Comparison of Aba Mengist beehive with top-bar and frame hives in Enebse Sar Midir and Bahir Dar Zuria Districts of Amhara Region, Ethiopia

***Kerealem Ejigu*[1], *Assemu Tesfa*[1], *Ashagrie Getnet*[2], *Mengist Demeke*[3] and *Seblework Takele*[2]**

[1]Andassa Livestock Research Center, PO Box 27, Andassa, West Gojjam, Ethiopia
[2] AgriService Ethiopia, Enebse Sar Midir Project Office
[3] Enebse Sar Midir District, Ansa Subdistrict

Abstract

*The productivity and suitability of the beehive developed by the farmer innovator Aba Mengist was compared with the standard top-bar and frame hives. The study was carried out in Ansa and Gunaguna Subdistricts of Enebse Sar Midir District and the Andassa Livestock Research Center apiary site in Amhara Region of Ethiopia. A total of 21 honeybee colonies were kept by six farmers with rich experience in beekeeping who were purposively selected for the research purpose. Both qualitative and quantitative data were collected, systematically analysed and interpreted using descriptive statistics. Among the farmers conducting the trial, the average honey yield of the Aba Mengist, top-bar and frame hives was 2.7, 3.56 and 4.7 kg per one harvest, respectively. On station, the honey yield from the Aba Mengist, top-bar and frame hives was 8, 11 and 10.5 kg/one harvest, respectively. Thus, in this experiment, the Aba Mengist hive yielded less honey than the top-bar and frame hives. However, it gave a higher yield than the local hives, of which the national average honey production is 5 kg. Moreover, the Aba Mengist hive has promising points such as low cost and easy availability of construction materials, not requiring a casting mould and honey extractor (which was repeatedly raised by farmers as a problem to engage in beekeeping with frame hives) and being easy for farmers to manipulate using their indigenous knowledge. However, the hive also has drawbacks such as low durability, too little space for the bees and non-suitability for colony inspection, honey harvesting and other types of hive manipulation. For these reasons, the technology is not ready to be promoted for wider use. It needs modifications to remove its weaknesses and, after that, it should be tested with more replications in different areas so as to allow a better understanding and evaluation of the hive. Improving the hive with "*sekela*" protection and other shade should be given attention to lengthen the service years of the hive.*

Introduction

Agricultural technologies have been developed at research centres and released to the farming community through extension workers, who regard the farmers only as receivers of technologies. Though many technologies were thus developed and released, their dissemination rate was usually low and they had little impact in bringing meaningful livelihood change in the community. Formal research institutes have been exerting their utmost effort to boost production and productivity of the agricultural sector through conducting on-station research with no or low involvement of end users (farmers) and extension workers at field level. Technologies developed in the research centres did not express their potential in other places because of many factors.

Experiences revealed that technology development that never considers participation of the end users does not address the felt needs of the farming community and its contribution to sustainable development is insignificant. AgriService Ethiopia (ASE) believes that farmers should have an opportunity to evaluate technologies in their vicinity at representative sites before wider use.

Among the technologies introduced by ASE so far, “modern” beehives were critically evaluated by farmer innovators with rich experience in beekeeping. Bradbear (2003) noted that, in sustainable beekeeping projects, all equipment must be made and mended locally which, in turn, contributes to the livelihoods of other local people. Considering cost effectiveness and management of the hives, ASE decided to promote the top-bar hive in the areas in which ASE was operating. This technology can be made more easily by the farmers using local materials, as compared to the frame hive. Moreover, the frame hive requires expensive materials to print the foundation sheets and to extract honey, which the farmers cannot afford.

According to ASE (2001), Enebse Sar Midir District has a high potential for beekeeping but few technologies were introduced to the area and they were not affordable by the local people. Top-bar and frame hives were introduced to farmers with rich experience in beekeeping so that they could test and evaluate the technology jointly on a pilot basis. Among these farmers, a particularly innovative one – Aba Mengist Demeke, a resident in Ansa Sub-district of Enebse Sar Midir (ESM) District – evaluated the suitability and adaptability of the introduced hives and come up with many constructive and valuable comments. This innovative farmer had been exposed to an experience-sharing visit to Bereh Alelitu District, where beekeeping activities had been fruitful. Over time, Aba Mengist became more practised with the new hives and evaluated them according to many parameters. He observed that the top-bar and frame hives have limitations such as: difficult to inspect, high mortality rate of bees during harvesting, difficulty to make the top-bar hive with the proper design, and the fact that poor farmers could not afford it.

Aba Mengist tried to alleviate these drawbacks and to develop new type of low-cost hive that suits the local farming system, improve honey production and makes beekeeping activities easier. He experimented with these ideas for three years in his garden until he was able to develop a beehive that combines features of the frame, top-bar and local (traditional) hives. He has now come to a position to be able to describe and explain the merits and demerits of this new technology and he used it for about twenty bee colonies.

ASE has been working closely with this innovative farmer by giving technical advice and material support in the course of this technology development process. It has also played a decisive role in promoting the new technology by organising annual field days and displaying the technology in workshops and training courses. To further promote and evaluate the technology at a wider level, ASE took up contact with Amhara Region Agricultural Research Institute (ARARI) and the Regional Bureau of Agriculture and Rural Development (BoARD). These two institutions responded promptly and formed a taskforce at regional level. The taskforce visited ESM District and the newly developed technology in Aba Mengist’s garden. Intensive discussion between the technical experts and the innovative farmer led to high appreciation of his achievement and an agreement to test his new technology at three sites: in Gunaguna and Ansa Subdistricts of ESM District and at the Andassa Livestock Research Center of ARARI for validation of the new beehive. Against this background, the following research was proposed and initiated.

Objective:

The objective of the study was to compare the productivity and local suitability of the beehive developed by Aba Mengist and the standard top-bar and frame hives.

Materials and methods

Site selection and experimental colonies

The study was carried out in two representative sites of Enebse Sar Midir District (Ansa and Gunaguna Subdistricts). Six farmers with rich experience in beekeeping – three from the lowlands (*kolla*) and three from the midlands (*woina dega*) – were purposively selected for the research purpose. The experiment was also conducted at Andassa Livestock Research Center apiary site using similar treatments of one replication. Three types of beehives – frame, top-bar and the "Aba Mengist" hive – were assigned as treatments to each participating farmer. A total of 21 bee colonies were purchased from the local market and were transferred to the treatments (beehives). The purchased colonies were introduced to the area 7–10 days before transferring, in order to allow the bees to adapt to the trial area.

The hive design and preparation

The Aba Mengist hive has three compartments arranged vertically, like the frame hive (Figure 1). The base/brood chamber (33cm wide x 49cm long x 20.5cm high) is the first part, where the queen lays eggs. The other compartments are the first and second supers, used as honey chambers, which are attached with the brood chamber. The dimension of one super is 33cm wide x 49cm long x 22.25cm high). Wide bars (Figure 2) are used instead of frames and are nine in number: three for each compartment, with a single wide bar having eight bars attached to it arranged parallel to each other (each 29cm wide and 15cm long). The hive can be constructed from locally available materials such as *Eucalyptus spp* (*Bahir Zaf*), *Arundinaria alpina* (*Kerkiha*), *Arundinaria donax* (*Shembeko*) and other plants that grow widely in many parts of the country. The materials for making the hive are low in cost and easily available, and their stems have a good quality of easily splitting with required dimensions using hand tools (Nuru & Edessa 2003).

1A	1B	1C	1D
1A: Empty hive without lids; the blue plastic is used to prevent comb attachment with lids (closures).	1B: After smoking, the lid of the second super is opened; here, bees are not constructing combs.	1C: After the lids of the two supers are opened; here, bees are constructing combs.	1D: After the first wide bar with honey has been harvested.

Figure 1: The Aba Mengist beehive at different stages of use

All the openings at the front side (Figure 1A) are used only for inspection and for honey harvest. Each compartment has a closure that can be tightened with an inner tube. The bee entrance is placed at the backside of the hive. The plastic material indicated in Figure 1A is used to prevent the honeycombs from attaching to the outer covering of the hive. Similarly, all the three compartments and wide bars are separated with such plastic lining.

For this experiment, Aba Mengist constructed his hives himself. During the day of transferring the colonies, the fixed bars of the Aba Mengist hive were smeared with molten beeswax, which the honeybees use as starting point for constructing honeycombs (Fig. 2). At Andassa Livestock Research Centre, the Aba Mengist hive was placed on a hive stand and was covered with a lid made from corrugated iron (Fig. 1).

Figure 2: Three wide bars, each with 8 bars smeared with wax

Management

This research was conducted in the backyards of the beekeeper farmers with rich experience and interest to conduct this research. The farmers' management system with respect to inspection of hives, keeping the experiment sites clean and protecting from enemies and predators was practised across all treatments and replications. The farmer innovator, Aba Mengist, coordinated the farmers' experimentation and gave the selected farmer researchers technical support about using his beehive. During the experiment, the farmer researchers and Aba Mengist shared ideas on all aspects and activities of the work. This research was also conducted at Andassa Livestock Research Center apiary site using similar treatments and management.

Data collection and analysis

Data collection was done during the dearth period and the season of major honey flow. The major variables tested throughout the research process included: swarming and absconding conditions, strength of the colony, amount of honey harvested, ease of management, disease and pest incidence, and farmers' opinion. Aba Mengist assessed the trial every 3–4 months with support from ASE, which coordinated and funded the research project. The collected qualitative and quantitative data were systematically analysed and interpreted using descriptive statistics.

Results and discussion

At farm level in ESM District, the average honey yield of the compared hives was 3.5 kg from the top-bar, 4.7 kg from the frame and 2.7 kg from the Aba Mengist hive (Table 1). This result is lower than that reported by Kerealem (2005). According to the farmers, the honey yield during the year of experimentation (2009/2010) was not good because the farmers did not manage the experimental hives well. The Andassa Livestock Research Center apiary site received only one Aba Mengist hive, so that the trial was made by one replication of this hive and of the top-bar and frame hives; honey yields recorded were 8.0 kg, 11.0 kg and 10.5 kg, respectively. The colonies used for the comparison and trial hives had a good strength and were disease free. The honey of the Aba Mengist hive was not fully ripe for harvesting (3/4 of the honeycombs were not sealed when the honey was harvested in the first week of November); this may have led to the low level of honey production. Normally, honey was harvested twice a year from the beehives but, in this participatory experiment, there was only one harvest.

From the total of six Aba Mengist hives, two colonies (33.3%) absconded from the backyards of two farmers. The farmers said that the reason for absconding was because the thin cover of the hive does not protect the bees from extreme cold. From one hive (17%), swarming occurred because of the low bee spacing, which prevented the bees from moving upward to the supers for more space.

Table 1: Honey yield of the experiment (kg/hive/harvest)

No.	Traits	Type of hive			Remarks
		Frame	Aba Mengist	Top-bar	
1	Average honey yield	4.7	2.7	3.46	On-farm level at one harvest
2	On-station honey yield	10.5	8	11	”
3	Number of swarms	2 (33.3%)	1 (17%)	0	
4	Rate of absconding	0	2 (33. 3%)	1 (17%)	
5	Durability of hive (years)	NA	5	NA	One respondent

NA: Data were not available

The mean honey yield recorded during the study period from the frame and top-bar hives was far below the national average (see Table 2). The type of traditional hive used in this comparison was one made reed grass, covered with long grass (*Hypernia spp*), as shown in Figure 3.

Table 2: Average yield (kg/hive/harvest) of traditional, transitional and improved beehives

Hive type*	Yield		National average	Potential yield
	On farmer's base	Research centre		
Traditional	3–5	-	5	10
Transitional	15	15–20	18	40
Improved	15–20	20–30	15–20	60

* The term “traditional” refers to a local beehive as shown in Fig. 3; “transitional” refers to a modified Kenya top-bar hive made of local wood; and “improved” refers to Langstroth and Kenya top-bar hives made out of better-quality wood.

Source: Holeta Bee Research Center (2000);

Figure 3: A traditional beehive made of reed-grass

Figure 4: Harvesting honey from the Aba Mengist hive

Strengths of the new technology

Based on the results of this study, the strengths of the Aba Mengist hive are: the parallel arrangement of the wide bars allows efficient smoking; all of the partitions have their own openings both for inspection and honey harvest and make both types of work easier and better in terms of reducing honeybee mortality; this technology does not require expensive beekeeping equipment like casting mould and honey extractor; all the construction materials including the wide bar can be made from low-cost, locally available materials.

Figure 5: Experimental hives at farm level (left) and on station (right)

Drawbacks of the new technology

The Aba Mengist hive has the following shortcomings from the perspective of the researcher. The bee spaces constructed in the wide bar were not accurate but, since bees are known engineers, they could modify and use it. The hive is not appropriate for placing honey and brood combs when transferring the colonies. It is difficult to use a queen excluder with the hive. It is heavy to transport. It is not appropriate for splitting colonies. Like local hives, the hive is not suitable for inspection, to control incidence of pests, for honey harvesting and for resource sharing from one hive to another during hive manipulation. The cost of making the hive is higher and the hive is more difficult to construct than the local hives and the non-wood top-bar hives. The Aba Mengist hive was not compared with the frame hive since the Aba Mengist hive does not use a casting mould, honey extractors etc.

Farmers' opinions

The farmers taking part in this research commented on the merits and demerits of the Aba Mengist hive. Most of them listed as merits: low space requirement, ease of honey harvest and inspection, ease of construction, low cost of construction and good quality of honey. As demerits, they listed: low durability and little protection for the bees from cold because of the hive's thin walls.

Most of them (83%) agreed that low durability was the main problem of the Aba Mengist hive; it might be damaged within a year if it is not supported by more durable material and covered with a shade roof. One participating farmer reported that three years might be an average service life of the Aba Mengist hive, if it is not reinforced. The developer of the hive, Aba Mengist, pointed out that constructing a protective roof (*sekela)* alleviates the problem of low durability and makes the hive stronger, elongating its period of use to over 30 years.

A *sekela* is a kind of shade roof that is used to protect the Aba Mengist hives. It is fixed to the ground and holds eight hives. It has four sides and a raised shelf on which the upper four hives are placed. The hives are attached to the *sekela* and sealed with a mixture of mud and dung. The Roman numbers shown in Figure 6 indicate the number of hives placed in one *sekela*.

The *sekela* is advantageous for both the beekeeper and the honeybees with respective advantages of using less space and protecting the bees from their enemies and predators. It also protects the bees from wind, rain and extreme sunlight and gives additional warmth for the bees.

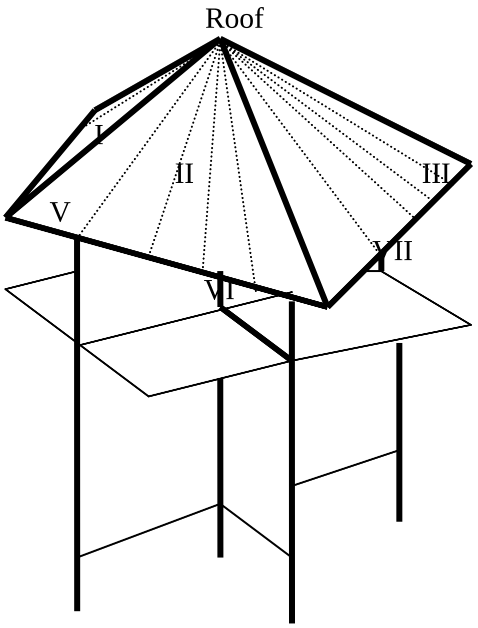

Figure 6: Sketch of *sekela* (left) and practical application of the Aba Mengist hive (right)

Summary and recommendation

According to the results of this experiment, the Aba Mengist hive has promising points such as low cost and easily availability of the construction materials; not requiring expensive beekeeping equipment like casting mould and honey extractor (farmers repeatedly raised this as a problem for beekeeping with frame hives); and easy manipulation by farmers using their indigenous knowledge. In the experiment in the field, the Aba Mengist hive yielded less honey compared with the top-bar and frame hives. However, on station, it gave a higher yield (8 kg/hive) than the national average honey production from traditional hives (5 kg/hive).

Protecting and reinforcing the Aba Mengist hive with *sekela* and other strong materials is the most important aspect that should be given attention to prolong the years of service of the hive. Bee spacing, which is more sensitive for honeybees, should be designed in a scientific way to avoid obliging the bees to construct extra combs. Generally, the hive has some drawbacks from the scientific perspective; it is therefore recommended that, before promoting the Aba Mengist hive for wider use, some modification in this new technology should be made to reduce or avoid its weaknesses. After designing the modifications together with the beekeepers, the hive should be tested with more replications in different areas so as to allow a better understanding of how the hive might be appropriate for resource-poor farmers.

Acknowledgements

The authors are grateful to Aba Mengist Demeke for developing the new hive and for his technical support throughout the study. The authors would like to thank Wondimeneh Mekonnen and Demelash Dagnaw for their technical assistance during the experiment. They also extend their gratitude to the participating beekeepers who carried out the experiment and provided valuable information during data collection. They thank Ann Waters-Bayer of the PROLINNOVA International Secretariat based at ETC Foundation in the Netherlands for commenting on and editing the manuscript. Last but not least, they thank the AgriService Ethiopia (ASE) team in Enebse Sar Midir District for initiating the study and providing financial and material support for it.

References

ASE (AgriService Ethiopia). 2001. Participatory Rural Appraisal findings of baseline information of Enebse Sar Midir Woreda. Mertule Mariam: ASE Enebse Sar Midir Project Office.

Bradbear N. 2003. Beekeeping and sustainable livelihoods. (Diversification Booklet 1). Rome: FAO Agricultural Support Systems Division.

Holeta Bee Research Center. 2000. Honey yield of different hives in Ethiopia (unpublished). Holeta: Holeta Bee Research Center.

Kerealem Ejigu. 2005. Honeybee production systems, opportunities and challenges in Enebse Sar Midir Woreda (Amhara Region) and Amaro Special Woreda (Southern Nations, Nationalities and Peoples Region), Ethiopia. MSc thesis, Alemaya University.

Nuru Adega & Edessa Negera. 2003. Study on making top bar hives and frames from cheap and locally available materials. Holeta: Holeta Bee Research Center.