

Full Length Research Paper

Pre-Scaling up of Transitional Locally Made Bee Hive Technology Package in West Shoa Zone, Oromia Region, Ethiopia.

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Pre scaling of transitional locally made bee hive technology package conducted in Adaberga, Gindeberet and Jeldu Woreda, Oromia region, Ethiopia with the main objective of disseminate technology package. As to the method, these Woredas selected purposively based on potentiality of the Woredas in beekeeping and non addressed areas with technology dissemination activity. Farmers research and extension groups (FREG) were used for technology dissemination. One FREG which contain 10 beekeepers established at each pre-scaling up site and there is one site in each selected Village Administration. Accordingly, two sites at Adaberga, four at Gindeberet and four at Jeldu Woreda selected. Backyard of model beekeepers used as center of learning and technology dissemination. At each sites, farmers development agents and experts trained, four transitional locally made bee hives with ant protection constructed, honey bee colony transferred to it and continuous honey bee colony follow up activities undertaken in partnership with FREG member, development agents and experts. Quantitative data collected for three honey seasons and analyzed using descriptive statics such as percentage and mean and presented in table. Qualitative data also collected and analyzed through explanation of idea, opinion and concept explanation method. As to the result, honey yield which ranges from 10.25kg/hive/season to 37kg/hive/season was harvested from pre-scaling up colonies and mean honey yield per hive per season at Adaberga, Gindeberet and Jeldu Wored was 16.1, 19.8 and 14.4 kg/hive/season respectively. It can be concluded that yield per hive at beekeeper's backyard can be improved if transitional locally made bee hive package used. Therefore, livestock office should give attention to the dissemination of technology package.

Keywords: Pre scaling up, transitional locally made bee hive, package, FREG, improved beekeeping

INTRODUCTION

Statement of the Problem

Agriculture in Ethiopia remains the cornerstone of the economy and the most important source of growth. It accounts for almost 48% of Growth Domestic Product, 85% of export earnings and also main income, livelihood and way-of-living for 85 % of Ethiopians living in rural areas (World Bank, 2016). Ethiopia is also the 10th largest producer of livestock in the world with 75 million head of livestock, has the largest concentration of livestock on the African continent (World Bank, 2016). Livestock contribute up to 20% to Ethiopia's GDP and livelihoods of 60–70% of the population (Central

Statistical Agency [CSA], 2013). Beekeeping, which is one of the important livestock subsectors, contributes significantly to the improvement of the livelihoods of the nation's population (Aklilu, 2002).

Ethiopia has a potential in beekeeping as the climate allows growing of different vegetation and crops which are a good source of nectar and pollen for honeybees. Large and diverse botanical resources combined with suitable climatic conditions make it conducive for the beekeeping business (Nuru *et al.*, 2001). Having such large resources, the country has

potential of producing over 500,000 tones of honey per year and the annual production of honey and beeswax is low compared to its potential (Ethiopian Apiculture Board [EAB], 2016). Ethiopia stands eighth by producing about 21% of the total world and about 21.7% of total African honey production (Tigray Agricultural Marketing Promotion Agency [TAMPA], 2007).

Beekeeping in Ethiopia plays an important role in income generation for farmers. Nationally, an average of 420 million Ethiopian Birr (ETB) is obtained annually from the sale of honey (Workeneh, 2007). Honey production of the country also meets beverage requirements of the urban and rural population. It is also demanded for its nutritional and medicinal values.

In Ethiopia, traditional, transitional and frame hives are used in beekeeping. About 5,207,300 hives exist in the country out of which about 95.96% was traditional, 1.06% transitional and 2.98% frame hives (CSA, 2013). Though the country had large apicultural resource, potential of producing over 500,000 tones of honey per year (EAB, 2016), the annual production of honey and beeswax is low compared to its potential. This is due to the reason that more than 95% of our beekeepers use traditional hive management practices which affect yield. To improve the traditional production system, improved box hives have been introduced and promoted in the country for the last 40 years but majorities of the beekeepers are still in traditional beekeeping system (Workeneh, 2007) due to the reason that this hive requires accessories that are not affordable at small scale level. This results in traditional production system which result in low production and productivity, poor pre and post harvest processing and handling techniques and practices combined with poor marketing efforts has kept it part of the subsistent sector (Meaza, 2010).

In most cases Ethiopian beekeepers are observed to use traditional hives which is very difficult to manage honeybees and to produce honey and honey products in the required quality and quantity. The maximum yield obtained from a traditional beehive so far is estimated on average to be below 7 kg /hive. However it has been observed as more than 15kg /hive crude honey can be produced if top-bar hive is used. Transitional locally made bee hive made from locally available materials is important for our farmers as it is extremely inexpensive and equally important as that of machine made top bar hives. As study report of Nuru and Edessa 2004 conducted at HOLETA bee research center sub-sites indicates, it is possible to use hand-made top-bar hives and frames from locally available materials (bamboo, *Arundinaria alpina*), shembeko (*Arundinaria donax*), shimel (*Oxytenathera abyssinica*) and eucalyptus). This hive does not also require accessory equipment like casting mold and honey extractor, which is not easily available in local area. Various participatory approach studies showed that an improved technology that is based on farmers' participation is easily transferable and

applicable. Farmers often accept that the experience of on farm demonstration, which is similar to their own situation. Therefore the main intention of this activity is to pre-scale up transitional locally made bee hive technology package in Adaberga, Gindeberet and Jeldu Woreda and to build beekeepers capacity in applying beekeeping technologies

Definition of Terms

In this paper different terms used to describe different types of bee hives. Definition of the terms explained below.

Traditional bee hive: is a type of bee hive used to provide an enclosure for the bee colony. This type of hive can be made from mud, clay. In this type of hive no internal structures, frames were provided for the bees, the bees created their own honeycomb within the hives. The comb is often cross-attached and cannot be moved without destroying it. From this hive, on average of 7kg/hive/season crude honey produced.

Transitional locally made bee hive: is frameless beehive in which the comb hangs from removable bars. The bars form a continuous roof over the comb, whereas the frames in most current hives allow space for bees to move up or down between boxes. This hive is similar in design with Kenyan top bar and made from locally available materials. From this hive, on average of 15kg/hive/season crude honey produced.

Frame/Box hives: is type of vertically modular bee hive that accepts frames. The hive frame is a key part of the frame/box hive since it can be removed in order to inspect the bees for disease or to extract the excess honey. From this type of hive, pure honey can be harvested and the average honey production is 25 kg/hive/season.

MATERIAL AND METHODS

Description of the Study Areas and Period

The research was conducted in West Shoa Woredas namely Adaberga, Gindeberet and Jeldu Woredas from 2011-2013. Detail description on study areas presented below.

Adaberga Woreda

Adaberga Woreda is one of the Woredas in West Shoa Zone, Oromia Region. It is located at 64 km North West of Addis Ababa on the road of Muger cement Enterprise and located at 9° 12' to 9° 37' N and 38° 17' to 38° 36' E (Oromia Bureau of Finance and Economic Development [OBoFED], 2014). Demographically, Woreda's total population is estimated to be 143,142,

out of these 85.7% settled in rural area where as 14.3% is urban dweller (OBoFED, 2014). Agro-ecologically, the Woreda divided in to 3 zones namely highland which comprises 29% of the total area Mid high land which comprises 34% of the total area and finally Low land which comprises 37% of the total area having range of temperature (21-29) ° C (OBoFED, 2014). Three types of soil texture exist in the Woreda. These are, Black covers 44%, Red 39% and Black sandy 17% (OBoFED, 2014). The total live stock population of this Woreda was estimated at 125,929 cattle, 47,035 sheep, and 47,035 goats. Regarding beekeeping, there are 234 box hives and 17803 traditional hives (OBoFED, 2014).

Gindeberet Woreda

Gindeberet Woreda is also one of the Woredas in West Shoa Zone, Oromia Region. It is located to the South West on 137 km from Ambo and 213 km from Addis Ababa to the West and located at 9° 21' to 9° 50' N and 37° 37' to 38° 08' (OBoFED, 2014). Demographically, Woreda's total population is 123,783 out of these 11.49% were urban dwellers (OBoFED, 2014). This Woreda is divided in to two agro-ecological zones namely mid which comprises 40% of the total area and lowland which comprises 60% area (OBoFED, 2014).

Jeldu Woreda

Jeldu Woreda is one of the Woredas in West Shoa Zone, Oromia Region. It is located to the East on 72 km from Ambo and 115 km from Addis Ababa to the West and located at 9° 01' to 9° 1' N and 37° 67' to 37° 40' (OBoFED, 2014). Demographically, Woreda's total population is 239,109 out of these 92.28% settled in rural area (OBoFED, 2014). Three types of soil texture exist in the Woreda. These are Verty soil 42.1%, Nito soil 36.83% and Sandy soil 21.05. The highest rainfall is 1270mm and the lowest is 700mm (OBoFED, 2014).

Study Design

To scale up and disseminate transitional locally made bee hive technology package in West Shoa Zone, ten pre-scaling up sites (two at Adaberga, four at Gindeberet and four at Jeldu) which is apiary of model beekeepers used as center of learning, 40 honey bee colonies (*Apis mellifera bandansii*) for at each sites transferred from traditional hive to transitional locally made hives and FREGs used 94 beekeepers participated.

Farmer Selection and Sampling Technique

For this study, Adaberga, Gindeberet and Jeldu Woredas were selected for pre-scaling up of transitional locally made bee hive technology package based on the assumption of potentiality of the sites, non addressed areas and close follow up. Ten pre-scaling up sites selected purposively based on convenience of the sites to disseminate the technology package. Ten beekeepers were selected purposively as members of FREG and one FREG established at each pre-scaling up sites. A total of 10 FREG, 94 beekeepers, established for pre-scaling activity. Apiaries of model beekeepers were used as center for learning and technology dissemination. Selection of the site and beekeepers was carried out in close consultation with the respective Woreda livestock offices.

Technology Transfer Approaches and Methods

FREGs were used for technology dissemination. At each pre-scaling up sites one FREG which contain 10 beekeepers was established. All activities in the technology dissemination process were undertaken with these FREG members. As to the method, practical training was given twice in the first and second years on selection of materials for construction, construction of hives, top bar preparation, hive standing making, colony transfer, follow up of established colony, protection of pest and predators and pre and post harvest handling of bee products.

After training, four transitional locally made bee hives with ant protection constructed at each pre-scaling site, a total of 40 transitional locally made bee hives and 10 hive stands constructed, honey bee colonies transferred to them and regular honey follow up activities (inspection, feeding, inserting/removing partition, honey harvesting and processing) were undertaken at each season for three consecutive years by Holeta Bee Research Center (HBRC) technical staff in partnership with FREG members, Development Agents (DAs) and Woreda level experts. On the other hand, each FREG member constructed on average two transitional locally made bee hives at their backyard for wider dissemination of the technology and with the intention of exercising what they learned from common pre-scaling up sites.

Method of Data collection

Primary data on numbers of sites and farmers selected; FREGs established; farmers, development agents and experts trained; hives and stands constructed; honeybee colonies transferred from traditional to transitional locally made bee hive; honeybee colonies absconded; frequency of inspection, feeding, inserting and removing partition; honey and

beeswax harvested; processed honey and beeswax and number of stakeholders involved collected and documented using data collection sheet, personal observation of sites and group discussion. Secondary data also collected from respective Woreda livestock office, literatures, research reports and internet search.

Method of Data Analysis

Quantitative data collected from pre-scaling up colonies analyzed using descriptive statistics such as percentage, mean and tables. SPSS computer software was also used to compute raw data. On the other hand, qualitative data was analyzed through explanation of idea, opinion and concept explanation method.

RESULTS AND DISCUSSIONS

Under this topic, main results on training of farmers and stakeholders, technology dissemination, honey yield and economic benefits of the farmer in the pre scaling up discussed.

Capacity Building

Capacity of the beekeepers, DAs and experts to apply transitional locally made bee hive technology package built through two rounds theoretical and practical training conducted at respective Woreda. Training given mainly focused on improved beekeeping management practices, pre and post harvest handling of bee products and honey bee queen rearing. Besides the training, FREG members, DAs and experts were participated on regular honey bee follow up activities seasonally during the research study.

As shown on table 1 below, capacity of 94 beekeepers, 10 DAs and 7 experts built through two round 5 days training and practical demonstration of the technology package. In addition, technical staff of Holeta bee researcher, six researchers, four technical assistants and five field assistants took part in pre-scaling up of the activity in establishing colony, feeding, inspection, harvesting and processing of honey from pre-scaling up colonies at pre-scaling up sites during project life span.

Technology Dissemination

After FREG members trained practically on hive making, they constructed on average two transitional locally made bee hives at their backyard. A total of 214 transitional locally made bee hives with its top bars constructed at Gindeberet and Jeldu districts. There is

no report on Adaberga Woreda on construction of hive and its top bar at FREG member's backyard which showed problems in appropriate beekeepers selection and no follow up at their backyard after training. Mean construction of hive with its top bars was 2.9 hives per FREG member during the first year of the activity. When Woredas compared, mean construction of the hive per FREG member was greater at Gindeberet Woreda than Jeldu Woreda which was 3 and 2.5 hives per FREG member respectively. Construction and use of transitional locally made hive costs only 22.5 USD and this cost is relatively cheaper than frame hive which costs 90 USD [Melaku (2005), Workineh (2007), Wongelu (2014)].

With regard to number of occupied transitional locally made bee hives with honey bee colonies after construction, 53.33% at Gindeberet and 42.86% at Jeldu were occupied with honey bee colonies. Moreover, from these occupied hives, 4.17% at Gindeberet and 16.67% at Jeldu absconded. (Table 2). This result shows follow up of FREG members by DAs and experts of respective Woredas after training at their backyard is very low which resulted in low dissemination of the technology package at FREG member's backyard.

Honey Yield and Economic Benefit

In this study, only honey yield obtained from pre-scaling up colonies established at model beekeepers apiary for three active seasons was used to compute the results. Honey yield which ranges from 10.25kg/hive/season to 37kg/hive/season was harvested from pre-scaling up sites. Mean honey yield 16.1, 19.8 and 14.4 kg/hive/season harvested at Adaberga, Gindeberet and Jeldu, respectively. Higher Mean honey yield, 27.13kg/hive/season, was recorded at Damota site than the other nine sites (Table 3).

As shown on table 3 above, the mean honey yield at Gindeberet Woreda was significantly different from Jeldu Woreda with greater mean. But Adaberga Woreda is almost similar with both Jeldu and Gindeberet. The reason why honey yield in Gindeberet Woreda is higher than the other Woredas could be ample forage for honeybees and seasonal monitoring and follow up of honeybee colonies is also better in this Woreda. The result of this research is in line with finding of Taye et.al, 2015 which states the average honey yield from this hive was 13.88kg/hive crude honey.

Regarding the benefit, beekeepers were benefited from honey sold on average of Ethiopian Birr (ETB) 1,056.25 (50 ETB/kg), ETB 991.00 (65 ETB/kg) and ETB 1125.25 (65 ETB/kg) per hive per season at Adaberga, Gindeberet and Jeldu Woredas respectively (1USD=19.0587ETB in 31/12/2013). The finding of this research is in line with similar studies which showed the beekeepers were benefited in using this hive [Melaku (2005), Workineh (2007), Wongelu (2014)].

Table 1: Number of beekeepers, Development Agents, Experts participated on training and pre scaling up

No	Woreda	Beekeeper	DA	Expert	Holeta bee research center staff*		
					Researcher	Technical assistants	Field assistants
1	Adaberga	16	2	2			
2	Gindeberet	38	4	3	6	4	5
3.	Jeldu	40	4	2			
Total		94	10	7	6	4	5

* covers all target areas in single trip

Table 2: Number of transitional locally made bee hives constructed by FREG members and occupied with honey bees

No	Woreda	Mean no of constructed by FREG members	No of hives occupied by honeybees in %	Abscinding rate in %
1	Adaberga	-	-	-
2	Gindeberet	3	53.33	4.17
3	Jeldu	2.5	42.86	16.67

* no data

Table 3: Mean honey yield/hive harvested at each Woreda

No	Woreda	Mean honey yield \pm SD
1	Gindeberet	19.8 \pm 5.2 ^a
2	Adaberga	16.1 \pm 0.2 ^{ab}
3	Jeldu	14.4 \pm 5.7 ^b

Different letters show significance differences

CONCLUSION AND RECOMMENDATIONS

It can be concluded that yield per hive at beekeeper's backyard with minimum cost can be improved if transitional locally made bee hive with its package used, knowledge and skill of the beekeeper on the technology upgraded, continuous follow up assured by DAs and experts. There was also strong challenge in adopting post harvest handling package (processing) by FREG members particularly at Gindeberet Woreda and this needs works on awareness creation. The overall finding of this study mainly underlined the importance of extension support to the beekeepers in giving technical back till the beekeeper develop confidence on the technology package. Therefore, livestock office respective Woredas should give strong attention to the improvement delivery of extension service given to the beekeepers. Works on awareness creation and convincing beekeepers and consumers on value added bee products should be done by all stakeholders at Gindeberet Woreda.

Conflicts of Interests

This research is sponsored by Oromia agricultural research institute and original work of the author. All individuals participated and references used fully acknowledged

Abbreviations

CSA	Central Statistical Agency
DA	Development Agent
EAB	Ethiopian Apiculture Board
ETB	Ethiopian Birr
FREG	Farmers Research and Extension
Group	
HBRC	Holeta Bee Research Center
OBoFED	Oromia Bureau of Finance and
Economic Development	
TAMPA	Tigray Agricultural Marketing
Promotion Agency	

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