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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, Demonstration, Protected area

INTRODUCTION

Ethiopia is one of the countries in the continent, which has the largest honeybee populations and owns big potential of honey production. Owing to its varied ecological and climatic conditions, Ethiopia is home to some of the most diverse flora and fauna in Africa. Its forests and woodlands contain diverse plant species that provide surplus nectar and pollen to foraging bees (Girma, 1998). 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, Ethiopia has the potential to produce about 500,000 tones of honey and 50,000 tones of beeswax per year, however, currently production is limited to 43,000 tones of honey and 3,000 tones of beeswax due to traditional way of beekeeping (MOARD, 2008).The ideal climatic condition and diversity of floral resources allow the country to sustain around 10 million honeybee colonies, of which 7 million are kept in local beehives under farmers management condition and the remaining exist in the forests as wild colonies, which makes the highest bee density country in Africa (Nuru, 2002).

Ethiopia, having the highest number of bee colonies and surplus honey sources of flora, it is the leading producer of honey and beeswax in Africa. Ethiopia has a share of around 23.58 and 2.13% of the total Africa and world honey production, respectively. The country is the leading honey producer in Africa and one of the ten largest honey producing countries in the world (Ayalew, 1990).

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

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requirements of the urban and rural population. It is also demanded for its nutritional and medicinal values.

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 share of the sub-sector in the GDP has never been proportionate with the huge numbers of honeybee colonies and the country's potentiality for beekeeping. Productivity is still low, leading to low utilization of hive products domestically and relatively low export earnings. Among the major challenges threatening the subsector in the study area are lack of improved beekeeping equipments and their accessories that are suitable to the socio-economic status and technical competence of the beekeepers, the shortage of bee forage and problems related to agrochemicals.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 below 7 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.

In central rift valley of Oromia region, more than 25 protected areas were 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. Despite the area has great potential for beekeeping development, the surrounding communities were not utilized this resources due to poor integration of improved beekeeping technologies with conservation of forest and natural ecosystems.

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

MATERIAL AND METHODS

Description of the study area

The study was conducted in Adami Tulu Jido Kombolcha and Arsi Negeledistricts of East Shoa and West Arsi Zones of Oromia, Ethiopia.

Adami Tulu Jido Kombolcha district

Adami Tulu Jido Kombolcha districtis located at 163 km away from Addis Ababa in south directionat an altitude of 1650 m above sea level in Central Rift-valley of Ethiopia. The agro-ecological zone of the area is semi-arid and sub-humid with acacia woodland vegetation type. The annual rain fall varies from 600-800mm and it is characterized by bimodal rainfall. Very short and unreliable rain during the months April-May, while most of the rain occurs during three months (June-August) and sometimes up to September (*Adami Tulu Jido Kombolcha Bureau of agriculture and metrological station*). The mean minimum and maximum temperature are 12.6 and 270c, respectively. The present population of the district is about 142,861 (71,883 male and 70,978 female) (Federal Democratic Republic of Ethiopia Population Censes Commission (FDREPCC), 2008).

Arsi Negele district

Arsi Negele district is located at 225 km away from Addis Ababain the South direction at an altitude of1500 to 2300 m.a.s.l(*Arsi Negele Agriculture and rural development office*, 2013).The average of rain fall ranges from 800 to 1400mm with the average minimum and maximum of temperature are 15° C and 20° C, respectively.The rain fall is bimodal, the long rain occurs from June to September and the short rain fall is from March to April with highest usually record in July and August, respectively (Arsi Negele Office of Agriculture and Rural Development, unpublished data).Agro-ecologically, Arsi Negele district is divided in to three major climatic zones on altitude including low land, mid land and high land.

Research site and farmer selection

For this study purpose, beekeeping potential sites were purposively selected with the criteria of having large number of participants in beekeeping, 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* protected area from Adami Tulu Jido Kombolcha district and *Kara Dibayu* protected area from Arsi Negele districtwere purposely selected 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. Then after, a total of twenty beekeepers were selected purposively as members of FRG and one farmers research group (FRG) established at each demonstration site.

Farmers training

After sites and farmers selected, theoretical and practical training sessions were given for two rounds for a total of fifty beekeeper farmers, fourdistrict honey experts and sixDevelopment Agents on selection of materials for construction, 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, protection of pest and predators, pre and post-harvest handling of bee products and participatory research (FRG) by researchers from different disciplines. After training, twenty two transitional locally made beehives constructed at demonstration sites and honeybee colonies transferred to them and regular honeybee follow up activities (inspection, feeding, honey harvesting and processing) were undertaken at demonstration site by Adami Tulu Agricultural Research Center technical staff in partnership with beekeepers, Development Agents (DAs) and district level experts.

The hive design and preparation

All materials required for top-bar hive construction such as locally available materials eucalyptus stick, nails and thin wire were ready before training date.

Procedures of top-bar hive construction

Frame work preparation

Four straight well matured and little bit thicker eucalyptus stick with length of 1 meter were cut. Again four supporters of 29cm height that were used to connect pair of the 1 meter length wood at both ends were made ready. The sizes of the supporters are a little bit smaller than the frame.Four stretchers of two with 22cm and other two with 40cm width were also prepared. The smaller size stretchers were fixed at bottom part of hives while the larger ones used at top part of the hive .Both ends of the stretchers were cut in slant form to make ease of fixation at joints.

Assembling the frame works

Pair of a 1 meter length wood was connected together by a 29cm height wood at both ends. At this time two rectangles of the same length and height were prepared. The bottom and top parts of these rectangles were fixed together at bottom and top parts with stretchers of 22cm and 40cm respectively. This kept the shape of top-bar hives in trapezium form.

Wall construction

It was constructed using splitted materials for ease of construction and to avoid narrowing of inside hive space. The wall construction materials were fixed to supporters by wires with nail.

Plastering hive wall with mud

The inner wall were plastered with fermented mud and cow dung very thinly to avoid holes**.**

Top-bar frame 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**.**

Bee colony transferring

Bee colonies were transferred from traditional hives to transitional hives 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.

Data collection and analysis methods

Data collection

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.

Data analysis methods

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. On the other hand, qualitative data was analyzed

through explanation of idea, opinion and concept explanation method.

RESULTS AND DISCUSSIONS

The study was conducted in the participatory approach with beekeepers at two protected areasnamely *Gallo Hiraphe* and *Kara Dibayu* in Adami Tulu Jido Kombolcha and Arsi Negele districts of East Shoa and West Arsi Zones of Oromia, Ethiopia. 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 1 below, capacity of fifty beekeepers, fourexperts and six Development Agentsbuilt through two round four days training and practical demonstration of the technology packages.In addition, four researchers and three 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 1: 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**

Table 2: 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	1.1	83	4.2
Arsi Negele	0.8	66.3	12.1

Table 3: Mean honey yield/hive harvested at demonstration site

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

Different letters show significance differences

Table 4. Farmers' opinions (Feedback) ontransitional locally made beehive

No	Opinion of farmers	Response (%)	
		Yes	No
1	Ease of construction	964	
2	Little disturbances to the bees	98	2
3	Easy to manipulate	991	
4	Improve honey yield and quality	973	
5	Ease of honey harvest and colony inspection	94	6
6	Low cost of construction	92	8
7	Easily availability of the construction materials	964	
8	Not requiring expensive beekeeping equipments	991	

CONCLUSION AND RECOMMENDATION

The finding of the study showed that the mean honey yield obtained from transitional hive was 15.4Kg and 12.1kg at Adami Tulu Jido Kombolcha and Arsi Negele District respectively.It can be concluded that honeyyield can be improved from 5 kg/hive of traditional hive to 15 kg/hive if transitional locally made beehive with its package used, knowledge and skill of the beekeeper on the technology upgraded and integrated with protected areas.Therefore, scaling up of transitional locally made beehive technology and integration beekeeping with protected area isvery important.

Competing Interests

The authors declare that they have no competing interests

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