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Demonstration and Evaluation of Solar Beeswax Extractor in Jimma Zone of South Western Oromia

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Abstract
The study was conducted in the Jimma zone of Oromia Regional State, Ethiopia. The objective of the study was to evaluate the improved solar beeswax extractor performance under farmers' condition in the study area. Four sites were selected as hosting centers for the popularization of the technology at different sites, namely Gandi calla, Omo Gurude, Suse and Kersa selected from three districts (Gera, Goma, and Kersa,) for the study. Accordingly, 51 farmers (41 female, 10 male), 7 agricultural workers (SMS and DA's), and 14 others (Kebele Administrators and Researchers) have attended the demonstration at different sites, involving men and women's participation. The evaluation result showed that, the technology had saved farmers' labor and time, having an average of 0.546 kg from 3 kg of honey combs and 18.17% extracted beeswax, performing in a better way than the local methods with a relatively lower percentage of product loss. The participant farmers' perception responses showed 66.67% that the extractor has a high capacity, whereas 33.3% responded to a medium level, and no respondents ranked it as having a low capacity for extracting beeswax. As a result, most farmers have a positive attitude towards this technology and its capacity.
Keywords: Solar beeswax, Extractor, Beehive, Honeycomb, Capacity
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Abbreviations

CSA	Central Statistical Agency
DA	Development Agent
EPPA	Export Products Promotion Agency
FGD	Farmers Group Discussion
FREG	Farmers Research Extension Group
Kg	Kilogram
mals	Meters Above Sea Level
SMS	Subject Matter Specialists

1. Introduction

Ethiopia is one of the few countries in the world with a long tradition of beekeeping. The country is estimated to have the largest bee colonies in Africa with over ten million bee colonies (Honey and Wax Potential Study, Southern nation nationalities and people's regional state, Regional Export Products Promotion Agency (EPPA), 2003). Ethiopia produces about 24,000 tons of honey and close to 32,000 tons of wax (estimate: Sahel, 2006).

There appears to be a significant amount of wax waste because the ratio of produced wax to honey is 1:6. According to estimates, selling honey together with the wax results in a "loss" of roughly 25% of the entire beeswax production (not extracted). This includes the beeswax loss from the sale of raw honey to consumers. Honey eaters spit away the residual beeswax after chewing the honey.

Oromia has the most beehives, followed by Amhara and Southern nation nations and peoples states, according to the Central Statistics Agency (2011/12). The Oromia region's Jimma and Illuababor districts had the most beehives (CSA, 2011/12).

Both rural and urban areas are seeing job growth because to the beekeeping business (Mengistu, 2011). The Ethiopian government has recently focused on getting unemployed women and young people involved in the manufacture of beekeeping supplies. In Ethiopia, there are 4,601,806 beehives total; 95.5% of them are traditional, 4.3% are transitional, and 0.2% are frame beehives (Beyene, David p. 2007).

Low-income individuals have the chance to supplement their income through the sale of bee products like honey and beeswax at a suitable market thanks to apiculture in southwest Ethiopia. Since the south-western region of Oromia is known for its natural resources, particularly its forests, a lot of honey is produced there, but there aren't enough advanced technologies in the region.

Method of honey production and beeswax extraction of Ethiopian farmers is still very traditional (MoARD, 2006). Therefore, farmers earn less income from honey and beeswax as bees eat more honey to prepare

foundation and honeycomb considered as a waste material.

To minimize these problems, solar beeswax extractor made by Jimma Agricultural Engineering Research Center demonstrated to the honey producers that helped to extract the foundation from honeycomb using the technology for the beehive use.

Objectives

- ✓ To demonstrate solar beeswax extractor technology.
- ✓ To evaluate solar beeswax extractor under the farmer's management.
- ✓ To assess feedback for further improvement on solar beeswax extractor technology

2. Methodology

2.1 Description of the study areas

This research was carried out in south-west areas of Oromia regional state, Ethiopia. Jimma zone was found in Oromia region, 353 km south-west from Addis Ababa. The total area of the zone is 18415 km2 and ranges between 7° 18′N and 8° 56′N latitudes and 35° 52′E and 37° 37′E longitudes. The zone has an elevation of 880 to 3360 meters (masl) above sea level. For 8 to 10 months receives an average annual rainfall of 1000 mm. Jimma zone temperatures range from 8 to 28 °C. The average temperature is 20 °C annually. Three districts were purposively selected from Jimma zone. The demonstration was conducted on purposively selected sites by considering one site in a Kebele to conduct the test. The specific sites were identified in collaboration with district agricultural experts and DA's from the selected Kebeles based on honey production potential.

A total of four Kebeles purposively selected from those districts of the zone based on beehive users honey production areas involving a group of 10 members of farmers composed of male, female and youth were organized in the selected kebele that conducted demonstration and popularization of solar beeswax extractor technology. Training was given to the FREG members and agricultural workers.

2.2 Parameters that have been considered for evaluation of solar beeswax extractor:

Moisture content

Moisture content (M_w) of substance is express as percentage by weight on wet basis and dry basis. The moisture content wet basis was calculated according

$$\% MC = \frac{M_w - M_d}{M_w} \times 100 \quad (2.1)$$

Where, M_w is the mass of the wet material and M_d is the mass of dry materials

Solar beeswax extractor efficiency

$$\varepsilon E = \frac{We}{Whe} \times 100 \quad (2.2)$$

Where, εE- extracting efficiency, %

We-weight of beeswax produced, kg

Wbe-weight of honey comb before extracting (melting), kg

2.3 Method of data collection and Type of data

Appropriate data collection methods such as FGD, household interview and observation were employed to collect both quantitative and qualitative data. The collected data includes; Technical performance of honey bee wax extractor technology, Total number of honey producer farmers, DA's, and SMS's participated on training and mini-field days conducted, and Farmers perception toward technology.

2.4 Method of data analysis:

The collected data were analyzed by using descriptive statistics.

3. Result and Discussion

Training Farmers, SMS and DAs on Solar beeswax extractor device

Both practical and theoretical trainings were given for the participant farmers, Subject Matter Specialists (SMS) and Development Agents (DA's) at the selected Kebele level on the operation and maintenance of the solar beeswax extractor to create awareness before actual demonstration carry out at large. Accordingly, a total of 43 farmers, 5 DA's and 3 Subject Matter Specialists were participated in training.

Table1. Training given to farmers, DAs and SMS

No	Location		Training Participants				
			Farmers		Others		Total
	District	Kebele	Adult	Youth	DAs	SMS	
1	Gera	Gandi callaa	9	2	1	1	13
2	Goma	Suse	7	3	1	1	12
		Omo Gurude	10	1	2	-	13
3	Kersa	Kersa	6	5	1	1	13
		Total	32	11	5	3	51

On-farm evaluation of the solar beeswax extractor

Table2. Average performance of solar beeswax extractor

Test sites (rep}	Input (old honey comb in kg)	output(beeswax in kg)	extraction percent
G1	3	0.54	
G2	3	0.59	
G3	3	0.525	
Average	3	**0.55**	18.39%
O1	3	0.675	
O2	3	0.63	
O3	3	0.62	
Average	3	**0.64**	21.39%
S1	3	0.51	
S2	3	0.508	
S3	3	0.47	
Average	3	**0.496**	16.53%
K1	3	0.51	
K2	3	0.52	
K3	3	0.48	
Average	3	**0.50**	16.78%
Total Average		0.546 kg	18.17%

The letters G, O, S, and K indicate the extractor was evaluated at four different sites

The evaluation result showed that the technology has saved farmers' labor and time; having an average output of 0.546 kg from an average of three kg of old honey comb and 18.17% more extracted beeswax than the local methods with less product loss.

Demonstration of the solar beeswax extractor

Table 3 participants on mini field day

No	Location		Participants of Mini- field day									
			Farmers				DAs & SMS		Others Stalk-holder		Total	
			Adult		Youth							
	District	Kebele	M	F	M	F	M	F	M	F	M	F
1	Gera	Gandi calla	8	1	2	0	1	1	3	0	14	2
2	Goma	Omo Gurude	10	0	2	1	1	1	2	1	15	3
		Suse	5	2	3	1	1	0	4	0	13	3
3	Kersa	Kersa	9	3	2	2	2	0	3	1	16	6
	Total		32	6	9	4	5	2	12	2	58	14

Accordingly 51 farmers (41 Female, 10 Male), 7 agricultural workers (SMS and DA's), 14 others (Kebele Administrators and Researchers) have attended the mini field days.

Farmers' perception on the technology attributes

Table4. Farmers' Perception on Solar beeswax extractor

No	Description	Response level	No. of respondents=33	Percentage (%)
1	Extracting capacity	High	22	66.67
		Medium	11	33.33
		Low	-	-
	Ease of operation and maintenance	Simple	29	87.87
		Not Simple	4	12.12
3	Affordability	High	20	60.6
		Medium	8	24.24
		Low	5	15.15

The participant farmers' perception responses showed 66.67% that the extractor has a high capacity, whereas 33.3% responded to a medium level, and no respondents ranked it as having a low capacity for extracting honey comb. As a result, most farmers have a positive perception of this technology concerning its capacity.

4. Conclusion and Recommendation

4.1 Conclusions

- The honeycomb extractor device has an average of 0.546 kg from 3 kg of honey combs and 18.17% extracted beeswax, performing in a better way than the local methods with less product loss.
- The participant farmers' perception responses showed 66.67% that the extractor has a high capacity, whereas 33.3% responded to a medium level, and no respondents ranked it as having a low capacity for extracting honey comb.
- As a result, most farmers have positively perceived this equipment because of its efficiency.

4.2 Recommendations

- Based on the results obtained, the evaluated solar beeswax extractor will be recommended for communities having small and medium beehive technologies.
- Advice and assistance are required for beekeepers and manufacturing enterprises to develop a mechanism for easily obtaining technology supplies in the required quality and quantity.
- The honeycomb extractor technology was actually liked by the participant farmers, and the prevalence of the local repair and maintenance agents is required for stability of the technology's use.

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