnaires to collect the required data. Descriptive statistics was employed to summarize variables, while inferential tools like independent samples t-test and chi-square were used to test variables under hypothesis. The results indicated that FREGs participants were better involved in diagnosis situations, result evaluation and dissemination than nonmembers. Some of the major constraints identified from the assessment include weak linkage among stakeholders, lack of habit of working together and poor participation of beekeepers in innovation system. The result also revealed that sex of household heads, experience in beekeeping, education level and family size showed significant difference. Hence, FREG approach has help project participants to improve their participation in research and development activity. However, substantial support is required from stakeholders in order to improve linkage and broaden its scope.

Keywords

Beekeeping, FREG, Performance, Synergy, Technology

1. Introduction

In earlier days agricultural research was devoted to searching for solution to problems which are seen important from the view points of the researcher. Accordingly, the solution seeking attempts were mainly taken as mere responsibility of the professionals. Farmers were considered as passive recipient of technologies developed on the research stations. In contrast, however, technologies from research station usually failed to meet the test of farmers' selection criteria; hence adoption rate became very low. This was the turning point to participatory research.

Since 1980s, an array of participatory extension methodologies and approaches that aim to involve farmers came to existence. For instance, starting from early 1980s farmer participatory research (FPR), participatory technology development (PTD), and participatory rural appraisal (PRA) were used in rural development programs. Recently, other new participatory research and extension methodologies such as Client Oriented Research (COR), Farmers Research Extension Groups (FREG), Farmers Field School (FFS), and Farmers Extension Group (FEG) have been developed and

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used at a wider scale [1].

Researchers have recognized the importance of working with farmers in the technology development, verification and transfer processes. In this connection, it should be noted that activities of the farmers' research group (FREG) employs joint problem identification, analysis, planning and implementation with keen participation of farmers as well as research and extension staff. Thus, empowerment of these groups and making their voices heard is very essential to understand their role in innovation and social capital involvement [2, 3].

FREGs and FEGs were established as a primary method of involving farmers in the research and extension process. They were formed in order to generate new technology or test technologies that have been released or are in the pipeline. According to Mafuru *et al*. [4] use of FREGs and FEGs increases the efficiency and increases farmer influence in the technology generation and increased research impact. Furthermore, it appears that eventually the FREGs would become pressure groups that would place demand on research and make it truly demand driven. Members of the FREGs and FEGs participate in identification of system constraints, planning, testing and evaluation of proposed research interventions and dissemination.

A number of improved beekeeping technologies have been disseminated through FREG. It is expected that beekeeping practices can be more productive with the active involvement of end beneficiaries and professional where convergence and synergy of knowledge from both groups is essential to develop beekeeping technologies that are effective, and that fit the socio-economic conditions of beekeepers. This involves the development and dissemination of technological options with an active participation of beekeepers at all stages.

Despite the central contribution of local innovations in demand-driven and client oriented technology generation, there is no comprehensive study conducted on beekeeping FREGs in the study areas. Besides, there is no documented information on beekeeping FREGs and the function of FREG and challenges of beekeepers' participation in FREG. This study was initiated to assess the main functions of FREG in beekeeping practices and the different limitations that influence beekeepers participation in FREG.

2. Methodology

2.1. Description of the Study Areas

The study was conducted in Oromia Special Zone Surrounding Finfine (OSZSF), West Shewa and Southwest Shewa Zones of Oromia regional state. These Zones are the prominent honey production areas in central Ethiopia. Southwest Shewa is one of the Zones of the Oromia regional State in Ethiopia. It has an elevation of 2227 m. a. s. l. Geographically, it is located at latitude of 8 ° 36' 33"N and longitude of 38 ° 14' 7"E. Oromia Special Zone Surrounding Finfinne is one of the zones of the Oromia Region in Ethiopia. It was created at 2008 from former Burayu Special Zone and parts of North Shewa, East Shewa, Debub, Southwest Shewa and West Shewa Zones. This zone is surrounding the capital of Ethiopia, Addis Ababa, which is called Finfinne in the Oromo language. The main reason for creating this special zone was to ease the co-operation and development of surrounding areas of Addis Ababa and to control the urban sprawl of this city on the lands of Oromia. West Shewa Zone is a zone in Oromia Region of Ethiopia, about 114 Km from the capital city of the country, Addis Abeba. It is geographically located between 8°17' and 9°56' N and 37°17' and 38°45'E. West Shewa shares the boundaries on north with Amhara Regional state and North Shewa oaf, on the East Addis Ababa region, on the west East Wollega and on the South west by south west Shewa and Jimma Zone. The total area of the zone is 15,086.15 km^2. It is subdivided into 22 districts and two independent urban administrative zones namely Ambo and Holeta [5].

Mixed crop and livestock farming system is the mode of agriculture practice in the zones [5]. The main crops cultivated in the area are: teff, barley, wheat, maize, sorghum, chickpea, bean, pea, lentil and haricot bean. In addition, irrigated vegetables such as potato, onion, garlic and cabbage also produced in the area. The major livestock reared includes: cattle, horses, donkey, goats, sheep, mules and poultry. They also engaged in beekeeping activities parallel to the above activities.

In the last two decades, FREGs were established to introduce different improved beekeeping technologies these Zones and among these movable frame hive, transitional hive, improved beekeeping management system, pre and post honey handling techniques were the most widely disseminated ones.

2.2. Sampling Technique

A multistage random and purposive sampling technique was used for the study. To this effect, Oromia Special Zone Surrounding Finfine (OSZSF), West and Southwest shewa Zones were purposively selected at first stage based on the prominence in beekeeping with established FREG and honey production potential. Second, Welmera District from OSZSF, Ambo and Ejere District from West Shewa Zone, Wonchi and Waliso from Southwest Shewa Zone were selected purposefully since the Districts were the only intervention areas where beekeepers FREGs established. As a result, nine kebeles were selected randomly from these Districts. Finally, 120 beekeepers (86 from FREG members and 34 from non-FREG) were selected randomly.

2.3. Data Sources and Collection Methods

Data on demographic and socioeconomic characteristics, socio-psychological, linkage and partnership, benefits, and challenges of working through FREG as well as improved

beekeeping technologies were investigated between FREG members and non-members to see the role of FREG in promoting improved technologies. To this effect, a combination of qualitative and quantitative data collection tools was employed to make use of the comparisons. Trained researchers administered the interview schedules and pre-testing was duly made to curtail if questions were not measuring what was intended to measure. The data explored from informal survey was triangulated with formal ones to understand real situations and to capture insights of why actors are doing what they formulate. A semi-structured interview schedule was employed to collect data to uncover if membership to FREGs does affect technology promotion or not. Similarly, three key informant interviews and three Focus Group Discussions were held for an in-depth understanding of some issues from each Zone. Secondary data were also collected from reports, statistics, research papers, and journals through critical review.

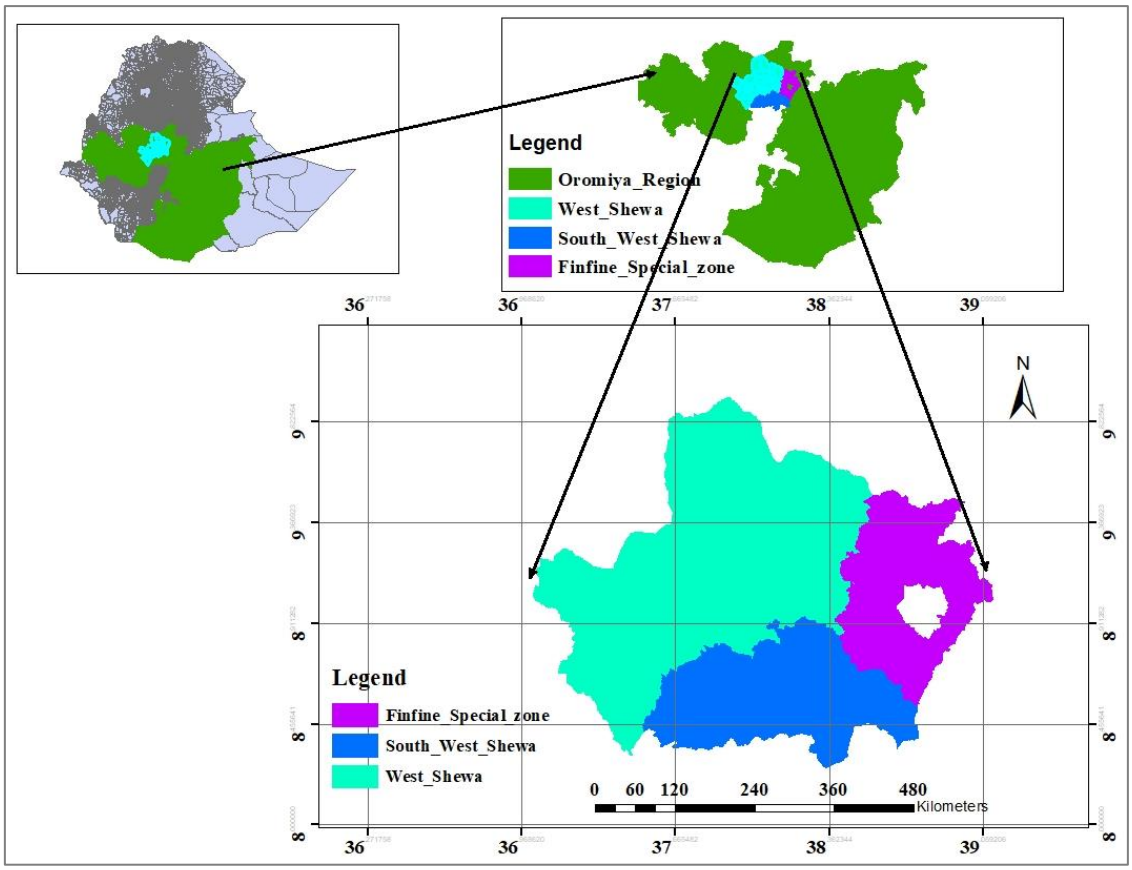

Figure 1. *Map of the study area, Source: ArcGIS Software (version 10.4), 2023.*

2.4. Data Analysis Method

For this study, quantitative data was analyzed using SPSS version 21 software. Descriptive statistics for summarizing data (mean, frequency, percent) and inferential statistics (t-test, chi square,) were used. A checklist method of performance appraisal was used to rate the function of FREG. Qualitative data from FGDs and key informants interview were also analyzed through on-spot analysis to avoid the apparent missing of relevant information. Rapid Appraisal of Agricultural knowledge Systems (RAAKS) tools used to analyze task and impact analysis (Tool B5 and B1), and information source exercises (Tool B3/A). Moreover, linkage matrix tool (B4/A) were used to examine the contribution of actors.

3. Results and Discussions

3.1. Characteristics of Respondents

Demographic and socioeconomic characteristics of the respondents during the study are presented in the following section.

Sex of the respondent: the result in table 1 reveals that a higher number of male headed households (90.7%) were found in beekeepers FREG as compared to females in non FREG households (32.4%) in the study areas, and there was statistically significant difference ($p<0.05$). The survey result also indicated that male take the largest share to be engaged in beekeeping activities in the study area. This is, perhaps,

women are constrained by indoor activity to participate in outdoor group activity compared to male household heads.

Age of the respondent: The mean age of the sample respondents was 46.54 years (Table 1). The mean of age of beekeepers involved in beekeeping FREG was 46. 81 years old while that of non-member was 45.85 years old. This reveals that beekeepers in the most productive age are actively engaged in honey production from both groups. However, significant difference was not observed between age of members and non-members of beekeeping FREG. In attribute to this Beyene and Verschuur [6] also reported from Wanchi district of Southwest Shewa zone that beekeepers in the most productive age are actively engaged in beekeeping activities.

Education status: The study shows that 79.07% and 48.57% of members and non-members were literate and illiterate, respectively (Table 1). Similarly with significant difference between members and nonmembers ($x^2 = 10.36$, $p<0.05$) there is association between the educational level of the respondents and being a member of the group. Thus, better educational status of members might have positively influenced the incorporation of local innovations to strengthen capacity of members and stimulates their existing knowledge to conduct on-farm researches with relevant experience and inquiring minds. The finding was congruent to the reports of Asgelil [7] that indicated positive relationship between education and role of local innovations.

Experience in beekeeping: The average experience for the entire sample was 13.88 years (Table 1). Moreover, the result also shows that the average previous beekeeping experience was 15.24 and 10.44 for FREG member and non FREG, respectively (Table 1). The previous beekeeping experience for the two groups were statistically different from each other at t-value of -4.803 ($p<0.001$), which showed that FREG members had significantly higher experience than non-members. It implies that experience provides beekeepers with a fast track succession of diagnostic knowledge to perform trial under his/her condition to evaluate and promote local innovations.

Family size of the respondent: From Table 1, the mean family size of members (5.66) equivalents) was a bit larger than the National average figure of 4.9 [8], while that of non-members (5.00 ME) was similar to the national average (Table 1). The mean difference was significant at less than 10 percent probability where larger family size assured availability of active labor force. The result is in agreement with the results of Chimdo *et al*. [9] who reported that family size played positive role in participation of local innovation where members made windfall profit.

Livestock holdings: As an integral part of the mixed farming system, livestock production meets urgent financial need, dietary requirements, loan repayment and overall cash security of the households. As shown in Table 1, mean TLU kept by the members and non-members of FREG during the study period was 4.73 and 4.51, respectively. There is no significant difference between the two groups in terms of livestock holding size.

Colony holding: The results in table 1 indicated that the average number of traditional bee colony hives owned by members and non-members were 3.19 and 3.41, respectively. However, there was no significant difference between members and non-members of beekeepers FREG at ($p < 0.05$) in number of traditional bee colony hive holding. Similarly, respectively the average number of transitional hives with bee colony owned by members and non-members were 0.58 and 0.18 while that of frame hive was 1.71 and 0.53 (Table 1). There was no significant difference between members and non-members of beekeepers in terms of transitional and frame hive possession.

Table 1. *Demographic and socioeconomic characteristics of respondents (N=120).*

Variable	**FREG members (N=86)**	**non FREG (N=34)**	**Total (N=120)**	**X^2**	**p-value**
	Percent	**Percent**			
Sex (dummy, 1=M, 0=F)					
M	90.7	67.6	84.2	7.478	.011**
F	9.3%	32.4	15.8		
Education					
illiterate	20.93	48.57	29.2		
grade 1-4	23.26	20.58	22.5	10.360	.040**
grade 5-8	34.88	17.65	30%		
grade 9-12	20.93	11.76	18.3		
Higher	0	0	0	t-test	p- value

Variable	FREG members (N=86)	non FREG (N=34)	Total (N=120)	X^2	p-value
	Percent	Percent			
Age of the HHH	46.81±8.544	45.85±9.468	46.54±8.786	-.538	0.734
Experience	15.24±7.818	10.44±8.273	13.88±8.208	-4.803	.003***
Family size	5.66±1.998	5.00±1.891	5.35±1.8.21	0.351	-0.061*
TLU	4.73 ±2.34	4.51±2.46	4.63+2.31	2.36	0.133
Mean traditional hive with bee colony	3.19	3.43	2.97	6.73	0.313
Mean transitional hive with colony	0.58	0.18	0.49	3.20	0.412
Mean of frame hive with colony	1.71	0.53	1.38	10.360	.116
Training					
Yes	100	20.58	77.5		
No	0	79.4	22.5		
Experience sharing					
Yes	0	22.73	8.3		
No	100	77.27	91.7		

***significant at 1%, ** 5%, and *10% probability level Source: Own survey, 2020

Study further show that all group members were provided with fundamental training while 79.4 % of non-members were not (Table 1). As a result, they acquainted with improved beekeeping management and marketing. These results suggest that acquisition of technical skills and knowledge of beekeeping were likely to adopt Knowledge of the Recommended Practices. According to FGD, FREG whose project terminated hardly have contact with extension. This, perhaps, confirm that graduated FREGs are reached self-reliance to independently operate beekeeping activities.

Moreover, 91.7% of respondents reported that no experience sharing was conducted to disseminate the information to others. Only 8.3% of respondents visited FREG site to observe management system individually. No experience sharing was done among FREGs (Table 1). Only 22.73 % on non-members able to visit nearby FREG sites by themselves (Table 1). Visiting demo site helps provide beekeepers with confidence and interest to try it out and non-target can be addressed.

3.2. Status of Beekeeping in the Study Areas

Respondents were requested why they engage in beekeeping? Consequently, 85% of them were initiated to start beekeeping enterprise to increase their annual income from bee products selling and for home consumption (15%) in the study area (Table 2). This implies that beekeeping significantly continue to contribute to household income making and source of nutrition for rural families.

The majority of the respondents (59.7%) in the study area got their colonies by catching swarms whereas 22.1% got their colonies by purchasing (Table 2). This is in line with Addis and Malede [10], who reported that 49.2% of the beekeepers started out by catching swarms. This study also consistent with Teshome [12], reported that 71% of respondents established their colonies by catching swarms. This might be due to the fact that the area is endowed with species of plants that are favored by bees as well as colonies are highly needed by beekeepers in the area. Very few beekeepers were supplied by donors (10.1%) and inheritance (8.1%) to produce honey.

Moreover, 56% of the respondents' harvest honey two times a year from frame hives and transitional, while only 44% of respondents did it once a year to leave honey for colony strength. This study is disagree with result to Segni [12] who reported that greater parts of the respondents (71.1%) collect honey once in a year while 28.9% of the respondent's harvested honey twice. Moreover, a study by Teshome [11] revealed that majority (65%) of respondent harvested honey once a year. The result in table 2 also shows that only 23.5% of respondents replied increasing honey production due to provision of improved bee forages around apiary. However, 63.7% of respondents replied that since few years ago honey production shows a declining state in yield per hive while 12.8% replied no change. Respondents reported that different problems affecting honey production in their areas. So, participants identified the major problems affecting honey yield with decreasing proportions were declining in bee forages availability (35.26%), agro-chemical application (32.87%) and pests and predators (29.37%). Only 3.33 % was due to others problem.

Table 2. *Status of honey production in the study area (N=120).*

Variables	Frequency	Percent
Why start beekeeping		
Income	78	65
Consumption	42	35
Sources of bee colony		
Swarm catching	72	59.7
Purchase	27	22.1
Donation	12	10.1
Inheritance	9	8.0
Frequency of honey harvest		
Once a year	53`	44
Twice a year	67	56
Honey production trends		
Increasing	29	23.5
Decreasing	76	63.7
No change	15	12.8
What affect honey production		
Declining forage	42	35.26
Agro-chemical application	39	32.07
Pests and predators	35	29.34
Others	4	3.33
Types of honey offered to market	120	100
Processed	64	53.3
Comb	43	35.8
Crude	13	10.9

Source: own survey, 2020

The study further showed the status of the existing honey market in the areas. In this instance, the majority of respondents (53.3%) supplied processed honey while 35.8% of respondents sell comb honey to their customers for its adulterants free. Only 10.9% of respondents sell crude honey to market to make local beverages.

Also, the average amount of honey yield obtained from traditional hives of the members and non-members of beekeepers FREG was 6.75 kg and 6.52 kg, respectively. The mean comparison of honey yield from traditional hive of members and non-members shows that no statistically significant difference is observed as shown in Appendix 1. The mean comparison of honey yield from transitional and movable frame hives was done across members and non-members. The mean yield obtained from transitional hive of members and non-members was 13.42 kg and 10.53 kg, respectively. There was significant difference between members and nonmembers of beekeeper FREG at 10%probability level in honey yield per transitional hive. The mean yield 19.92 kg and 15.14 kg was obtained from frame hive of members and non-members of beekeepers, respectively. The mean yield obtained from modern hive of members and non-members of beekeepers group were statistically significant at 10% probability level (Appendix table A1). This is similar to the result Beyene and Verschuur [7] who reported 5.22, 10.83 and 15.2 for traditional, transitional and modern hive respectively. Focus group result stated that input supply such as training, continuous follow up and provided bee materials helped FREG members to improve honey yield and quality.

3.3. Sources and Types of Beekeeping Knowledge

Further to identify relevant beekeeping actors who potentially contribute to strengthening FREG, FREG members were requested to response to who established them in group and empower technically as well as provide them with basic inputs. The tasks matrix provides information about the gaps in essential beekeeping knowledge provision. From Table 3 matrix analysis confirms that HBRC took the lead to transfer beekeeping technology, provide capacity building, inputs provision and market information to the target. Next, livestock resources development and fishery of the respective Districts plays beekeeping information sharing, advisory services and training roles. Others extension organizations found in the areas provide insignificant position to the beekeeping FREG. However, HBRC considered the central prime movers because it has been playing grand role through generation, adaptation and dissemination of improved beekeeping technology in the area. The center, therefore, acts as both source of information and channel of beekeeping knowledge. This implies that other concerned bodies are letting behind to put into effective FREGs for beekeepers benefit.

Table 3. Analysis of beekeeping information across actors.

Sources of information	Knowledge related tasks analysis					
	technology transfer	technical advise	training	input supply	financial support	market
HBRC	***	***	***	**	---	*
Livestock Agency	**	*	*	---	---	---
Ambo ARC	---	---	---	---	---	---
Ambo University	---	---	---	---	---	---
NGOs	---	---	---	---	---	---

***, ** & * refers high, medium & low knowledge contribution to FREG, respectively.
--- refers 'no contribution.'

3.4. Members' Benefits from Being Participate in FREG

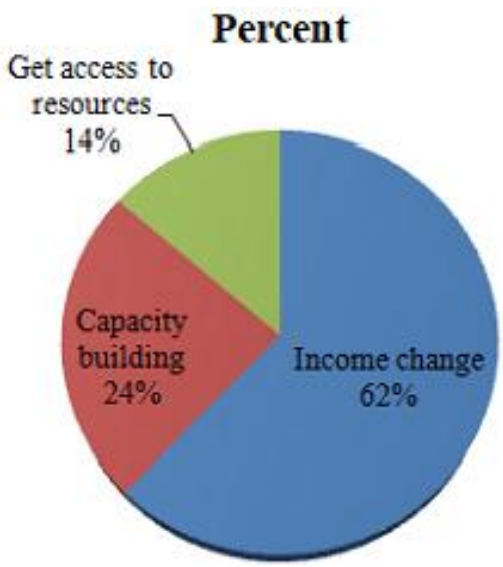

Figure 2. Benefits of beekeepers FREG.

Beekeepers reported that different pulling forces derived them to prefer group work compared to work alone. Consequently, 62% of FREG members were replied to increase their annual income due to close access to improved beekeeping technology package (Figure 2). Although size of hive holding per head differs between the members and non-members, the result has shown that group member enjoy a relatively better yield from transitional and frame hives. There was statistically significant yield difference between members and non-members at significance level of 10% in terms of transitional and frame hive (Appendix table A1). The mean of processed honey selling price per kg of members and non-members' was 250.00 and 220.00 Ethiopian birr, respectively. Statistically there is significant price disparity between members and non-members at a significance level of 5% (Appendix table A1). It implies that being a member of beekeeper group has a tendency to earn higher income by collecting together their honey to influence market. This is in fact most honey buyers need honey in large quantity and neglect small quantity which may reduce market price. Unlike, 24 % and 14 % of members were built beekeeping capacity and gets access to relevant resources being a member of beekeeper group, respectively (Figure 2). They preferred team work in order to develop analytical skills in farmer based beekeeping research. This is true that result demonstration of trials increase clients' ability to evaluate research results. Besides, grouped individuals have power to attract services like training, advisory services and expensive material which are inaccessible to individually.

3.5. Comparisons of Individual and Group Based Beekeeping Extension Services

Based on cross sectional survey results, relative advantages and disadvantages of individual based and group based beekeeping technology promotion are presented below.

Demerits of beekeeping group work: The study confirms that 64% of respondents were identified conflict in the group due to free rider or low commitment and clash of opinion as shortcomings of group based beekeeping extension approach compared to one-to- one extension (Appendix table A3). This implies that unequal contribution of group members can cause decreased motivation which may lead to group inefficiency and productivity. Likewise 36% of respondents were replied *share busy time*/distance as one of limit of working beekeeping in team. This is because apiary is either at communal land or somewhere else which is not equidistance to all members and thereby hard to walk some km during night.

Demerits of lonely engage in beekeeping: Study shows that poor access to basic beekeeping extension services (56.7%) and insufficient knowledge (20.8%) were the major demerits of

working independently (Appendix table A3). Similarly, 22.5% of respondents were identified low social networks and poor initiation as demerits of working alone beekeeping. This shows that small scale beekeepers, who engage alone, possess low social relation with high transaction cost to receive information, lose development support, motivation and encouragement in challenging world of hardship.

Merits of beekeeping working alone: In the same way 57.6% of respondents were responded less conflict as major advantage of independently engage in honey production compared to group work (Appendix table A3). Focus group discussants stated that "Under working alone, there is no need to worry about competitive or lazy coworkers, and there is more room to concentrate and a smooth workflow. So that beekeeper makes his/her own decisions, and there's no body to interrupt his/her works." The remaining 42.4% of respondents replied more efficient as merit of working alone (Appendix table A3). It saves time and allows effective colony follow up at back yard at any time. This is because there's no outside pressure to decide what to do – and when. This indicates that self-management allow individual to determine their own schedules.

Merits of beekeeping group work: From appendix 3, 40% of respondents were identified synergy as the most important merits of work in group compared to individual. This implies that convergence and synergy of knowledge from beekeeping actors and beekeepers bring combined strength and collective action to solve common problems as well as paves the way to low cost dissemination of technological option with an active participation of beekeepers at all stages. Also, 36.7% of respondent indicated that working in group creates close access to basic beekeeping services compared to independently engage in beekeeping. Appendix table A3 further shows that 23.3% respondents identified relevant beekeeping information sharing as advantages of group work compared to individual based. Connection of group members with extension institutions provide members with problem-solving skills and unique experience for unified perspectives. Lack of beekeeping information could adversely affect honey productivity. When people apply unique skills to common tasks, they often create more effective solutions than independent workers.

3.6. Assessment of Main Function of Beekeeping FREG

It's very vital to know how well FREG approach meeting anticipated targets compared to conventional high cost approach. A checklist method of performance appraisal was used to rate the status of beekeeping FREG. FREGs deviation from the anticipated targets shows under performing. On spot analysis was also used to avoid the apparent missing of relevant information.

Capacity development: The study shows that compared to FREG member, 79.4%% of non FREG have no sufficient beekeeping knowledge and skills (Table 4). For instance, FREG under HBRC project lasts for at least three years to develop clients' capacity on the introduced technology package. This indicates that organized beekeepers get advantage of necessary services (technical empowerment) than unorganized one. Group discussant of non FREG also said that "Basic services provided by extension actors give priority for organized farmers compared to unorganized."

Beekeepers' innovation: The result indicated that 82.56% and 17.44% of group members involved in promotion of improved beekeeping management package, and demonstration and evaluation of Participatory Variety Identification with improved management, respectively (Table 4). This shows that introduced technology enable beekeepers to analyze, evaluate and decide to choose what is appropriate to their condition. For instance, demonstration and evaluation of selection of promising bee forage along improved beekeeping management packages increased their confidence on beekeeper based trial activity. This implies that, beekeepers collectively acquired new skills and new knowledge, gaining confidence and self-esteem via test new technology. Only 21% of non-members were captured in promotion of improved beekeeping management package.

Decision making: Similarly 94% of group members involved from planning through implementation to result evaluation of introduced technology. This shows that being a member of group increases beekeepers' decision making ability on issues relate to them and develop sense self-confidence. Different roles and responsibilities assigned to group members helped to enhance their decision making skills. Only 6% of group members fail to participate in collective decision making due to several reasons (Table 4).

Capacity to diagnose and analyze situation: The study reveals that compared to FREG member, 79.4% of non FREG member cannot diagnosis cause and effects of exogenous factors independently unlike group members (Table 4). A few (4.65%) of non-members know about causes and effects of bee enemies, impact of bee forage on honey yield, and as prevailing market information on where and when to sell. Moreover, group members started to sell large volume of honey to influence market price (Appendix table A1). Result shows that there is statistically significance difference between group and non-grouped beekeepers in terms of market price at a significant level of 95% (Appendix table A1).

Build social capital: On spot analysis result shows that some FREG members can collect relevant information on the trial and capable to locate sources of information. FGD of group members indicates that "Being involved in FREG enables build social relationship and pursue wider concerns, initiates new scene under organized collective action. It further create conducive conditions to cooperate and share experience and skill within FREGs as well as the tendency to have close link and intimate collaboration with research, extension, and others who have adequate information. The majority of non-members (76.47%) were not a member of any

farmers based organization (Table 4).

Culture of sharing information and advice to other beekeepers: The study shows that on average group member was able to impart acquired knowledge to three farmers with minimum and maximum of two and 11 non- member beekeepers in their locality, respectively. In some places FREG transformed to farmer extension group (FEG) according to FGD. For instance, at Goleliban kebele of Welmera district, FREG members provide colony transferring, harvesting and extraction services in adjacent kebele-Kersa. The general intension for FREG was this at all. However, on average, non-group member was able to transfer acquired knowledge to one beekeeper. Result shows that there is statistically significance difference between group and ungrouped beekeepers in terms of mean technology transfer to others at a significant level of 10% (Table 4).

Table 4. *Assessment of function of FREGs (N=120).*

Variable	Member (%)	No member (%)
Do you have sufficient beekeeping knowledge & skill?		
Yes	100	20.59
No	0	79.4
What type of technologies do introduced to you?		
Participatory Variety Identification & improved management package	17.44	0
Improved beekeeping management package	82.56	20.59
Do FREG members involved in FREG to result evaluation		
Yes	94.2	0
No	5.8	0
Can you diagnosis cause & effects of beekeeping problem?		
Yes	100	4.65
No	0	79.4
Are you a member of any farmer based organization		
Yes	100	23.53
No	0	76.47
To how many beekeepers did you transfer knowledge?	Mean=3.18 t-test: 121, p-value: 0.013**	1.0

** 10 % probability level Source: Own Survey, 2020

3.7. Beekeeping Marketing and Input Supply Sources

Furthermore, the result in figure 3 shows that 100% and 26% group members and non-members reported to get access to market for their beekeeping, respectively. According to FGD, having close association with different actors create conducive environment to get access to where and when to sell, what types of honey market wants, know competitor price and quality etc. The remaining 74% of non-members do not have access to reliable market for honey due to several reasons. Key informants replied that common honey market places were Ambo, Weliso and Sebeta districts.

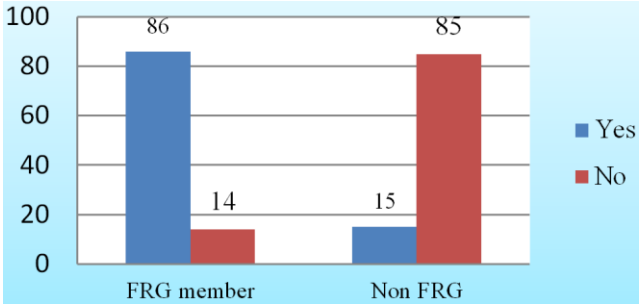

Figure 3. *Access to market information.*

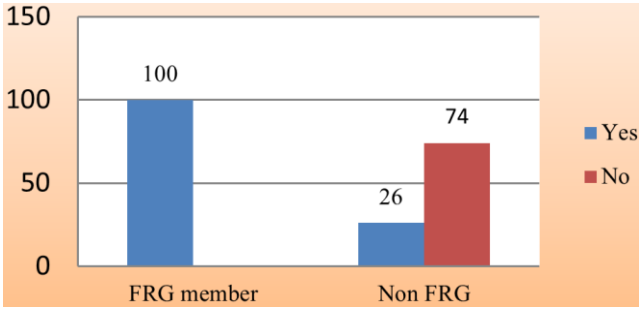

Figure 4. *Access to input supply.*

As to the result in figure 4, the study further show that 86% of members and 15% of non-members have access to beekeeping input supply to purchase beekeeping tools and materials. However, 85% of non-members and 14% of members reported that lack of access to basic beekeeping input is a big problem. Beekeeping input suppliers play a paramount role to provide beekeepers with necessary bee materials. Key informants said that 'It's not available in the area since bee tools suppliers are very remote from the area."

3.8. Challenges Faced Beekeepers FREG

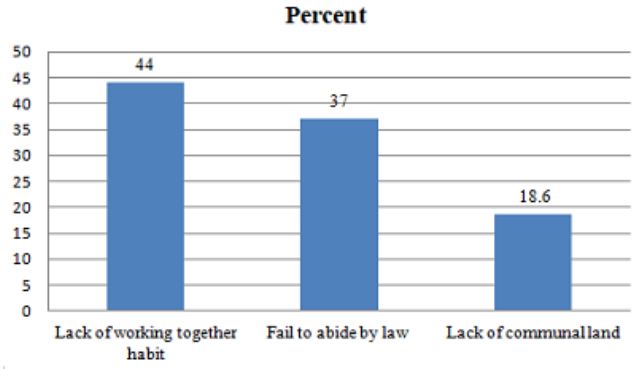

Figure 5. *Challenges to beekeepers FREGs (N=86).*

Results from figure 5 shows that majority (44%) of the respondent replied that lack of habit of working together was the major challenge to beekeeping FREG beekeeping. In our country the culture of working together for common benefit is unlearnt. The deep rooted culture of work alone affects technology intake and dissemination of the technology benefits to the rest. As a result collective action for technology utilization is at infant stage in the country. Passive participation of members to contribute to groups' goals resulted group sanction. Similarly, fail to abide by law (37%) and lack of communal land (18.6%) also other problems to the healthiness of FREG activities. These can cause several further problems that hinder groups' goals and performance if not properly administered.

Furthermore group members were asked whether they continue to function or not just after funding project terminate. About 86.01% of respondents replied to continue to strengthen the group to further expand the scope of their business (Table 5). Although almost all members of the groups were satisfied being take part in the FREG, the remaining 13.95% (Table 5) replied uncertain to function like before project live since collective action needs external body to regulate the routine activities of the group.

Table 5. *FREG members' general idea on FREG approach.*

Variable	Frequency	Percent
Does your group nonstop functioning after project end		
Yes	74	86.01
No	12	13.95
General idea on FREG		
Encourage/promote FREG approach	48	55.81
Create sustainable FREG strengthening (follow up)	38	44.19

Source: own survey, 2020

Finally, they were asked about what general idea they have on beekeeping FREG. The study result shows that 55.81% of respondents reported better further encourage and promote FREG for small beekeepers to solve their in access to new technologies. About 44.19% of them reported that better create sustainable FREG strengthening system. They like FREG approach but its implementation phase interrupts them. Lack of sustainability of FREGs and FEGs activities might be resulted from lack of commitment from farmers, research, extension, or concerned bodies.

4. Conclusion and Recommendation

The study revealed that people in most productive age are actively engaged in honey production in the study area with a moderate experience in beekeeping. The mean yield obtained from transitional hives of the two groups was statistically significant at ($p < 0.05$). Likewise the mean yields obtained from frame hive per harvesting year of the two groups were statistically significant at ($p < 0.05$). The results of this study also revealed that the trend of honey yield in the study area is decreasing annually due to deforestation, agrochemical poising, and pests and predators. From the field study conducted, it was also concluded that the practice of beekeeping FREG was at infant stage to fully benefit from the roles of FREG since the culture of working together is very poor. However, FREG approaches have assisted to improve the participation of beekeepers in research and development activity. Moreover, substantial supports from stakeholders in order to strengthen

beekeeping FREG and broaden its scope seem poor. Hence, looking into the benefits and challenges of the study results, the following points are forwarded as recommendation.

1. The beekeepers FREG should be sustained and strengthened to address technology adaptation and dissemination through participatory using multidisciplinary team.
2. Research and extension organizations, community and farmer based organizations, and rural service providers should be strengthened for effective innovation.
3. Organizational collaboration needs to be strengthened to harness local knowledge.
4. Awareness creation through intensive training, experience sharing, public meeting and work shop should be organized for the district beekeepers.
5. Farmer-to-farmer linkage for information dissemination should be fostered and scaled up with committed involvement of community-based organizations.

Abbreviations

ARC	Agricultural Research Centre
COR	Client Oriented Research
FFS	Farmer Field School
FPR	Farmer Participatory Research
FREG	Farmer Research Extension Group
FGD	Focus Group Discussion
HBRC	Holeta Bee Research Centre
NGO	Non-Government Organization
OSZSF	Oromia Special Zone Surrounding Finfine
PRA	Participatory Rural Appraisal
PTD	Participatory Technology Development
RAAKS	Rapid Appraisal of Agricultural Knowledge System
SPSS	Statistical Package for Social Sciences
TLU	Tropical Livestock Unit

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Author Contributions

Teshome Kassa came up with the study's objectives and aims. He helped with editing and critical evaluation as well. Draft preparation, funding procurement, data collecting, data validation, and formal analysis were all done by Lalisa.

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Data Availability Statement

The data is available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

Appendix

Table A1. *Average honey yield per hive types and honey prices.*

Variable	Member	Non member	T-test	P value
Average honey yield of traditional hive (Kg)	6.75	6.25	-0.235	0.101
Average honey yield of frame hive (Kg)	13.42	10.53	1.78	0.082*
Average honey yield of frame hive (kg)	19.92	51.14	0.962	0.067*
Average selling price of processed honey /kg	250	220	0.561	0.039**
Average selling price of comb honey per kg	195	180	2.35	0.07*
Average selling price of crude honey per kg at local market	170	155	0.515	0.210

** 5%, and * 10 % probability level

Table A2. *Perception of beekeeping FREG (N=120).*

Variable	Frequency	Percent
Are you perceived of FREG		
Yes	90	75
No	30	15
From who do you heard about FREG?		
HBRC	71	79.2
livestock	15	16.7
neighbor	4	4.1
NGO	0	0
Ambo University	0	0
Ambo ARC	0	0
Are you a member of FREG		
Yes	86	71.67
No	34	28.33
Who organized you?		
HBRC	77	89.2
Ambo ARC	0	0
livestock res. Dev't & fishery	9	10.8
Ambo University	0	0
Ambo ARC	0	0
NGOs	0	0
Group size		
10-15	20	23.25
15-20	44	51.16
20-25	22	25.58

Table A3. *Comparison group based and individual based beekeeping extension (N=120).*

Method	Merit	Demerit
One-on-one service	Less conflict (57.6%)	Poor access to resources (56.7%)
	More efficient (42.2%)	Inadequate bee knowledge (22.5%)
		Poor social network (20.8%)
Team work	Synergy (40%)	Group friction (64.2%)
	Close access to services (36.7%	Share busy time (35.8%)
	Information sharing (23.3%)	

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