

Demonstration and Participatory Evaluation of Improved Beekeeping Technology Package Through Youth Organizing

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Abstract
The study was conducted in Kofale district to demonstrate and evaluate improved beekeeping technology package and strengthen research extension farmer's linkage in beekeeping technology generation and transfer. From this district, two peasant associations were selected purposively based on their potentiality for honey production and accessibility for field monitoring. Beekeepers were selected based on their interest, colony ownership, accessibility and willingness to share experiences for other beekeepers. A total of 2 FREG comprising 20 farmers were (15 male and 5 female) were established. The mean amount of honey produced per annum from modern, transitional and traditional hives was 25.31 kg, 15.47 kg and 6.53 kg, respectively. The net benefit that obtained from modern, transitional and traditional hives was 5700 ETB, 5724 ETB and 452 ETB, respectively. Therefore, government organization and development partners should focus on scaling up and promoting of modern and transitional hives with full packages in to the areas where there is a gap to popularize the technologies.
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1. Introduction

Ethiopia is one of the top 10 honey producers in the world, and it is the leading one in Africa (USAID, 2012). The ideal climatic conditions and diversity of floral resources allow the country to sustain around10 million honeybee colonies (CSA, 2009). These have enabled Ethiopia to take the total share of honey production around 23.58% and 2.13% of the African and worlds, respectively (Kebede *et al.,* 2015). This makes the country rank 1st in Africa and 10th in the world (Kebede *et al.,* 2011). There are an estimated 5.15 million beehives in Ethiopia, and 95% of the total beehives are traditional, while the percentage of transitional (Kenya top bar) and modern beehives are 1.63 percent (81,596) and 2.8 percent (139,682), respectively (CSA, 2012a). These beehives are managed by approximately 1.4-1.7 million farm households, who keep beehives as a means of additional income generation (Desalegn, 2011). Despite the long tradition of beekeeping in Ethiopia, having the highest bee density and being the leading honey producer, the level of honey production and productivity in the country is remain low. 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).

Ethiopia has the potential to produce 500,000 tons of honey per year and 50,000 tons of beeswax per annum. However, due to different constraints, the recent production is only 53,675 tons of honey. This shows that the country is producing around 10% of its potential (CSA, 2012a). Thus, the beekeepers have benefited less and the contribution of beekeeping sub-sector to the state gross domestic products has been limited (Tessega, 2009). To solve these problems, Adami Tulu Agricultural Research center exerted much effort in technologies generation, adaptation and dissemination of beekeeping technologies that can make boost honeybee products and maximize benefit. In this regards, a considerable number of information and technologies have been generated. However, due to weak linkage between research, extension workers and beekeepers, the dissemination of improved beekeeping technologies is very slow to reach to significant size of beekeepers. Similarly also regarding to qualitative aspect, processing of crude honey into table honey and the crude beeswax into pure form is not practiced by the beekeepers of the study area. As a result, still the beekeeping is predominantly in traditional ways using traditional hives with low production and productivities of the subsector which has the maximum honey yield is below 7 kg per hive (Beyene and David, 2007). To improve this scenario, integration between Research, extension workers and farmers is paramount important to moderniz apiculture sector through improving availability and application of apiculture technologies; improving skills and knowledge of all actors.

Therefore, the study was planned to demonstrate and evaluate improved beekeeping technology package through participatory demonstration approach, to create awareness on the improved beekeeping technologies and to strengthen research-extension-farmers linkage in beekeeping technology generation and transfer in the study area.

2. Materials and Methods

2.1 Description of the study area

The study was conducted in Kofale, Oromia region, Ethiopia. The latitude and longitude of district is 7°00"N and 38° 45 E 7°1′N with an elevation ranges from 2460 to 2790 meters above sea level. Kofale district is located at 279 km to South direction of Addis Ababa the capital city of Ethiopia and about 25 km from Shashemene zonal town. It receives an annual rainfall of 1800-3050 mm and has an annual temperature range of 17°C-22°C. The district has two agro-ecologies which are high land (Dega) 90% and mid-land (Weina Dega) 10% (DOANR, 2017).

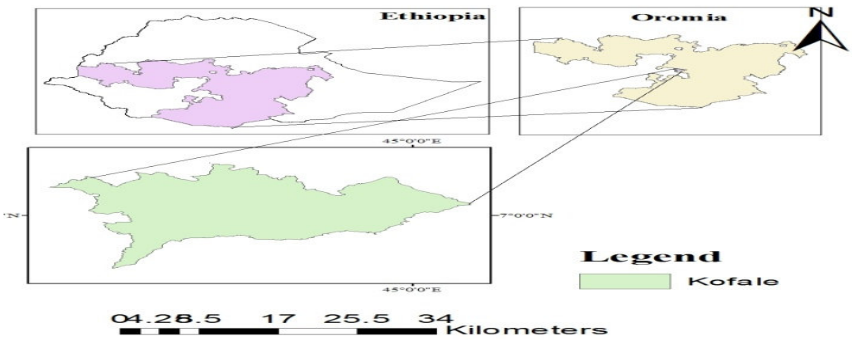

Figure 1. Map of the study area
Source: Own sketch Arc map version 10.1, 2023.

2.2 Site and beekeepers selection

Purposive sample selection procedure was employed to select site and beekeepers in collaboration with experts from district agriculture and natural resource office and development agents. Accordingly, two Kebeles (PAs) were selected purposively based on their potentiality, appropriateness of the area and suittability for frequent monitoring and evaluation. Similarly, beekeepers were selected in collaboration with agricultural Office experts, and Developmental Agent based on beekeepers to do in group, past experience in beekeeping, ownership honeybee colony, accessibility for supervision of activities and willingness to share experiences for other beekeepers. Farmers research and extension group (FREG) approach was followed to select beekeepers and group under trial beekeepers. Two FREGs having 20 members consideration of gender issues were formed. In each FREG, four (4) hosting beekeepers and a total of eight (8) were selected with the rest being participant beekeepers. The trail beekeepers were used as replications and selected based on past experience in beekeeping and working in group, number of traditional hives possessed, access to roads and genuineness and transparency to explain the technology to others.

2.3 Training and experience sharing

As the technologies are new for the community, the training was given in two phases. In the first phase, a theoretical training was given to the youth beekeepers, Development Agents (DAs) and agricultural experts. The training was mainly focused on beekeeping system, seasonal colony management, honey plant and site selection, hive product handling, honeybee diseases and enemy control and bee product marketing. In the second phase, practical training was given on the design and construction of transitional hive, foundation sheet making, colony transferring, crude honey and beeswax processing methods, colony inspection and feeding methods. Finally, field day was organized to disseminate and promote technologies to other stakeholders and share the lessons with different stakeholders.

2.4 Provision of input

Adami Tulu agricultural research center was delivered full package technologies for the beneficiaries in the study area. The full packages used were box hives, refined beeswax, queen excluders, bee veil, over all, smoker, chisel, hand glove and bee forage seeds were delivered to youth beekeepers. This was done on before colony establishment.

2.5 Colony establishment

Bee colonies were transferred from traditional hives to transitional and modern hives with the participation of researchers, technical assistance, development agents and experimental youth beekeepers at each demonstration site during active season. All the colonies were kept under the shades of each apiary. All seasonal colony management practices such as feeding, controlling hive temperature/shade, and protecting against the attack of enemies (pests) were regularly performed. During colony transferring, at least three combs contain honey, two combs contain pollen and two combs contain bee brood were attached on top-bars and frames and put for the newly transferred bee colonies to maintain and minimize colony absconding but for honey, pollen and brood less colonies, external colony feeding with sugar syrup and bean flour (*Shiro*) was undertaken at each demonstration site.

2.6 Seasonal colony management practices

Active and dearth periods bee colony management practices such as apiary management, swarm controlling, colony transferring, colony inspection, pests management, insert/remove queen excluder/ partition, honey harvesting, processing and colony feeding were undertaken across the season for the attainment of healthier, strong and productive bee colony to boost honey and beeswax production.

2.7 Method of data collection and analysis

Both quantitative and qualitative data were collected through, measurement, filed observation, interview, Focus Group Discussion by using checklist and data sheet tools by using. The collected qualitative data were honey yield data, total number of beekeepers, DAs and district experts participated on training and field visits, total number of colonies transferred, total number of colonies successful, costs of production and income gained. While qualitative data were beekeepers' perceptions towards the new technologies. The collected quantitative raw data were subjected to analysis of SPSS software version 23. Descriptive statistics such as frequency, mean, percentage and standard deviation were used and presented in tabular form while qualitative data were analyzed using narrative explanation and argument. Colony adaptation success per hive type was calculated using the following formula:

$$\text{Colony adaptation rate} = \frac{\text{Number of colonies lived in hive for one year}}{\text{All number of colonies transferred to hive type}} \times 100$$

Economic analyses were used to analysis cost benefit data. Cost benefit analysis of each beehive type was determined using the following below formula. Simple descriptive statistics farm budget techniques and Gross Return analysis frequency, percentages and tables were utilized. The farm income model is as shown (Onwumere *et al*., 2012; Folayan and Bifarin, 2013).

$$NI = GR - TC$$

Where: NI = Net Income for honey production, GR = Gross Returns to honey production, TC = Total production cost. The total revenue represents the honey sales while the total expenses (TVC + TFC) represent direct purchases for the beekeeping project. Total production cost includes fixed cost (e.g. colony cost, rent on land, cost of hives, etc.) and variable cost (labour, transportation cost, cost of supplementary feed, cost beeswax etc). The gross return represents the income from honey sales while the total production costs represent direct expenses and purchases for the beekeeping activities.

3. Results and Discussion

3.1 Capacity Building

Training is one of the fundamental extension tool used in technology intervention and dissemination. Both theoretical and practical training was given to beekeepers, DAs and experts. Totally 35 youth beekeepers, 3 Subject Matters Specialists and the rest 2 were development agents were participated (Table 1). Out of the trained participants 31 (77.5 %) were males while the remaining 9 (22.5%) were females.

3.2 Field day

Field day is a method of motivating people to adopt new technologies by showing what has already achieved under field conditions. In other words, it is to show performance and profitability of new technologies and to convince them. A total of 62-stakeholders out of them 50 beekeepers, 4 Subject Matters Specialists, 2 development agents and 6 supervisors have participated on field day organized at Gurmicho site. Participants discussed the condition of improved beekeeping technologies with trial beekeepers, sharing their experiences and identifying criteria such as ease of inspection and management, honey yield and quality, time and labor saving, swarm control and hive durability

Table 1: Descriptive result on capacity building for different stakeholders

Capacity building methods	Stakeholders	Composition		
		Male	Female	Total
Training	Beekeepers	27	8	35
	Subject Matters Specialists	2	-	2
	Development Agents	2	1	3
Mini field day	Beekeepers	38	12	50
	Subject Matters Specialists	3	1	4
	Development Agents	1	1	2
	Supervisors	4	2	6

Figure 2: Pictures captured during training for beekeepers about improved beekeeping technologies

3.3 Stakeholders' roles and their responsibilities

In technology evaluation and demonstration stakeholders: Beekeepers, researchers, Development Agents and district agricultural experts had their own responsibility.

Table 2*:* Roles and responsibility of different stakeholders during technologies demonstration and evaluation

Stakeholders involved	Role played by stakeholders
Researchers	1. Farmer selection and group formation 2. Technical backup for the FREG members and other actors 3. Provision of the required inputs 4. Provision of training 5. Follow up all the field activities 6. Organizing field days and supervision 7. Data collection and analysis 8. Report writing
District experts	1. Assist in site and participant beekeepers' selection 2. Assist in providing training and field days 3. Supervising of the development agent 4. Motivating beekeepers to participate in technology demonstration 5. Facilitate technology distribution
Development Agents	1. Involved in selection and monitoring of youth beekeepers 2. Follow up the FREGs and the fields 3. Involved in collection of the required biological and social data 4. Communicate with researchers about status of the field 5. Collaborate organizing field visits/ field day
Beekeepers	1. Providing trail colony 2. Provision of supplementary feed and water for bee colonies 3. Providing land free of rents 4. Actively participate in the training 5. Provide labor for all field activities(land preparation, planting and weeding 6. Construction of shed for honeybee colonies 7. Follow up of the activities and reporting in case of emergency 8. Share skills and experiences to neighboring beekeepers

3.4 Honey yield from different types of beehive

The mean amount of honey produced per annum from modern, transitional and traditional hives was 25.31 kg, 15.47 kg and 6.53 kg, respectively. The findings of the study showed that the mean honey yield obtained from modern and transitional hives was higher compared to traditional hive. The result is in line with (Nuru, 2007;

Workneh *et al*., 2008) indicated that the honey yield of traditional, transitional and frame was 5-8 kg, 10-15 kg, and 20-25 kg, respectively. This result contradicted with (Taye and Marco, 2014) who reported that the average amount of honey harvested /hive/year from traditional hive, transitional hive and modern hive in Wonchi district of south west Shewa Zone were 5.22kg, 10.83kg and 15.2kg , respectively. These results are indicators of the existence of room for increasing performance of these beehives through good management practices coupled with favorable beekeeping environment.

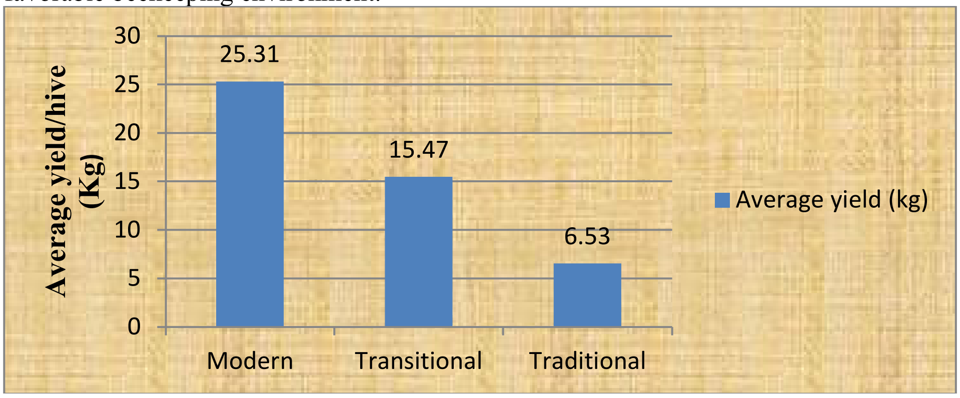

Figure 3. Mean amount of honey produced from modern, transitional and traditional hives

Figure 4: Colonies established and honey harvested from the established colonies

3.5 Colony established and survived

Colony transfer is preferably undertaken during honey flow period by the beekeepers in the area. Bee colonies were transferred from traditional hives to transitional and modern hives with the participation of researchers, technical assistance, development agents and experimental youth beekeepers at each demonstration site during active season. Accordingly, a total of 22 transitional hives with top bars were constructed by youth beekeepers at the study sites. Then, a total of 22 transitional and 18 modern hives were occupied with honeybee colonies.

Table 3: Number of colony established, survived and absconded

Sites	Transitional hive			Modern hive		
	No. of colony established	**No. of colony survived**	**No. of colony left the hive**	**No. of colony established**	**No. of colony survived**	**No. of colony left the hive**
Gurmicho	12	10	2	10	10	0
Koma Bitacha	10	7	3	8	6	2
Total	22	17	5	18	16	2

3.6 Costs-Benefit Analysis

Cost benefit analysis was used to evaluate the changes from one technology to another by comparing the changes in costs and benefits associated with each practice. Only white honey harvested from the added super was used for profitability analysis. The average farm gate price of 1 kg of honey from modern and transitional hives was 500 ETB while the average farm gate price of 1 kg of honey from traditional hive was 350 ETB. Total revenue was calculated by multiplying price by yield obtained (TR= y*p), gross marginal rate were calculated by subtracting total variable cost from total revenue (GM=TR-TVC).In this regard, for the profitability analysis, comparison of the net benefits from traditional, transitional and modern hives was made per hive basis. The result of cost benefit analysis revealed that an average return of 5700 ETB, 5724 ETB and 452 ETB can be gained from modern, transitional and traditional hives, respectively in one harvesting season (Table 4). As can be seen from (Table 4) hive wise analysis reveals that the highest profit was gained from modern hive as compared to transitional and traditional hives. This result agrees with the findings of (Workneh, 2011) reported that the total incremental net benefit from modern hives exceeds the benefit from traditional hives by more than two times. Similarly, (Belete and Berhanu, 2014) reported that the adoption of box hives makes smallholder beekeepers more profitable than with traditional hives, with a 20% increase in the variability of input cost and output prices.

Table 4: Cost benefit analysis of different types of beehives

Variables	**Type of hives used**		
	Modern	**Transitional**	**Traditional**
Average yield (kg /hive) (q)	25.31	15.47	6.53
Sale price(ETB/kg)(p)	500	500	350
Total Revenue (TR=y*p)	12655	7735	2286
Variable costs			
Cost of beeswax (Birr/hive)	850	-	-
Feed cost	1000	1000	1000
Transportation cost	120	120	120
Labor cost (p/day)	1400	1400	540
Total Variable Costs TVC	3370	2520	1660
Fixed costs			
Cost of beehive (Birr/hive)	2200	950	150
Cost of hive stands (Birr/hive)	720	720	-
Cost of honeybee colony (Birr/colony)	500	500	-
Annual depreciation of hive (25%)	165	71	23
Total Fixed Costs (TFC)	3585	2241	173
Total Costs(TC)=TVC+TFC	6955	4761	1833
Gross Margin (GM)=TR-TVC	9285	5215	626
Profit=GM-TFC	5700	2974	453

3.7 Expenditure of income generated from honey selling

Beekeeping plays a significant role in increasing and diversifying household incomes of beekeepers from their own honeybee production. Table 5 shows, the expenditure of money collected from selling of honey. Accordingly, 25.4% used for purchasing agricultural inputs, 20.5% food crops, 19.5% for purchasing animal feed and drug,13.2% for children school fees, 11.7% for purchasing livestock,7.3% used for house construction and the rest 2.4% for saving.

Table 5: Ranking of the expenditure of income generated from honey selling

Purpose of expenditure	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**Index**	**Rank**
Purchasing of agricultural input	5	2	0	1	0	0	1	0.254	1
Purchasing of crop for food	3	1	0	0	4	1	1	0.205	2
Purchasing of animal feed and drug	0	0	1	8	0	1	0	0.195	3
School fees	0	3	0	2	0	0	1	0.132	4
Purchasing of livestock	1	2	1	0	0	0	0	0.117	5
House construction	1	1	0	0	1	0	0	0.073	6
Saving	0	0	1	0	0	0	0	0.024	7

3.8 Annual bee forages plantation practices

To demonstrate the adapted and recommended annual bee forages, land was prepared according to required standards. Planting of annual bee forages (Aschynomene *uniflorum, Mellitotus alba and Sinapis alba*) was done on beekeepers field by researchers, DAs and Beekeepers. Fields were managed by participant beekeepers with close supervision of researchers and DAs. Frequent field visits to beekeepers land, monitoring, and follow up actions were done based on knowledge and technical needs. Annual bee forages called Aschynomene *uniflorum, Mellitotus alba and Sinapis alba* were used for the study. Each plant species was planted on a plot size of 3m*3m with seeding rate of 5kg/ha, 4kg/ha and 10 kg/ha for Aschynomene *uniflorum, Mellitotus alba and Sinapis alba,* respectively.

Figure 5: Picture captured during planting and at vegetative stage of annual bee forages

Figure 6: Pictures captured during field day organized

3.9 Demonstration of crude beeswax processing method

Crude beeswax was collected from the local honey wine making houses and small holder beekeepers. The collected crude beeswax were placed separately in clean water and left to soak for 24 hours so that any remaining honey, sheath and water soluble dirt were dissolved in plastic basin or bucket. After straining, the wax was melted in sufficient boiling water. Then the wax was poured into sisal and squeezed manually. When the wax ceases to run through, the sisal was twisted and squeezed pulled slowly between two horizontal sticks. Then the droplet from the filter was stored and cooled in the bucket and placed in right position without moving from place to place. This is important to have a good shape of beeswax. Movement of bucket can bend the shape of beeswax. These all steps were shown to beekeepers in order to preserve their beeswax from traditional hives. For this demonstration purpose, 12 kg crude beeswax (*sefef*) and 12 kg crude honey were purchased from local honey wine making house and small holders' farmers, respectively. The percentage of pure beeswax produced from 12.4 kg crude beeswax (*Sefef*) was 16.9% while the percentage of pure beeswax produced from crude honey 12.4 kg was 28.2% (Table 6).

Table 6. Pure wax produced from crude beeswax with manual extraction

Source of beeswax	**Initial wt/kg**	**Final wt/kg**	Percentage of pure beeswax produced
Local honey brewery	12.4	2.1	16.9
Crude honey	12.4	3.5	28.2

Wt=weight

Figure 7: Picture captured during melting and manual extraction of crude beeswax


Figure 8: Picture captured refined beeswax and during foundation sheets making

3.10 Beekeepers perception and hives preference

Evaluation of demonstrated beehives by beekeepers is very important to know their perception and opinion either they perceive them positively or not. A total of 23 beekeepers' were interviewed to evaluate and select the best from the two types of hive depending on their ease of inspection and management, honey yield and quality, time and labor saving, swarm control and hive durability and the result was presented in (Table 7). Accordingly, the new introduced modern and transitional hives technology was preferred by most beekeepers in terms of all criteria set by the beekeepers.

Table 7: Beekeepers feedback responses (N=23)

No	Evaluation/selection criteria	Scale measurement	Type of hive			
			Modern		Transitional	
			No	%	No	%
1	Ease of inspection and management	Simple	20	87	18	78.3
		Medium	3	13	5	21.7
		Difficult	-	-	-	-
3	Yield and quality	High	21	91.3	17	73.9
		Medium	2	8.7	6	26.1
		Low	-	-	-	-
4	Time and labor saving	High	16	69.6	14	61
		Medium	7	30.4	9	39
		Low	-	-	-	-
5	Swarm control and hive durability	High	17	73.9	12	52.2
		Medium	6	26.1	8	34.8
		Low	-	-	3	13

4. Conclusions and Recommendation

Demonstration and evaluation of improved beekeeping technologies through participatory approach was conducted in Kofale district of West Arsi zone of Oromia to demonstrate and evaluate improved beekeeping technology package, to strength farmers' knowledge of honey production and strengthen research extension farmer's linkage in beekeeping technology generation and transfer. The improved technologies contribute to improve the production and productivity of beekeepers that helps to enhance the living standard of beekeepers. From the result of the study, the average of honey yield and gross return per hive/year at beekeeper's backyard can be improved with minimum cost if improved beekeeping technologies with all packages used. The result of demonstration and participatory beehive evaluation study showed that the average honey yield per hive per year of modern hive (25.31 kg), transitional hive (15.47 kg) and traditional hives (6.53 kg). Partial budget analyses also implied that adoption of improved beekeeping technologies make small holder beekeepers more profitable than traditional practice. From the types of hive demonstrated and evaluated here, modern and transitional hives were mostly preferred by beekeepers considering their honey yield and quality, ease of inspection and management, time and labor saving and swarm control and hive durability. Therefore, government organization and development partners should focus on scaling up and promoting of modern and transitional hives with full packages.

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References

Belete, G., Berhanu, G., 2014. Perceptions of smallholder farmers on improved box hive technology and its profitability in northern Ethiopia. J. Agric. Extension Rural Dev. 6 (12), 393–402. http://dx. doi.org/10.5897/JAERD14.0592

Beyene, T & David, P. (2007). Ensuring small scale producers in Ethiopia to achieve sustainable and fair access to honey markets. Paper prepared for international development enterprises (IDE) and Ethiopian society for appropriate technology (ESAT), Addis Ababa, Ethiopia. MoARD. (2005). Annual Reports Addis Ababa, Ethiopia

CSA. Statistical Abstracts. Central Statistical Agency. Addis Ababa, Ethiopia, 2009.

CSA (Central Statistical Authority). 2012a. Agricultural Sample Survey. Retrieved fromhttp://www.csa.gov.et/index.php?option=com_rubberdoc&view=category&id=75 &Itemid=561

Desalegn, P. 2011. Ethiopian Honey: Accessing International Markets with Inclusive Business and Sector Development. Post Implementation Review Report, November.Pp:1-7.

DOANR (District Office of Agriculture and Natural Resource). 2017. Reports of Kofale district office of agriculture, 2017. Kofale, Ethiopia.

Folayan, J.A., and J. O. Bifarin. 2013. Profitability analysis of honey production in Edo North

Gezahegne Tadesse .2012. Apiculture in Ethiopian. Agriculture 3rd ApiExpo Africa 2012 26th - 29th September 2012, Addis Ababa, Ethiopia.

Gidey Y, Mekonen T. Participatory Technology and Constraints Assessment to Improve the Livelihood of Beekeepers in Tigray Region, northern Ethiopia. CNCS Mekelle University. 2010; 2(1):76-92 https://www.ajol.info/index.php/mejs/article/view/49654

Kebede Nigussie, Subramanian PA, Gebrekidan Mebrahtu. Physicochemical Analysis of Tigray Honey: An Attempt to Determine Major Quality Markers of Honey. Bulletin of the Chemical Society of Ethiopia, Addis Ababa, Ethiopia, 2011, 26(1). https:// www. Ajol.info/index. php/ bcse/ article /view/72967

Kebede, A., Kerealem, E., Tessema, A. and Abebe, J. 2015. Feed Resource of honeybees in Kewet district of Amhara, Ethiopia. Beekeeping in the Amhara region, Amhara Regional Agricultural Institute, Ethiopia. Journal of Resources Development and Management, Vol.7: Pp: 1-6.

Nigussie, K., Subramanian, P.A. and Gebrekidan, M. 2011. Physicochemical Analysis of Tigray Honey: An Attempt to Determine Major Quality Markers of Honey. Bulletin of the Chemical Society of Ethiopia, 26(1), 127-133.

Nuru, A. 2007. Atlas of pollen grains of major honey bee flora of Ethiopia, Holeta Bee Research Center, Oromia Agricultural Research Institute, and the Netherlands International Development Organization

Onwumere, J., F. Onwukwe, and C.S. Alamba. 2012. Comparative Analyses of Modern and Traditional Bee Keeping Entrepreneurships in Abia State, Nigeria. *J. Econ.Sustain. Dev*.3:1-9

Tessega B (2009). Honeybee Production and Marketing Systems, Constraints and Opportunities in Burie district of Amhara Region, Ethiopia. MSc Thesis. Department of Animal Science and Technology Bahir Dar University, Ethiopia.

Taye, B. and V. Marco, 2014. Assessment of constraints and opportunities of honey production in Wonchi District South West Shewa Zone of Oromia, Ethiopia. American Journal of Research Communication, 2014, 2(10): 342-353} www.usa journals.com, ISSN: 2325-4076.

USAID (United States Agency for International Development). 2012. Agricultural Growth Program-Agribusiness and Market Development (AGP-AMDe) Project. Submitted by ACDI/VOCA to Contracting Officer's Representative Tewodros Yeshiwork, USAID Ethiopia.

Workneh, A., R. Puskur, and R.S. Karippai. 2008. Adopting improved box hive inAtsbi Wemberta district of Eastern Zone, Tigray Region: Determinants and financial benefits. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers project working paper 10. ILRI (International Livestock Research Institute), Nairobi, Kenya

Workneh, A., 2011. Financial benefits of box hive and the determinants of its adoption in selected district of Ethiopia. Am. J. Econ. 1 (1), 21–29. http://dx.doi.org/10.5923/j.economics.20110101.03