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PEER-REVIEWED ARTICLE

Assessing the Knowledge Level of Beekeepers on Improved Beekeeping Management Practices in Peri-Urban Areas of Southwestern Nigeria

Sunday I. Ogunjimi^a, Abiodun O. Ajala^b, and Chinwe Egbunonu^a

^aDepartment of Agricultural Economics and Extension, Federal University Oye-Ekiti, Ekiti State, Nigeria;

^bDepartment of Agricultural Economics and Extension, Landmark University Omu-Aran, Kwara State, Nigeria

ABSTRACT

The study was conducted to assess beekeepers' knowledge of improved management practices in peri-urban areas of southwestern Nigeria. A multistage sampling procedure was employed to select 90 respondents from the study area. Results show that beekeepers in southwestern Nigeria had inadequate knowledge of improved beekeeping management practices, which resulted in low skill in most of the practices. Most of the beekeepers encountered problems ranging from inadequate skill, drought, honeybee pests and diseases, and death of the colony. The authors recommend that farmers be well-trained in improved management practices so as to enhance food security.

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Introduction

Beekeeping (apiculture) has been an important part of agriculture in southwestern Nigeria for ages. Before the development of sugarcane refining in the 19th century, honey was the only widely available sweetening agent (Farinde, Soyobo, & Oyedokun, 2005). Honey bees (*Apis mellifera*) are one of the most well-known, popular, and economically beneficial insects. The Technical Centre for Agricultural and Rural Cooperation (CTA, 2007, p. 1) identifies the following economic reasons for keeping bees: bees pollinate crops and thus help increase yields; high demand for honey exists in local, regional, and international markets; propolis, collected from plants by bees to cover the inside of the hive, treats a broad range of ailments; pollen collected from plants by bees to feed their larvae, is used in the perfume industry, and is a food additive and a medicine; royal jelly, made by young bees from gland secretions and fed to the queen to make her strong, has medicinal properties; and beeswax is used in cosmetics, candles, and polishes.

CONTACT Sunday I. Ogunjimi ✉ jimisunday@yahoo.co.uk or jimisunday@gmail.com 📧 Department of Agricultural Economics and Extension, Federal University Oye-Ekiti, Ekiti State, Nigeria.

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Honeybees can be kept almost anywhere where there are flowering plants that produce nectar and pollen. While indigenous beekeepers kept bees in primitive hives or cut down bee trees to get honey for home use and for sale (Jaycox, 1985), modern-day beekeeping utilizes improved management practices and equipment which includes the bee hive, which is made up of a bottom board (wooden stand on which the hive rests), frames and foundation (wooden frames that hold sheets of beeswax), hive body (a large wooden box holding the frames), and an excluder placed between the brood nest and the honey supers (shallow boxes, with frames of comb in which bees store surplus honey). This surplus is the honey that is harvested by the beekeeper.

Seasonal beekeeping management practices include retrieving swarms, transferring bees, and honey harvesting. An on-going (weekly or monthly) management practice in honey production is the regular inspection of the colony once it is established. Farinde et al. (2005, p. 33) indicate this inspection is to assess the status of the brood, space needs for expansion and reduction of the population for nectar flow during build-up and dearth periods, and adequacy of honey stores and to detect possible invasion of the colony by predators.

In Nigeria, most honeybees are reared in hives constructed of wooden reeds and tree trunks. Harvesting is carried out with crude technologies. This has limited the quantity and quality of honey produced in southwestern Nigeria (Oluwatusin, 2006). The low yield of honey and other beekeeping products results from insufficient management practices and lack of adequate beekeeping training (Bhusal & Thapa, 2005; Masuku, 2013). In an effort to increase honey production and quality and other allied products, the Nigerian government extension service, working through the Agricultural Development Programme (ADP), has encouraged beekeepers in southwestern Nigeria to adopt improved management practices. This initiative has resulted insignificant improvement in the management of hives, bees, and production of honey and wax. Therefore, this study was conducted to assess beekeepers' level of knowledge of improved beekeeping management practices in peri-urban areas of southwestern Nigeria. The specific objectives were to:

1. examine beekeepers' socioeconomic characteristics in the study area;
2. assess the level of awareness of improved management practices introduced to beekeepers;
3. determine farmers' level of knowledge of improved management practices;
4. assess the skill level of beekeepers in improved management practices; and
5. identify the constraints to beekeeping and honey production in the study area.

Methodology

The study was carried out in Osun and Ekiti States of southwestern Nigeria between the months of March and April 2015, because of these states' known high potential for honey production. The interview schedule was administered five years after the introduction of improved management practices to beekeepers by the Agricultural

Development Project of Nigeria, under the National Fadama Development Project supported by the World Bank intervention between 2008 and 2013.

The target group for the study consisted of the members of the Beekeepers' Association of Nigeria (BAN). A multistage sampling procedure was employed to select the respondents from the study area. At the first stage, three major beekeeping and honey-producing Local Government Areas (LGAs) were selected. In the second stage, three communities were selected from each LGA. In the last stage, 10 beekeepers were randomly selected from each community giving a total of 90 respondents.

Farmers' knowledge of honey production was determined using respondents' mean test scores on survey questions related to knowledge of swarming, hiving, baiting, identification of nectar and honey flow periods, determination of ripe honey, time of harvest, correct method of honey extraction from the comb, and record keeping. The scoring of each practice was done on a 4-point Likert scale with "highly knowledgeable" scored as 3, "moderately knowledgeable" scored as 2, "low knowledge" scored as 1, and "not knowledgeable" scored as 0 (Vogt, 1999). The mean score with standard deviation was used to categorize the knowledge level into high, moderate, and low levels. A score of mean plus standard deviation was considered as "high" knowledge level, mean minus standard deviation was considered as "low," and the difference between high and low was considered as "moderate" knowledge level. Awareness was determined through scoring each practice on a three-point Likert scale with "have seen" scored as 3, "have heard" as 2, and "never heard" as 1. Skill was determined through scoring each practice on four-point Likert scale with "high skilled" scored 3, "moderately skilled" scored 2, "low skilled" scored 1, and "no skill" scored 0. The data were processed using the SPSS package Version 16 (SPSS Inc., Chicago, IL, USA) and descriptive statistics such as mean, percentage, frequencies, and regression analysis were used to analyze the data.

Results and discussion

The socioeconomic characteristics of respondents, presented in [Table 1](#), show that 51.1% were between the ages of 30 and 60 years. This indicates that the majority of the beekeepers in southwestern Nigeria were within a productive age range. Furthermore, the majority (63.3%) were males. These demographics corroborate the findings of Tijani, Ala, Maikasuwa, and Ganawa (2011) who reported that the majority (90%) of the beekeepers in Nigeria are male and opined that this might be the result of male farmers' greater responsibility for the feeding of household members. Thus, they may engage more in beekeeping to supply their households with food and other basic needs. Analysis further shows that the majority (87.8%) of beekeepers realized annual income of less than 51,000 Naira per annum (US\$252.52), which is less than the World Bank standard of US\$1 per day (US\$365 per annum) for people in developing countries. This is an indication that the majority of the respondents generated low income from the sale of honey, which might be as a result of small-scale and crude methods of honey production. If farmers expand their scope of production, income would likely increase.

Table 1. Distribution of beekeepers according to socioeconomic characteristics.

Variables	Frequency	Percentage	Mean/Standard Deviation
Age			
<30	13	14.4	
30–60	46	51.1	
≥61	31	34.5	42.5/13.8
Sex			
Male	57	63.3	
Female	33	36.7	
Marital status			
Single	58	64.4	
Married	26	28.9	
Divorced	6	6.7	
Level of education			
Never	1	1.1	
Primary school	18	20.0	
Secondary school	46	51.1	
Tertiary	25	27.8	
Type of occupation			
Full-time occupation	5	5.6	
Part-time occupation	85	94.4	
Extension contact in the last 1 year			
No contact	27	30.0	
1–4	44	48.9	3.8/1.2
5 and above	19	21.1	
Training attended in the last 1 year			
Never attend training	46	51.1	
1–4	35	38.9	3.6/0.9
5 and above	9	10.0	
Source of training*			
Extension agents	40	44.4	
Research institutes	27	30.0	
Cooperative society	13	14.4	
NGO	10	11.1	
Contact farmers	10	11.1	
Source of information*			
Other farmers	64	71.1	
Extension agents	42	46.7	
Cooperative society	35	38.9	
Research institutes	38	42.2	
Mass media	40	44.4	
NGO	22	24.4	
Income realized from beekeeping/annum (Naira)			
≤10,000	9	10.0	
11,000–20,000	29	32.2	
21,000–30,000	12	13.3	29,435/7,065
31,000–40,000	12	13.3	
41,000–50,000	17	18.9	
51,000 and above	11	12.2	

Note. Source: Field survey, 2015.

*Multiple responses.

The educational attainment of beekeepers plays an important role in their ability to acquire new techniques and technologies. The majority of the beekeepers surveyed (98.9%) were literate, while only one of the beekeepers had never been to school. This indicates that most farmers can read instructional manuals. High educational levels imply that beekeepers could be easily trained in improved management practices. Ayansola (2012), in a study of apicultural practices in southwestern Nigeria, reported that a majority of the respondents (76.1%) had between 11 and 20 years of formal education. Also, Mujuni, Natukunda, and Kugonza (2012)

found that beekeepers surveyed in western Uganda had attained secondary or tertiary education. The similar findings with respect to education show that beekeeping is undertaken by the educated, which may stimulate acceptance of improved technologies, since education facilitates farmers' adoption of innovations (Natukunda, Kugonza, & Kyarisiima, 2011; Onemolease, 2005).

Almost all of the respondents (94.4%) engaged in beekeeping as a part-time business, while the other 5.6% did it full-time. This indicates that many people have not realized the full economic potential of beekeeping as a source of income and employment generation. This finding is consistent with that of Ayansola (2012), who reported that a majority of beekeepers keep bees part-time.

Almost half (48.9%) of the respondents indicated they had between one and four contacts with extension agents in a year. This is abysmally low in a country where the Training and Visit (T&V) system is practiced, where extension agents are expected to visit contact farmers at least twice a month (24 times per annum; Akubuilu, 2008). The low contact is obviously the result of the low national average extension agent to farmer ratio of 1:1986 in Nigeria (Ihimodu, 2002).

Beekeepers' awareness of improved management practices

Table 2 shows that the grand mean awareness score of the respondents for improved management practices in beekeeping was 2.0. Mean scores were calculated and ranked in descending order of awareness. Processing practices, such as use of correct method of honey extraction from the comb were ranked first ($M = 2.9$), followed by marketing of honey and beeswax ($M = 2.8$); packaging ($M = 2.7$); site selection ($M = 2.7$); hive installation ($M = 2.5$); routine inspection ($M = 2.5$); prevention of swarming ($M = 2.3$); time of harvesting ($M = 2.3$); identification of nectar ($M = 2.1$); baiting ($M = 2.1$); determination of ripe honey ($M = 2.1$); and robbing, disease and pest control ($M = 2.0$). Feeding ($M = 1.9$) and recordkeeping ($M = 1.5$) were ranked lowest. Figure 1 shows that 64.4% had high level of awareness

Table 2. Beekeepers' awareness of improved management practices in mean rank order.

Improved Management Practices	Mean	Rank
Processing such as use of right method of honey extraction from the comb	2.9	1st
Marketing of honey and beeswax	2.8	2nd
Packaging	2.7	3rd
Site selection	2.7	3rd
Hive installation	2.5	5th
Routine inspection	2.5	5th
Prevention of swarming	2.3	7th
Time of harvesting	2.3	7th
Identification of nectar	2.1	9th
Determination of ripe honey	2.1	9th
Baiting	2.1	9th
Robbing, disease and pest control	2.0	12th
Feeding	1.9	13th
Recordkeeping	1.5	14th
Grand mean	2.0	

Note. Source: Field survey, 2015.

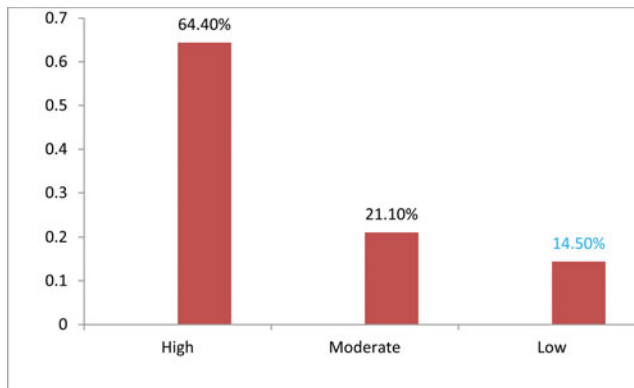


Figure 1. Beekeepers' Level of Awareness of Improved Management Practices.

of all the management practices, 21.1% had moderate, and 14.5% had low awareness. The findings indicate that beekeepers were highly aware of the improved management practices except feeding and recordkeeping, of which they have low awareness.

Beekeepers' knowledge of management practices

Table 3 shows that the grand mean score for the beekeepers knowledge of management practices was 1.51. The rank order of knowledge levels in beekeeping management practices is as follows: marketing of honey and beeswax ($M = 1.98$); processing practices, such as use of correct method of honey extraction from the comb ($M = 1.85$); storage ($M = 1.68$); packaging ($M = 1.57$); hive installation ($M = 1.55$); baiting ($M = 1.53$); knowledge of swarming ($M = 1.36$); routine inspection ($M = 1.35$); robbing, disease and pest control ($M = 1.35$); identification of nectar and honey flow periods ($M = 1.33$); determination of ripe honey ($M = 1.31$); time of harvest ($M = 1.30$); feeding ($M = 1.25$); and recordkeeping ($M = 1.24$). It could

Table 3. Beekeepers' knowledge of improved management practices in mean rank order.

Management Practices	Mean	Rank
Marketing of honey and beeswax	1.98	1st
Processing such as use of right method of honey extraction from the comb	1.85	2nd
Storage	1.68	3rd
Packaging	1.57	4th
Hive installation	1.55	5th
Baiting	1.53	6th
Knowledge of swarming	1.36	7th
Routine Inspection	1.35	8th
Robbing, disease and pest control	1.35	8th
Identification of nectar	1.33	10th
Determination of ripe honey	1.31	11th
Time of harvest	1.30	12th
Feeding	1.25	13th
Recordkeeping	1.24	14th
Grand mean	1.51	

Note. Source: Field survey, 2015.

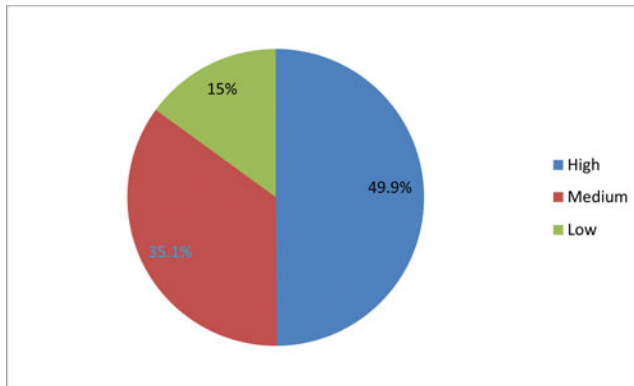


Figure 2. Pie Chart Showing the Knowledge Level of Beekeepers on Improved Management Practices.

be inferred from the findings that the majority of the beekeepers had low knowledge of the management practices, except for marketing, processing, and storage, in which they were moderately knowledgeable. The moderate knowledge of marketing, processing, and storage might be due to the beekeepers' indigenous experience in bush honey harvesting in which fire is used to drive away the bees in order to harvest honey for processing and sale in the local market. This practice can lead to bee death. Such wild honey hunters do not rear bees and may not have the technical know-how (management practices) with regard to beekeeping.

Figure 2 depicts the beekeepers' level of knowledge in improved management practices. Almost half (49.9%) were moderately knowledgeable, while 35.1% had low knowledge; only 15% had high knowledge, despite high awareness. The higher the knowledge level, the greater the skill and higher the productivity of the beekeepers. Low and moderate knowledge levels will have a negative impact on the adoption of improved management practices and will, in turn, lead to low production of honey and other allied products. A good knowledge of accessible markets (especially in urban centers), packaging, and presentation will allow the producer to charge more for the honey produced (Paterson, 2006). Our findings are contrary to those of Farinde et al. (2005) who reported that the majority of beekeepers in Oyo State had a high level of knowledge in honey production.

Skill in improved beekeeping management practices

Skill in beekeeping management practices was calculated and ranked by mean score (see Table 4). Processing of honey was ranked first, with a mean score of 1.81, while packaging of honey and other allied products ($M = 1.57$) ranked second. Other management practices were ranked as follows: marketing ($M = 1.55$); storage of honey and wax ($M = 1.52$); retrieving swarms through baiting of hive ($M = 1.52$); site selection ($M = 1.50$); time of harvest ($M = 1.49$); hive installation ($M = 1.45$); routine inspection ($M = 1.43$); knowledge of swarming ($M = 1.42$); determination of ripe honey ($M = 1.42$); identification of nectar ($M = 1.31$) and robbing, disease and pest control ($M = 1.20$). Record keeping ($M = 1.18$) was ranked last. The latter

Table 4. Respondents' skill in beekeeping in mean rank order.

Improved Management Practices	Mean	Rank
Processing of honey	1.81	1st
Packaging of honey and other allied products	1.57	2nd
Marketing	1.55	3rd
Storage of honey and wax	1.52	4th
Retrieving swarms through baiting of hive	1.52	5th
Site selection	1.50	6th
Time of harvesting	1.49	7th
Hive installation	1.45	8th
Routine inspection	1.43	9th
Knowledge of swarming	1.42	10th
Determination of ripe honey	1.42	10th
Identification of nectar	1.31	12th
Robbing, disease and pest control	1.20	13th
Record keeping	1.18	14th
Grand mean	1.50	

Note. Source: Field survey, 2015

Table 5. Level of beekeepers' skill in improved management practices.

Level of Skill	Frequency	Percentage
Low	50	55.6
Medium	31	34.4
High	9	10.0
Total	90	100

Note. Source: Field survey, 2015.

result is consistent with a study by Mujuni et al. (2012) that reported a generally low level of record keeping in the Bushenyi District of Uganda, where beekeepers were not conversant with the importance of records on their farms, despite their high level of literacy.

With regard to the overall level of skill of beekeepers (Table 5), 55.6% had low skill in all the improved management practices, while 34.4% were moderately skilled and only 10.0% had high skill. These results imply that the majority of the beekeepers had low skill in most of the management practices, except for in a few cases like processing, in which they claimed to be more skilled. These findings are in line with our findings on knowledge level. Since beekeepers had inadequate knowledge in almost all beekeeping management practices, it is expected that they will not be adequately skilled in those practices.

Constraints to beekeeping production

Table 6 shows the ranked mean scores of problems confronting beekeepers, in descending order of severity. Inadequate training on improved management practices (technology know-how), with a mean of 3.62, was ranked highest. This was followed by inadequate credit facilities ($M = 3.59$) and inadequate beekeeping materials ($M = 3.54$). Bee aggressiveness ($M = 3.26$) was ranked fourth. Next in the order was inadequate information on production ($M = 3.18$), followed by inadequate extension support ($M = 3.12$), shortage of bee forage ($M = 2.78$), inadequate

processing technology ($M = 2.66$), and reduction of honeybee colonies ($M = 2.50$). Unavailability of market ($M = 2.23$) was ranked 10th and inadequate storage facilities last ($M = 2.11$). The findings indicate that the first nine problems encountered by the beekeepers were considered major problems, with an above average mean score of 2.50. It could be interpreted that most of the beekeepers surveyed encountered a lot of problems. This supports the finding by Ouma, De Groot, and Owour (2006) that access to credit is prominent among the problems affecting farmers' use of improved agricultural technologies. Our findings are also in line with those of Fakayode, Babatunde, Olowogbon, and Adesuyi (2010), who reported that beekeepers in Ekiti State were faced with many of the same problems such as inadequate credit, pests and diseases, bee aggressiveness, bush burning, absconding of bees, theft, inadequate technical assistance, and poor markets. Farmers who have access to training and credit are more likely to adopt improved technologies than farmers who do not have access to training and credit facilities. This is because adoption of improved technologies may require extra resources and commitment that can only be met through acquisition of knowledge and other material incentives.

Poor market accessibility is also one of the major problems faced by beekeepers in other developing countries. According to a study carried out by Yirga and Teferi (2010) in Ethiopia, the market for honey is generally poor, mainly due to a limited number of buyers, poor market infrastructure, and poor market information. Ethiopian beekeepers in the Tigray region also cited other critical constraints and problems affecting honey production—including inadequate availability of production technologies; limited availability of bee flora, mainly due to deforestation; and lack of beekeeping knowledge and skill.

Hypotheses testing

Table 7 presents the results of the regression analysis on selected personal and socioeconomic characteristics of beekeepers. Regression analysis was used in order to show the magnitude of change in the knowledge level of beekeepers as a result of a unit change in the selected independent variables. The results of regression coefficient (b) show that years of schooling ($b = .173$; $p \leq .01$) result in a high

Table 6. Constraints to beekeeping in mean rank order.

Constraints	Mean	Rank
Inadequate training on improved management practices	3.62	1st
Inadequate credit facilities	3.59	2nd
Inadequate beekeeping materials	3.54	3rd
Bee aggressiveness	3.26	4th
Inadequate information on production	3.18	5th
Inadequate extension support	3.12	6th
Shortage of bee forage	2.78	7th
Inadequate processing technology	2.66	8th
Reduction of honeybee colonies	2.50	9th
Unavailability of market	2.23	10th
Inadequate storage facilities	2.11	11th

Note. Source: Field survey, 2015.

magnitude of change in beekeepers' knowledge of improved management practices, which implies that a unit increase in years of schooling would result in an increase in beekeepers' level of knowledge. This may be because, the more the farmers seek knowledge, the more likely they develop interest in the improved practices and the higher their level of involvement. Results of regression coefficient (b) further show that income realized and extension contact ($b = .177$; $p \leq 0.05$) correlate significantly with beekeepers' level of knowledge of improved management practices. The implication of this is that a unit increase in extension contact would result in an increase in the level of knowledge of improved beekeeping management practices. The reason for this increase might be because an increase in extension agent contact would increase information flow to beekeepers, which would lead to increased knowledge of improved management practices and, in turn, increase their skill. A unit increase in income realized from sales of honey and other allied products will also bring about an increase in the level of usage of improved management practices and level of knowledge. This implies that an increase in the income realized by beekeepers from sales of honey and other allied products will serve as an incentive to become more involved in management practices, which will increase their level of knowledge.

Conclusion and recommendations

Beekeepers in southwestern Nigeria have inadequate knowledge of improved management practices in beekeeping, resulting in low skill in most practices. The major problems confronting peri-urban beekeepers include inadequate knowledge of improved management practices, lack of credit facilities, untimely supply of inputs, inadequate information, low extension contact, and inadequate processing technology. The results of regression analysis show that a unit increases in years of schooling, extension contact, and income are correlated with an increase in the level of knowledge of improved management practices. It is recommended that adequate training on improved beekeeping management practices be organized by the Nigerian government through the extension agencies and non-governmental organizations. Moreover, there should be follow-up visits by extension agents to ensure that the desired results in beekeepers' knowledge and skills are achieved. Nigerian agricultural engineers should be empowered to combine beekeepers' indigenous

Table 7. Multiple regression analysis showing the relationships between respondents' personal, socioeconomic characteristics, and knowledge level.

Variables	Regression Coefficient (b)	t-Value	p-Value
Age (year)	-.044	0.555	.579
Extension contact	.177*	-1.468	.043
Years of schooling	.173**	3.090	.002
Income realized by beekeepers	.037**	7.477	.000
Constant	12.443	1.956	.510

Note. Source: Field survey, 2015.

**Significant at $p \leq .01$.

*Significant at $p \leq .05$.

knowledge with modern knowledge to devise appropriate adaptive technology. If these recommendations are put in place, an increase in honey production may be achieved.

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