

Challenges to Adoption and Sustained Use of Modern Bee Hives in Kitui County, Kenya

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DOI: <https://dx.doi.org/10.47772/IJRISS.2025.9020230>

Received: 31 January 2025; Accepted: 14 February 2025; Published: 13 March 2025

ABSTRACT

In Kenya, beekeeping is a feasible livelihood diversification economic activity especially in the arid and semi-arid regions facing substantial rainfall variability since beekeeping is not fully depended on rainfall amounts and distribution. However, most of the beekeepers in Kenya use the traditional log hive which is less productive. Therefore, beekeeping is yet to improve the socio-economic welfare of most farmers. Traditional log hives produce honey of low quality and quantity. Failure to adopt the modern bee hives suggests existence of challenges limiting the adoption. The main objective of this study was to determine the challenges to adoption and sustained use of modern bee hives in Kitui county, Kenya. During the study a total of 110 beekeepers (42 adopters and 68 non-adopters) from the five selected locations of Mwingi Central subcounty namely; Waita, Nuu, Kivou, Mwingi and Mui were administered with questionnaires. The Statistical Package for Social Sciences (SPSS Version 20) was employed in data analysis. Based on Chi-square statistics the study proved the hypothesized challenges; unavailability of modern bee hives, unsuitability to local bees and lack of skills in modern beekeeping as statistically significant challenges to adoption of modern bee hives. On challenges to sustained use of modern bee hives, marketing, absconding of bees and drought were found significant. It was concluded that the challenges were limiting the adoption and sustained use of modern bee hives. The study recommends; establishment of more honey collection centres in rural areas, construction of more earth dams by county government and more modern beekeeping training organized by county government to train beekeepers on modern apiculture.

Keywords: Challenges, modern beehives, adoption, sustained use, farm technology

INTRODUCTION

Background to the study

Over the years, beekeeping has developed into an important economic activity across the world with an annual honey production of about 1.6 million tons and net annual income reaching up to 1 billion US\$ (FAOSTAT, 2015). According to FAOSTAT (2009) leading honey exporters include China, USA, Turkey, Ukraine, Argentina, Germany, India, Mexico and the European Union. China for instance exported honey worth 284 million US\$ in 2009. High honey production per hive has been recorded in Canada (64kg), Australia (55kg), Argentina (40kg) and China (33kg) (Food and Agricultural Organization of the United Nations, FAO, 2005). Such countries have already embraced modern beekeeping to a large extent hence the high production. Apparently, apiculture in many parts of the world is practised using traditional bee hives with a very small percentage especially in developing countries using modern bee hives.

In Africa, beekeeping has been mostly practised using traditional methods. In some places hives are not even used. However, honey production in hives is well developed in African countries such as Egypt, Kenya, Uganda, Tanzania and Ethiopia (FAO, 1990). The largest honey producing and exporting counties in Africa include;

Ethiopia, Tanzania, Angola, Central African Republic and Kenya. Ethiopia is the leading honey producer in Africa. Beekeeping has been a long-standing practice in Ethiopia and accounts for 1.3% of her agricultural gross domestic product. One out of 10 households keep honeybees. There are approximately 5,250,000 bee hives in Ethiopia producing approximately 54,000 metric tons annually (Demisew, 2016).

In Kenya, beekeeping is a highly potential sub-sector given that two thirds of the country's total land area is arid and semi-arid where apiculture can be an appropriate livelihood diversification option. Employment opportunities may also be created through value addition. Beekeeping can therefore play a strategic role in line with the country's long-term plan, the Vision 2030, by alleviating poverty. However, Kenya only produces 25% of her estimated potential of 100,000 metric tons annually (Kiptarus et al., 2015). This is partly attributed to the use of the less productive traditional bee hives. Bee hives types used in Kenya are broadly grouped into two; traditional and the modern ones. The most common traditional and modern hives used in Kenya are the traditional log hive and the Langstroth hive respectively (FAO 1990). On average honey produced from the traditional log hive and Langstroth hive is 5-10kg and 30-35kg per harvest respectively (Muya, 2014).

The low production has made the beekeepers remain in poverty and the continued failure to realize food security. Various development agency interventions through the government and Non-Governmental Organizations (NGOs) have failed to stimulate more efficient honey production on a larger scale in the semi-arid regions in Kenya such as Kitui and Kibwezi (United Nations Development Programme, 2012). Evidence from previous studies show that there is an excess of demand over supply and relatively high local prices on both domestic and regional markets for honey and beeswax in Kenya (Bees for Development, 2006; Carroll & Kinsella, 2013).

Bee keeping in Kitui county has the same high potential to bring substantial economic returns since it is located within arid/semi-arid climatic region where rainfall is unreliable. The apiculture sector was well outlined as an area of interest in the Kitui County Integrated Development Plan 2013–2017 (County Government of Kitui, CGoK, 2014) as an enterprise that can contribute to poverty reduction in the county. However, income from apiculture is still low owing to the low amounts of honey produced. The low performance is due to the failure of beekeepers to adopt the more productive modern bee hives.

Statement of the problem

A study of beekeeping in Kitui county by Mugendi (2011) revealed that most of the beekeepers in the county exclusively use traditional bee hives (log hives). The county has approximately 377,199 log hives and 6,355 modern box hives producing an average total of only 1.8 tons of honey annually (County Government of Kitui, CGoK, 2015). Therefore, there is need to empirically examine the challenges facing adoption and continued use of modern bee hives. To establish this, the study investigated the challenges to adoption and sustained use of modern hives technology in the selected study area, Mwingi Central Sub- County of Kitui County.

MATERIALS

Farm technology adoption

Feder et al. (1985) classified adoption into aggregate and individual adoption. Individual adoption is whereby the farmer decides to incorporate the technology in production. By contrast, aggregate adoption refers to the spread of a technology in a region. This study was framed on the first type of adoption whereby individual beekeepers were investigated on their adoption behavior of modern box hives. Rogers (1962, p. 15) defined adoption as “the mental process through which an individual passes from first hearing about an innovation to final adoption.” According to Rogers and Shoemaker (1971, p. 32) adoption is as “a decision to make full use of new ideas as the best course of action available.” The authors also explained that the decision to adopt or reject the new technology is dependent on social, economic and technical determinants. Therefore, when making a decision, the individual undergoes several mental stages. Rogers (2003) conceptualized the stages within which adoption of a new technology occurs. The author proposed five stages comprising of the processes passed by an individual to accept or reject an innovation.

The process starts with the knowledge stage which occurs when an individual gains awareness about existence of the technology and gets to understand how it works. The individual then reaches the persuasion stage where

they gain either positive or negative attitude towards the technology. Third is the decision stage and occurs after the individual undertakes activities that lead to a choice of either adopting or rejecting the technology. Next is implementation which occurs when the individual starts using the new technology. Finally, is the confirmation stage which occurs when the individual, after implementing the new technology seeks reinforcement of the decision. However, the adopter may later abandon the technology. In such a case the adoption is termed unsustainable indicating presence of challenges to sustained use of the technology.

Salim (1986) further observed that the adoption uptake is not a uniform process since most farmers do not adopt agricultural technologies immediately they get knowledge about them. According to Diederer et al. (2003) different farmers adopt agricultural technologies at different times and they can be grouped into three categories. The first category is the innovators and they are the first to adopt and make use of the new technology. In the case of beekeeping these are the beekeepers that adopted the box hives before anyone else. Early adopters fall in the second category and refer to the individuals who belong to the first quarter of adopters. The last category is the late adopters and comprise of those individuals who already took up the innovation but were not among the first quarter of the targeted potential users. The different categories of adopters were however not studied separately. For this study, adopters were the beekeepers who had used modern box hives for at least two years before the study period. Both adopters and non-adopters were investigated on their challenges to adoption and sustained use of modern bee hives.

Challenges facing modern apiculture and adoption of associated technologies

Mujuni et al. (2012) in their study carried out in Bushenyi District, Uganda found that the main constraint to beekeeping was lack of equipment (improved hives, hive tools and harvesting gears). Farmers depended on hiring or borrowing the equipment from their fellow farmers. Other challenges included bad weather, transport difficulties, pests and diseases. Changes of weather patterns led to prolonged droughts affecting flowering patterns thus low honey yields due to lack of enough nectar. It was also found that heavy rains led to destruction of earthen hives leading to huge losses. The weather challenge was also reported by Monga and Monocha (2011) who found that management of colonies during extreme weather conditions was a major challenge faced by beekeepers in Panchkula District, India.

The study conducted by Gebiso (2015) in Oromia Region, Ethiopia reported that chemicals like herbicides and pesticides application for crop production was the main challenge facing the enterprise. The farmers further suggested timely application of herbicides that is, before the flowering of cultivated crops. This would minimize death of bees as they only go for the pollen and nectar after the crops flower thus saving them from consuming the chemicals. The second and third highest ranked constraints were predators and lack of skills and knowledge on modern bee hive management, respectively. The identified predators were lizards, birds, ants and spiders. Other reported challenges were, lack of beekeeping accessories, lack of adequate bee forage and lack of capital.

According to a study conducted by Adgaba et al. (2014) on factors influencing adoption of box hives in Saudi Arabia, the major constraints leading to low adoption rates were transportation problems, unsuitability of the box hives to local bees and the high initial capital required. Moreover, lack of training on modern beekeeping and extension support, unavailability of the box hives and lack of awareness of the technology were also mentioned as limiting constraints. When beekeepers are faced with such challenges the adoption rates shall remain low. The challenges pertaining modern box hives adoption and sustained use need to be identified and resolved.

METHODS

Study area

The study was conducted in Mwingi Central Sub- County which is one of the 8 sub-counties of Kitui County (Figure 3.1). The sub- County covers an area of 4,141.4 km² and lies between latitudes 0°48'S to 1°12'S and longitudes 38°0'E to 38°48'E. The area experiences a hot tropical climate. Annual temperatures range from 21°C–34°C while annual rainfall ranges between 500–700 mm with most of the months dry. The altitude ranges from 860–1090m above sea level. The soil type is mainly the red-brown sandy soil of low fertility. Natural

vegetation mainly comprises of the thick thorn-bush type with scattered trees owing to the low rainfall (County Government of Kitui, CGoK, 2014). Small scale farmers in the area grow crops such as maize, millet, sorghum, green grams, cow peas and pigeon peas with some farmers growing mango and watermelon horticulture crops (CGoK, 2014). Farmers also keep livestock such as beef cattle, goats, donkeys and chicken. Beekeeping is also a common economic activity in the area.

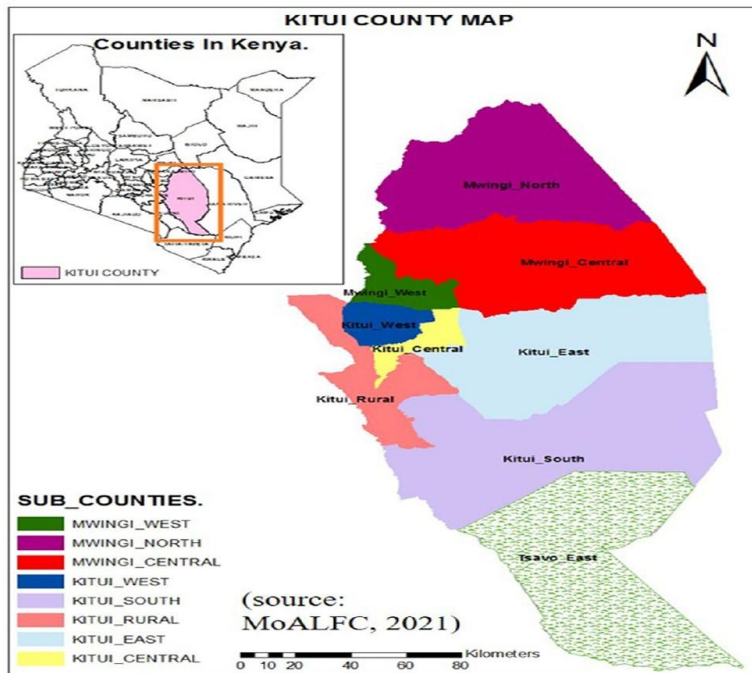


Figure 3.1: Map of Kitui County showing Mwingi Central sub-county.

Sampling technique and sample size

The study targeted the registered beekeepers (both adopters and non-adopters) in Mwingi Central Sub- County. The beekeepers belong to various groups which have been registered with the Mwingi beekeepers Community Based Organization, CBO. All registered beekeepers sell their comb honey to the CBO where it is processed, packaged and marketed.

There were 20 groups in the sampled area which had a total of 522 registered beekeepers. The beekeepers were stratified into adopters and non-adopters. In this study adopters were beekeepers who had continuously used at least one modern box hive for the last two years before the study while non adopters were beekeepers who had exclusively used traditional hives in the same period. Simple random sampling was employed to select 42 adopters and 68 non-adopters making a sample size of 110 beekeepers.

Data collection

Each of the 110 beekeepers was administered with a structured questionnaire to provide primary data. Interviews were conducted on selected key informers to provide in depth information. Secondary data was obtained from research reports and journals, CBO records, government publications and other relevant written materials. A pilot study preceded the main field research to pre-test the research instruments on their feasibility and reliability.

Data analysis

The collected data was analyzed both quantitatively and qualitatively. Qualitative data was categorized, cleaned and coded to fit their respective themes. SPSS-20 was employed in analyzing data quantitatively. Descriptive statistics such as cross-tabulations, means and frequencies were utilized to describe and summarize the beekeepers’ socio-demographic characteristics and adoption challenges. Chi-square which is an inferential statistic was used to make conclusions and generalizations about characteristics of the population.

RESULTS AND DISCUSSIONS

Socio-demographic characteristics of the respondents

A total of 110 respondents were administered with questionnaires during the study. Out of this, 60.9% and 39.1% were male and females, respectively. This means that more males than females are involved in beekeeping. Such results were expected since beekeeping is predominantly a male activity (Nightingale, 2006). In terms of marital status 86.4%, 6.4%, 2.7% and 4.5% of the total respondents were married, single, divorced and widowed, respectively. The mean age of the respondents was 54.7 years. Ages of the beekeepers appeared unevenly distributed across the four age groups. Only 17.3% of the respondents fell under 21-40 years. 44.5% and 33.6% fell under 41-60 and 61-80 years respectively. The remaining 4.5% were more than 80 years old. This implies that beekeeping is more common among the older than the younger adults. In terms of level of education 11.8%, 32.7% and 30.0% of the respondents had gone through lower primary, upper primary and secondary education respectively. A meager 6.4% had gone beyond secondary education level. Further, 19.1% of the total respondents had not undergone any formal education. This indicates that literacy level in the study area is likely to be higher than that of the county which is at 63.2% (CGoK, 2014).

The findings also showed that 54.5% of the respondents had an off-farm employment activity while the remaining 45.5% did not have and therefore were solely dependent on farming for their livelihood. Such results were expected since the area experiences low and unreliable rainfall and therefore majority of the beekeepers have to seek other forms of generating income for their livelihoods. The most common type off-farm activity was business at 25.5% followed by casual labour at 19.1%. Only 8.2% of the total respondents were civil servants. Majority of the respondents (20.9%) earned between Ksh. 5,000-10,000. 15.5%, 10.9% and 7.3% earned between 10,001-15,000, over 15,000 and less than 5,000, respectively. The level of income from these off-farm activities is low indicating possibility of financial challenges among the respondents. The figures on socio-demographic characteristics are shown in Table 4.1

Table 4.1: Socio-demographic characteristics of the respondents.

Characteristic	Frequency	Percentage
<u>Gender</u>		
Male	67	60.9
Female	43	39.1
<u>Marital status</u>		
Married	95	86.4
Single	7	6.4
Divorced	3	2.7
Widow(er)	5	4.5
<u>Age</u>		
21-40	19	17.3
41-60	49	44.5
61-80	37	33.6
81 and above	5	4.5
<u>Education level</u>		

None	21	19.1
Lower primary	13	11.8
Upper primary	36	32.7
Secondary	33	30.0
College	6	5.5
University	1	0.9
<u>Form of off-farm employment</u>		
None	50	45.5
Micro business	28	25.5
Civil servant	21	8.2
Casual labour	21	19.1
Others	2	1.8
<u>Income from employment</u>		
None employed	50	45.5
<5,000	8	7.3
5,000-10,000	23	20.9
10,000-15,000	17	15.5
15,000+	12	10.9

Source: Survey output.

Challenges facing adoption of modern box hives

Each of the hypothesized challenge facing adoption of modern box hives was tested for statistical significance. Chi-square test in Table 4.2 shows that unavailability of the box hives, unsuitability to local bees and lack of skills were significant at $P < 0.05$.

Table 4.2: Chi-square results on challenges facing adoption of modern box hives.

Challenge investigated	Chi-square value	d.f.	P-value
Unawareness	1.150 ^a	2	.563
Unavailability	31.717 ^a	4	.000*
Lack of enough apiary land	6.265 ^a	4	.180
Unsuitability to local bees	10.436 ^a	4	.034*
High cost of inputs	6.586 ^a	3	.086
Lack of skills	12.931 ^a	3	.005*

Lack of extension support	8.001 ^a	4	.092
Lack of credit/ loan	.301 ^a	3	.960

Significant at P<0.05 Source: Survey output.

Unsuitability to local bees here is used to refer to the situation whereby local bees reject modern bee hives due to the nature of the hives. Where the problem exists, a group of swarming bees would look for other types of hives rather than settle and establish a colony in a modern bee hive. The findings indicate that the bees would not prefer to settle on some of the modern bee hives especially the furnished ones which have a smell unfavorable to bees. The results were in agreement with those of Adgaba et al. 2014 who reported unsuitability of modern box hives as a challenge limiting adoption of modern hives in Saudi Arabia.

Lack of enough modern beekeeping skills was found significant. The results indicate that most beekeepers are not well acquainted with modern bee keeping practical skills. They would not take the risk of acquiring the costly modern bee hive then fail to utilize them. The results concur with those of Adgaba et al. (2014). Unavailability of the box hives was also found a significant challenge. This implies that the boxes were unavailable for purchase. The local manufacturers get discouraged from supplying adequate hives for fear of not making sales since most of the beekeepers only wait for free donated modern bee hives.

Unawareness about the box hives was found insignificant since 98.2% of the respondents were aware of the technology (Table 4.3). Unawareness here referred to the situation whereby the respondent had never heard about or seen modern bee hives. The beekeepers had learnt of the modern hives from various sources such as; extension officers, radio, neighbors, television, magazines and newspapers. Some newspapers and television stations offer educative programs on modern farming technologies. For instance, the ‘Shamba Shape Up’ on Citizen TV and ‘Seeds of Gold’ on the DAILY NATION have been good source of information to many farmers. A beekeeper who has adopted modern bee hives may pass skills on the new technology to the neighboring beekeepers. This implies that in the study area, almost all beekeepers were aware of modern bee hives despite the low adoption rate.

Table 4.3: Frequency distribution on awareness of modern bee hives.

Response	Frequency	Percentage
Yes	108	98.2
No	2	1.8
Total	110	100

Source: Survey output.

The other hypothesized challenges including; lack of land for an apiary, high cost of inputs, lack of extension support and lack of credit were found non-significant to adoption of modern box hives.

Challenges to sustained use of the modern box hives

A chi-square test was also run on the hypothesised challenges facing sustained use of modern box hives to determine their statistical significance. The results in Table 4.4 show that marketing, absconding of bees and drought were significant at P<0.05.

Table 4.4: Chi-square results on challenges to sustained use of modern beehives.

Challenge investigated	Chi-square value	d.f.	P-value
Marketing	10.546 ^a	4	.036*

Unprofitability	4.095 ^a	4	.393
Pests & diseases	3.400 ^a	5	.639
Shortage of bee forage	2.936 ^a	4	.569
Absconding of bees	8.373 ^a	3	.038*
Drought	11.175 ^a	4	.025*
Poor roads	3.671 ^a	4	.452
High maintenance costs	3.976 ^a	4	.409

Significant at P<0.05

Source: Survey output.

The significant results on marketing may be attributed to the fact that all the registered beekeepers depend on the Mwingi CBO as their only market for honey produced from modern bee hives. Honey harvests from modern bee hives must be extracted from the combs using a centrifugal extraction machine only found in the CBO situated in Mwingi town. The CBO is quite far from the beekeepers in the interior. This was consequently identified as a challenge because of the transport costs incurred. Drought was also found significant as the area lies in a semi-arid region. Drought leaves most of the vegetation dry including bee forage. This reduces honey yield due to inadequate nectar sources. During the dry season the beekeepers have to supplement the bee feed by availing sugary water solutions in several open containers around the apiary. Similarly, Monga and Monocha (2011) found that management of colonies during extreme dry weather conditions was a major challenge faced by beekeepers in Panchkula District, India.

Absconding of bees was also found significant. Absconding refers to the movement of the entire honeybee colony from a hive thus abandoning it. Honeybees may abscond due to various reasons such as lack of feed, disease attack, air pollution due to excessive use of agrochemicals in nearby farms or due to any other substantial disturbance. As the pigeon peas and mango farmers make use of pesticides to keep away pests the air gets polluted with agrochemicals which repel bees away. The findings were in congruence with those of Gebiso (2015) who established that chemicals like herbicides and pesticides in crop production was the main challenge facing beekeeping in Oromia Region, Ethiopia. The farmers further suggested timely application of herbicides that is, before the flowering of cultivated crops. This would minimize death of bees as they only go for the pollen and nectar after the crops flower thus saving them from consuming the chemicals.

The other hypothesized challenges including unprofitability, pests and diseases, shortage of bee forage, poor roads and high maintenance costs were found insignificant. Therefore, existence of such challenges doesn't necessarily hinder the sustained use of modern beehives. During the study, the respondents listed other challenges facing sustainability of the modern bee hives. As shown in Table 3.5, 35% and 16.3% of the respondents mentioned theft and poor honey prices respectively.

Table 4.5: Other challenges on sustained use of modern bee hives.

Challenge	Frequency	Percentage
Theft of honey	28	35
Poor honey prices	13	16.3
No response	39	48.7
Total	80	100

Source: Survey output.

Honey theft is common because some beekeepers place their apiaries in the forest and no fencing is provided. The challenge of poor honey price is faced by beekeepers who sell the honey through brokers. The price per kilogram is between Ksh. 200 to 250 through brokers. The same quantity earns the beekeeper Ksh. 300 when sold directly to the honey processing cooperative at Mwingi. The beekeepers who cannot reach the cooperative end up selling their hive produce to brokers at a lower price.

CONCLUSION AND RECOMMENDATIONS

Data analysis proved existence of a number of challenges facing adoption and sustained use of modern bee hives. Action should therefore be taken in relation to the findings. Marketing of the honey should be improved by establishing more collection centers within the interior of rural areas to reduce the distance travelled by bee keepers as they transport their honey to the Mwingi Beekeepers CBO for processing and packaging. This can be easily done through county government funding. Since the problem of drought is likely to persist, the farmers should be trained on better drought resilience and coping strategies such as rain water harvesting to alleviate water shortage during long droughts. Through county government facilitation, earth dams should be constructed to improve water availability for the bees during droughts. This would also reduce the challenge of absconding of bees which is partly caused by drought.

The challenge of unavailability of modern bee hives could progressively reduce as more beekeepers adopt the modern hives encouraging the local manufacturers to increase supply. In order to trigger more adoption, the county government through the relevant department should avail modern bee hives to willing beekeepers on affordable loan programs or donations. The county government through agricultural extension services should organize modern bee keeping training programs to progressively alleviate the challenge of lack of modern bee keeping skills. In conclusion is that with substantive solutions to the challenges facing adoption and sustained use of modern bee hives, more beekeepers would adopt modern bee hives thus increasing the quantity and quality of honey produced in the study area and other regions within Kenya with the same capacity in apiculture.

ACKNOWLEDGEMENT

We acknowledge that the success of this study is attributed to the assistance provided by various individuals whom we wish to appreciate. We thank Dr. Muiruri Philomena and other lecturers of Geography Department in Kenyatta University, for their constructive advice during the research work. We also thank Mwingi Beekeepers and Food Crops Cooperative Society workers and Agricultural Extension Office Mwingi Central Sub- County, Kitui County for providing the much-needed information. God bless you all.

Funding sources: The authors received no financial support for the research and authorship.

Conflict of interest: The author(s) declares no conflict of interest.

Disclaimer Statement: This paper comes out of one of the objectives in a thesis submitted in partial fulfillment of the requirements for award of the degree of Master of Arts in Geography in the school of Humanities and Social Sciences of Kenyatta University.

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