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Demonstration of Transitional Locally Made Beehive Around Protected Areas in Central Rift Valley of Oromia, Ethiopia

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Abstract

The study was conducted in Adami Tulu Jido Kombolcha and Arsi Negele districts of Oromia regional state of Ethiopia with the objective of enhancing the production and productivity of beekeeping in the area through demonstration of transitional locally made beehive around protected areas. Beekeepers around protected areas were purposively selected based on their interest in beekeeping, experience in traditional beekeeping, proximity of residence to protected areas and non-addressed areas with technology dissemination activity and two farmers research groups (FRG) consisting a total of 20 members were established to conduct the demonstration of beekeeping technology. Theoretical and practical training sessions about seasonal bee management practices, intermediate beekeeping construction, implementation and honey harvesting techniques integrated to natural resources rehabilitation was given to a total of 50 beekeepers,4 district honey experts and 6 development agents. After training, twenty four transitional locally made beehives were constructed and honeybee colonies were transferred and inspected regularly undertaken to follow up the progress of the bee colonies in partnership with FRG members, experts and development agents. Both qualitative and quantitative data were collected, systematically analyzed and interpreted using descriptive statics such as percentage, mean and presented in table. Accordingly, an average of 15.4kg and 12.1kg of honey was harvested per harvesting season from transitional beehive at Adami Tulu and Arsi Negele, respectively. Therefore integration of intermediate beekeeping technology with protected areas can enhance the income of household and encourages planting of bee forages which directly contributes for sustainable forest managements. Thus government and other stakeholders at all levels should provide technical services for beekeeping to align improved beekeeping to protected areas and all best practices should be scaled up so that honey production is increased and sustained.

Keywords: transitional beehive, honeybees, beekeeping, demonstration, protected area

1. Introduction

Ethiopia has huge potential for beekeeping production because of its endowment with diversity in climate and vegetation resources offering potentially favorable conditions for beekeeping. These have enabled Ethiopia to take the total share of honey production around 23.58% and 2.13% of the African and world's respectively (Workneh, and Puskur, 2011). Due to its wide climatic and edaphic variability, Ethiopia is endowed with diverse and unique flowering plants of 6000 to 7000 species thus making it highly suitable for large number of colonies and long practice in beekeeping (Fitchel and Admasu, 1994; Gidey and Mekonen, 2010). Having such large resources, Ethiopia has the potential to produce about 500,000 tons of honey and 50,000 tons of beeswax per year, however, currently production is limited to 43,000 tons of honey and 3,000 tons of beeswax due to traditional way of beekeeping (MOARD, 2008). Despite the long tradition of beekeeping in Ethiopia, having the highest bee density and being the leading honey producer as well as one of the largest beeswax exporting countries in Africa, the productivity is still low, leading to low utilization of hive products domestically and relatively low export earnings. One of the prominent factors for this low honey production and productivity is a traditional way of honey production system by smallholders. To improve the traditional production system, improved beehives have been introduced and promoted in the country for the last 40 years but majorities of the beekeepers are still in traditional beekeeping system (Workineh, 2007) due to the reason that this hive requires accessories that are not affordable at small scale level.

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 5 kg /hive. However it has been observed as more than 15kg /hive crude honey can be produced if transitional hive is used. Transitional locally made beehive made from locally available materials is important 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 (*Arundinariaalpina*), shembeko (*Arundinariadonax*), 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. Varies participatory approach studies showed that an improved technology that is based on farmers' participation is easily transferable and applicable.

Beekeeping development is possible to raise communities' awareness of the natural environment and lead them to engage in the conservation activities. Loss of trees has negative implications for beekeepers which mean loss of bee forge, loss of nesting sites for bees, loss of places to keep hives and low honey production (Albers and Robinson, 2011). More often, climate change adaptations and integrated production options are focused on agricultural production and little efforts have been focused integrated beekeeping to climate change adaption despite its great potential for employment creating, conservation and poverty alleviation simultaneously.

In past few years, the Ethiopian government made different efforts for afforestation and protection of the remaining forests. In central rift valley of Ethiopia, more than 25 protected areas exist and they cover 2252.5ha. Vegetation coverage and diversity of flowering plants, particularly of grasses and fauna increased following exclosure establishment and become a highly suitable for sustaining large numbers of bee colonies and promoting beekeeping practices in a large scale in area. However, the surrounding communities did not benefit from these area closures because they poorly linked to watershed rehabilitation and management programme regardless of beekeeping potential.

Therefore, the objectives demonstrate transitional locally made beehive technology package around protected areas and build beekeepers capacity in applying beekeeping technologies.

2. Material and Methods

2.1 Description of the Study Area

The study was conducted in two districts of the Ethiopian mid rift valley namely: Adami Tulu Jido Kombolcha (ATJK) and Arsi Negele districts. The study area is located within a distance of 163 km to 225 km away from Addis Ababa in south direction (Table 1). The rainfall is bimodal, the long rains occurs from June to September and the short rains are from March to April with peak in July and August, respectively.

Table 1. Description of location, elevation, temperature, rainfall and soil type for the study sites

Parameters	Adami Tulu	Arsi Negele
Latitude	7^{o}9'N	7^{0}21'N
Longitude	38^{o} 7'E	8^{0}42′E
Altitude (masl)	1650	2500
Mean temperature (oC)	25 to 28	15.8 to 18.8
Mean annual rain fall (mm)	769	880
Soil type	Sandy	Loam

Source: ATARC (Adami Tulu Agricultural Research Center), Zeleke and Solomon (2012), Adami Tulu Agricultural Research Center Metrology Team, unpublished data

2.2 Research Site Selection

For this study purpose, beekeepers around protected areas were purposively selected with the criteria of beekeepers' experience and interest, potential area for beekeeping, abundance of honey bee colonies in traditional hives, availability of protected areas, accessibility of the areas to transportation service and

socio-economic value of bee products. Accordingly, *Gallo Hiraphe* and *Kara Dibayu* protected areas were selected from Adami Tulu Jido Kombolcha and Arsi Negele districts respectively and used for demonstration of transitional locally made beehive technology package. Farmers' selection was done by peasant association leaders and development agents working in the area. Discussion was made with selected farmers on their interest, objectives of the study, how to do together in the future.

2.2.1 Household Selection and Farmer Research Group (FRG) Establishments

Two Farmers Research Group (FRG), each consists 10 members were established at demonstration sites and briefed on the objective of the study. All activities in the technology demonstration process were undertaken with these FREG members.

2.2.2 Farmers Training

After sites and farmers selected, theoretical and practical training sessions were given for two rounds to a total of 50 beekeepers, 4 district honey experts and 6 development agents on top-bar hive construction and design, top bar frame preparation, routine honeybee colony management and inspection, bee biology, beekeeping practices, procedure of bee colony transferring from traditional hives to transitional beehive, follow up of established colony, seasonal colony management practice, honey harvesting technique, pre and post-harvest handling of bee products. After training, twenty two transitional locally made beehives were constructed at demonstration sites and honeybee colonies transferred to them and inspected regularly by Adami Tulu Agricultural Research Center technical staff in participation with beekeepers, Development Agents (DAs) and district honey expert.

2.2.3 Top-Bar Frames Construction

Mature and straight kacha trees (*Aloe sp*.) were cut and splitted with the required dimensions (3.2cm wide and 48cm long) using hand tools**.**

2.2.4 Bee Colony Transferring

Bee colonies were transferred from traditional hives to transitional hives during active season with the participation of researchers, technical assistance, development agents and experimental farmers' at each study site during active season. During colony transferring, all materials including two combs contain honey, two combs contain pollen and two combs contain bee brood were attached on top-bara frame 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 study site.

2.3 Data Collection and Analysis Methods

Data collection sheets and check lists were developed by the researchers at team level. Data related to amount of honey yield per hive, number of farmers, development agents and experts trained, number of hives constructed, number of honeybee colonies transferred from traditional to transitional locally made beehive, honeybee colonies absconded, feeding and frequency of colony inspection were collected and documented using data collection sheet, personal observation of site and group discussion. The collected data were statistically analyzed using descriptive statistics such as percentages, frequencies, means, minimum, maximum and standard deviations. SPSS version 20 was used to compute raw data. Moreover, qualitative data was analyzed through explanation of idea, opinion and concept explanation method.

3. Results and Discussions

Under this topic, main results on training of farmers and stakeholders, technology demonstration and honey yield in the demonstration discussed.

3.1 Capacity Building

Capacity of the beekeepers, development agents and experts to apply transitional locally made beehive technology package built through two rounds theoretical and practical training sessions conducted at respective district. Training given mainly focused on selection of materials for construction, construction of transitional beehives, top bar preparation, routine honeybee colony management and inspection, bee biology, beekeeping system, procedure of bee colony transferring from traditional hives to transitional hive, follow up of established colony, protection of pest and predators and pre and post-harvest handling of bee products. As shown on table 2 below, capacity of 50 beekeepers, 4 experts and 6 development agents built through two rounds training and practical demonstration of the technology packages. In addition, 4 researchers and 3 technical assistants took part in demonstration of the activity in establishing bee colony, feeding colony inspection, honey harvesting and processing of honey at demonstration sites during the study period.

Table 2. Number of beekeepers, experts and development agents participated on training and demonstration of transitional beehive

No	District	Participants				
		Beekeeper	Expert	DA	Researcher	Technical Assistant
1	Adami Tulu	26	2	3	2	2
2	Arsi Negele	24	2	3	2	1
	Total	50	4	6	4	3

3.2 Technology Dissemination

After practical training given to farmers' research group members on hive making, they constructed on average two transitional locally made bee hives at their backyard. A total of 24 transitional locally made bee hives with its top bar frames were constructed at Adami Tulu Jido Kombolcha and Arsi Negele districts. Mean construction of hive with its top bar frames were 1.3 and 1.1 hives per FREG member at Adami Tulu Jido Kombolcha and Arsi Negele districts respectively. From the constructed transitional locally made beehives, 84% and 66.3% beehives were occupied with honeybee colonies at Adami Tulu Jido Kombolcha and Arsi Negele districts respectively. Moreover, from these occupied beehives, 4.2 % at Adami Tulu Jido Kombolcha and 12.1 % at Arsi Negele were absconded (Table 3).

Table 3. Number of transitional beehives constructed by FRG members and occupied with honeybee colonies

District	Mean no hive constructed by FRG member	No hive occupied by honeybee (%)	Absconding rate (%)
Adami Tulu	1.3	84	4.2
Arsi Negele	1.1	66.3	12.1

3.3 Beehive Productivity

An average of 15.4 ± 0.75 and 12.1±2.5 kg of honey per hive per season were harvested at Adami Tulu Jido Kombolcha and Arsi Negele respectively. Higher mean honey yield, 15.4 kg per hive per season was recorded at Adami Tulu Jido Kombolcha than Arsi Negele district 12.1 kg per hive per season (Table 4). The reason why honey yield in Adami Tulu Jido Kombolcha district is higher than Arsi Negele district is might be due to much diverse flowering plants species of the area. The amount of honey harvested was 5 kg in traditional hives before project intervention and increased to 15.4 kg per hive after changed to transitional hives. This indicated that improved beekeeping practices contributes to income generation of the households and reduce deforestation of the trees in the protected areas. This was supported by Hussein`s (2000) findings which confirm that beekeeping enhances the income generation potential of small holders and promotes the conservation and utilization of natural resources that are being rapidly depleting. Beekeeping is a practical tool for raising an awareness of the communities to manage watersheds and could favor natural resources conservation (Alemtsehay, 2011; Albers and Robinson, 2011). The present result was in agreement with the result reported by Chala et al, (2013) found that average honey yield per year/colony was 14.70±0.62 kg for transitional hive.

Table 4. Mean ± Standard error of honey yield per hive per harvesting season

No	District	Mean honey yield + SD
1	Adami Tulu	15.4 ± 0.75^{a}
2	Arsi Negele	12.1 ± 2.5^{b}

*The mean in table having different superscript are show statistically variation at $p<0.05$

Table 5. (Line) Opinion of farmers toward transitional locally made beehive

No	Opinion of farmers	% of respondents	
		Yes	No
1	Ease of construction	96	4
2	Little disturbances to the honeybee	98	2
3	Easy to manipulate	99	1
4	Improve honey yield and quality	97	3
5	Ease for honey harvesting and colony inspection	94	6
6	Low cost of construction	92	8
7	Easily availability of the construction materials	96	4
8	Not requiring expensive beekeeping equipments and accessories	99	1

4. Conclusion and Recommendations

The result of demonstration technology study showed that the average honey yield per hive per harvesting season of transitional hive was 15.4kg and 12.1kg at Adami Tulu Jido Kombolcha and Arsi Negele districts, respectively. As result of demonstration of the technology, the amount of honey harvested was 3-5kg in traditional hives before project intervention and increased to 15.4 kg per hive after changed to transitional hives, indicating that the integration of improved beekeeping with conservation and rehabilitation of natural resources would be an important incentive to mobilize communities to participate in rehabilitation programs for both economic and environmental reasons. Protected areas have different bee floras have varied flowering and flowering season one come after the other. Because of this, honeybees did not suffer from the seasonal food shortage especially during dearth periods in the study areas. Therefore, demonstration and scaling up this technology should be promoted for sustainable natural resources rehabilitation and to diversify the household income. Also the government and other stakeholders at all levels should provide technical services to align improved beekeeping to watershed conservation so that income generation from honey production is increased and sustained.

Competing Interests

The authors declare that they have no competing interests

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