Assessment of performance indices of frame hive beekeeping and the traditional technology in Kenya: A case of Kitui County.

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Abstract

A survey was conducted to assess the performance indices of frame hive beekeeping and the traditional technology in Kenya. The overall objective was to investigate the performance of frame hive technology of beekeeping relative to traditional hives in Kitui County, Kenya. The specific objectives were to establish the factors responsible for the adoption rate of frame hives within selected beekeeping groups in Kitui County and to compare honey production and household incomes among beekeepers using frame and traditional hives. Data were collected from four sites of Mulundi, Kasaala, Waita and Kyuso Locations of Kitui County. Systematic random sampling was applied to select 30 households per site giving a total of 120 households. Sixty nine out of 120 respondents, representing 58% were beekeepers, an indication that beekeeping was an important socio- economic undertaking in the area. Sixty five percent of the beekeepers relied on fixed combs, traditional, log hives, while 35% used modern technology with mainly Langstroth hives. 20% of modern beekeeping cited high yield, 17% gave easy to access and monitor the hive and 15% mentioned improved quality of products as reasons for choosing frame hives. For traditional hives, beekeepers cited affordability (29%), environment friendly (18%), easy to construct (15%) and low maintenance at 9%. The results revealed that honey production was high with traditional hives compared to Langstroth hives hence; beekeepers using traditional methods earned high incomes than those with modern technology. Further analysis using binary logistic regression indicated that gender of a household head, size of a household, size of land and access to extension services influenced the adoption of beekeeping technology. From the findings of this study, it was recommended that focused extension training be provided so that beekeepers can acquire necessary skills on bee management. Packages targeting women and youth need to be developed in an effort to encourage modern beekeeping by these groups.

Key words: performance, production, traditional log hive, Kitui County

Introduction

Beekeeping also known as apiculture, is the act, science and or business of managing honey bees for the purpose of producing honey, beeswax and other bee products for consumption and industrial use. In the old days, the production of honey was a major industry in the African economy and as observed by (Nightingale, 1976); honey was a vital factor in African culture and was used in many ways as an article of trade.

Beekeeping contributes to incomes as well as food security through provision of honey, beeswax and pollen as food and propolis, bees' venom and royal jelly in medicine in addition to pollination services. Beekeeping supports millions of households in Sub-Sahara Africa (Gidey and Mekonen, 2010). Beekeeping provides pollinators, which enhance crop yield.

The beekeeping industry contributes to the wider rural economy through trade (Paterson, 2006). Kigatiira, (1976) noted that the beekeeping industry in Kenya is worth millions of shillings and plays important role in the economy of arid areas. Beekeeping requires very little financial or labor input. It is a flexible and gender friendly enterprise which does not compete for resources such as land with other agricultural activities. Beekeeping is possible in arid areas and places where other crops have failed (Bradbear, 2002).

In Kitui county, honey is used as medicine (treat open wounds and burns), as food, it is a rich source of energy, highly valued as a non- perishable and easily stored source of food. Honey is also used in brewing of traditional honey beer (*kaluvu*) which is valued in marriages and initiation rituals and other traditional ceremonies.

Majority of beekeepers in Kenya still use traditional production systems which comprise mainly hollow log hives (Caroll, 2006). These hives constitute the largest number of hives in the country estimated at 1,273,000 with 73% of the hives concentrated in the eastern part of the country (Muya, 2004).

Modern beekeeping practice involves the use of improved technologies which are easy to manipulate and manage. The main types of hives used are the comb hives and the movable frame hives. Other accessories that go together with modern beekeeping include the catcher box, protective clothing, smoker, hive tool, bee brush and the honey extracting and refining equipment. Some management practices are also considered as part of the improved beekeeping technology which includes seasonal management, routine colony inspection, colony division, artificial feeding and pest control.

These are the most advanced hives in design and are used by commercial beekeepers in many parts of the world (Patterson, 2006). The frames can be removed, inspected and when full of honey, extracted and returned to the hive for the bees to continue filling with honey.

Materials and methods

Study sites

The study was conducted in Kitui County, Kenya. The County is located between longitudes $37^0$50' and 39^0 0' east and latitudes 0^0 10' and 3^0 0' south. The County borders Machakos and Makueni to the west, Embu and Tharaka- Nithi to the north, Tana River to the east and Taita- Taveta to the south. The County covers an area of approximately 20,402square kilometers including 6, 90.3Km2 occupied by uninhabited Tsavo National Park. The rural population is 1,012,709 which occupies 23020Km^2 of the County (KNBS, 2009 population census).

Topographically, the central part of the county is characterized by hilly ridges separated by wide, low lying areas and has slightly lower elevation of between 600m and 900m above sea level. To the eastern side of the county, the main relief feature is the Yatta plateau, which stretches from the north to the south between rivers Athi and Tana. The plateau is almost plain with wide shallow spaced valleys. The highest areas in the County are Kitui Central, Mutitu Hills and Yatta Plateau. Due to the high altitude these areas receive greater rainfall than other areas in the county and are also the productive areas. There are many seasonal rivers in the county. Only few rivers in the periphery of the county have perennial flows. The Tana River to the north separates Kitui from Embu and Tharaka- Nithi Counties and river Athi to the west and south- west separates the county from Machakos and Makueni Counties. River Tana has several tributaries draining the north portion of the county.

The County experiences two rainy seasons, with long rains in April and May and short rains in November to December. The dry periods are August to September and January to February. The amount of rainfall follows topographical features of the landscape. The hills such as Mumoni in Kitui Central and Mutitu in the western part of the county receive500-1050mm while the eastern and southern receive less than 500mm. in general, most of the county experience less than 750mm of rainfall in a year.

The maximum mean annual temperatures in the county vary between 14^0C and 18^0C in the eastern parts. The maximum mean annual temperature vary between 26^0C and 30^0C in western parts of the County and 30^0C and 34^0C in the eastern parts (GoK, Kitui District Development Plan, 1994- 1996).

Majority of the people in the county depend on agriculture and livestock related activities for their livelihood. The author established that 47% of the farmers keep goats, 16% keep sheep and about 65% keep bees using traditional log hives.

The population of this study consisted of all farmers with at least one bee colony and was managing it independently. Due to enormity of this population, a sample size of 120 respondents was selected using purposive and simple random sampling techniques from the four study sites of Kasaala, Mulundi, Waita and Kyuso.

Collection of data

Primary data were collected from the respondents through formal interviews by administering questionnaires and on-spot field observations. In addition, a focus group discussion was conducted with a group of respondents from the four Locations where they dealt with pertinent issues concerning the performance of frame hive beekeeping technology.

Secondary data were available from various sources including books, thesis, reports, journals, official reports from relevant government departments. The collected data were analyzed using percentages and frequency distribution while regression was used to analyze inferential statistics. The analysis was to assess the performance of frame hive beekeeping technology among beekeepers.

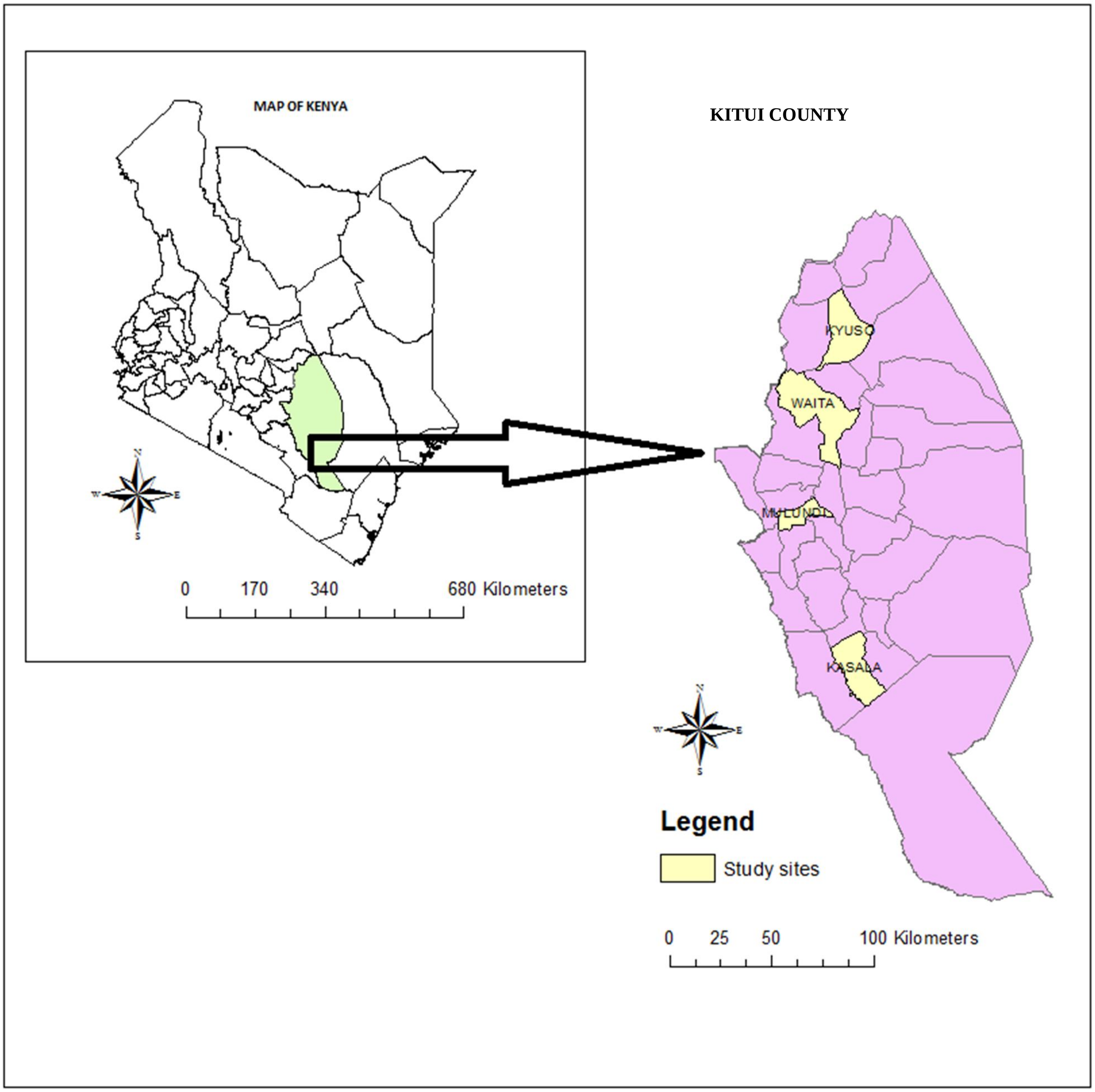

Figure 1: Map of Kenya showing Kitui County and the study sites; Kasaala, Mulundi, Waita and kyuso Locations in August 2012.

Results and Discussion

Data analysis

Descriptive and inferential statistics were used to analyze the data. These included frequencies and percentages, whilst in the inferential statistics included binary regression Chi- square to determine the adoption of beekeeping technology.

Table 1 represents descriptive statistics of factors that determine adoption of a beekeeping technology. The link between household socio-economic characteristics and beekeeping technology adoption was examined with respect to age, gender of a household head, level of education of household head farm size, access to extension services, access to credit and membership to self- help groups. 58% regarded beekeeping as a major economic activity. Seventy seven percent of beekeeper were in the age bracket of 18-55, 20% were above 56 years, while 3% were below 18years. According to the survey, 23% of the respondents had no formal education, 64% had attained primary education, while 8% and 5% had attained both secondary and tertiary levels of education respectively. Of those who had attained primary education, 53% were involved in beekeeping while 47% were not beekeepers. For those who had secondary education, 89% and 11% were beekeepers and non- beekeepers respectively, an indication that higher education level did not necessarily translate to higher adoption rate. The results showed that majority of respondents 41% owned 5 and 9 acres, 36% owned 1 and 4 acres with 23% owning 10 acres. This is an important factor when it came to the number of hives a farmer could keep as shown in tables 2 and 3.

Table 1: The number (n) and percentage distribution of Age (years), Education and Occupation of respondents per Location

	Kyuso	Kasaala	Waita	Mulundi	Total Frequency	Total Percent
Age(years)						
Below 18	3	0	0	0	3	3
18 – 35	12	3	5	6	26	22
36 – 45	5	10	16	7	38	32
46 – 55	2	6	7	13	28	23
56 and above	8	10	3	4	25	20
Education						
None	7	9	5	6	27	23
Primary	17	20	18	23	78	64
Secondary	5	0	3	1	9	8
Tertiary	1	0	5	0	6	5
Occupation						
Farming	9	29	22	30	90	75
Business/charcoal burner	7	0	3	0	10	8
Employment	7	0	0	0	7	6
Civil service	3	0	2	0	5	4
Others	4	0	4	0	8	7
Total	30	29	31	30	120	100

Table 2: Effect of land size (acres) and the number of beekeepers at various Locations

Land size (acres)	Kyuso	Kasaala	Waita	Mulundi	Total Frequency	Total Percent
1.0 – 4.0	5	5	4	11	25	36
5.0 - 9.0	8	15	4	1	28	41
10.0 and above	9	3	4	0	16	23
Total	22	23	12	12	69	100

Table 3: The total number of Traditional (T) and Langstroth (L) hives in various Locations

Land (acres)	Kyuso		Kasaala		Waita		Mulundi		Total
	T	L	T	L	T	L	T	L	
1- 4	4	1	5	0	1	3	2	10	26
5- 9	6	2	15	0	4	1	0	1	29
10 and above	4	1	3	0	4	2	0	0	13
Total	14	4	23	0	9	6	2	11	68

The survey revealed that a mere 4% of the beekeepers had received credit for beekeeping activities an indication that there was lack of credit hence a key constraint to adoption of modern beekeeping technology in the area, as shown in table 4. Concerning access to market, 53% sold their honey to middlemen with deliveries to local refinery accounting for 47% as is indicated in table 5. Only 14% of the beekeepers had received some training on bee management and of those trained 5% and 8% were in traditional and modern beekeeping respectively. The results as in table 6 suggested that acquisition of training influenced adoption of modern technology as observed by Zegaye et al., 2001who reported that training contributed positively to farmer's adoption decision.

Table 4: The number of beekeepers who had access to credit for beekeeping per study site

Hive technology	Kyuso	Kasaala	Waita	Mulundi	Total Frequency	Total Percent
Traditional	2	0	1	0	3	100
Langstroth	0	0	0	0	0	0
Total	2	0	1	0	3	100

Table 5: The number of beekeepers who had access to market in the four locations for traditional and Langstroth technologies

Market type	Kyuso		Kasaala		Waita		Mulundi		Total	Percent
	T	L	T	L	T	L	T	L		
Local consumer	9	1	2	0	6	2	1	1	22	46
Middle men	0	0	23	0	1	1	1	0	26	54
Total	9	1	25	0	7	3	2	1	48	100

T= Traditional,
L= Langstroth(Modern)

Table 6: Number of beekeepers who had received training on bee keeping per study site

Hive technology	Kyuso	Kasaala	Waita	Mulundi	Total	Percent
Traditional	2	0	1	1	4	57
Langstroth	1	0	1	1	3	43
Total	3	0	2	2	7	100

Further results obtained from the study showed that 65% and 35% of the beekeepers were using traditional and modern technologies respectively. For modern beekeeping, 48% and 4% used Langstroth and Kenya Top Bar Hives respectively. Those in traditional technology gave reasons for its adoption as follows; affordability and availability (29%), environmentally friendly (18%), easy to construct (15%) and low maintenance cost (9%) as illustrated in figure 2.

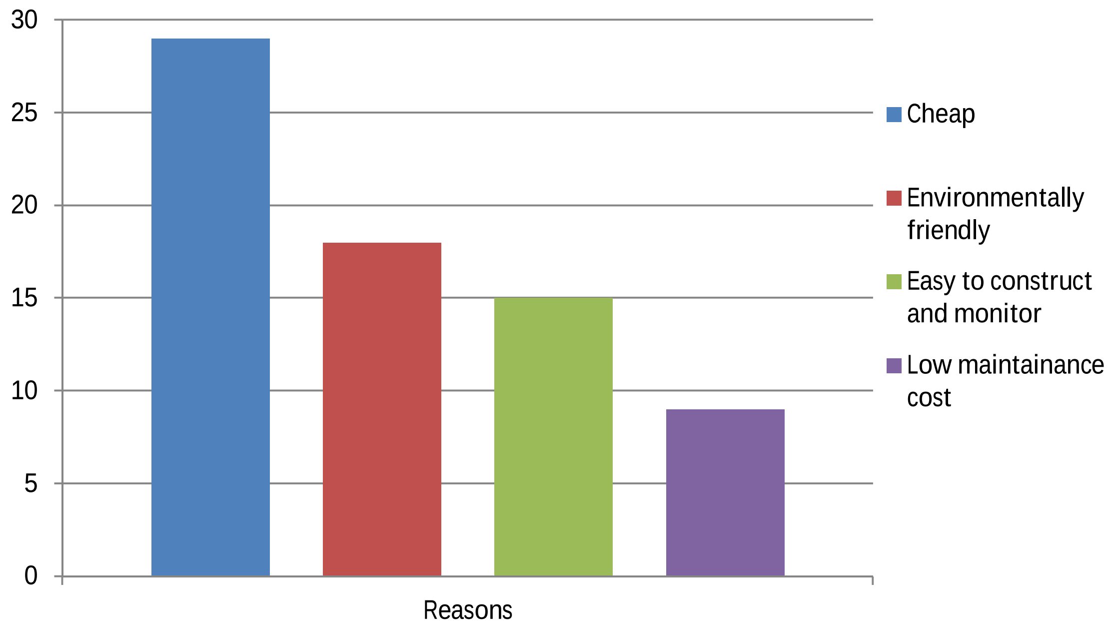

Figure 2: Households reasons for choosing traditional log hive

Of the 59% using modern technology, cited high yield (20%), more convenient to access (17%) and 15% quality of products as reasons for adoption of this method as illustrated in figure 3. Men owned more hives regardless of the technology used compared to women at 21 and 6 hives respectively. Most beekeepers had more log hive than Langstroth as shown in tables 7and 8.

Table 7: Number of households owning traditional bee hives per study site

Number of hives	Kyuso	Kasaala	Waita	Mulundi	Total Frequency	Total Percent
1 - 5	6	0	2	0	8	16
6 - 10	3	3	2	1	9	19
11 - 20	2	6	0	1	9	19
21 and above	3	14	5	0	22	46
Total	14	23	9	2	48	100

Table 8: Number of households owning Langstroth bee hives per study site

Number of hives	Kyuso	Kasaala	Waita	Mulundi	Total Frequency	Total Percent
1 - 5	2	0	3	10	15	70
6 - 10	0	0	1	1	2	10
11 - 20	2	0	0	0	2	10
21 and above	0	0	2	0	2	10
Total	4	0	6	11	21	100

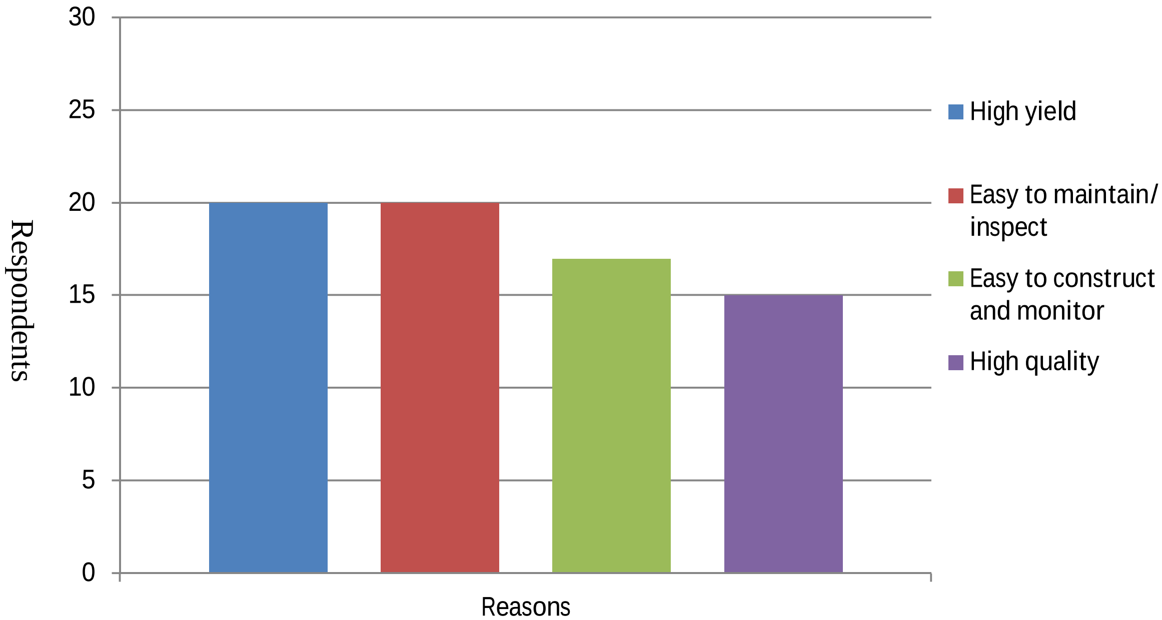

Figure 3: Households reporting reasons for choosing Langstroth hive.

The number of harvests ranged from zero to a maximum of three with 80% having harvested twice and only 8% harvested thrice mainly in traditional beekeeping. High occupation rate in traditional hives was cited as the reason for the number of harvests, while for modern technology lack of accessories contributed to low number of harvests. Twenty three percent of traditional beekeepers did not at all. Fifty eight percent, representing twenty eight traditional beekeepers harvested between (0-20 kg) and 42% got above 20kg. For the modern technology, majority 67% reported no honey harvests at all with only 33% reporting no harvests at all. The mean yield was 47Kgs with the highest beekeeper harvesting 200kg. The low yields reported may be attributed to the long drought that had ravaged the area consecutively in the last two years, leading to the migration of honey bee colonies. In traditional hives beekeepers who harvested between 21-100kg were twenty two while in Langstroth hives were only two. Regarding average incomes from sale of honey, results showed that the level of income was high with the beekeepers in traditional compared to Langstroth hives. In traditional beekeeping, the highest honey sale recorded was Kshs.186, 600, while for modern beekeeping; the highest honey sale recorded was Kshs.61, 000. The beekeepers who earned between Kshs.2, 500 - 10,000 in traditional hives were seventeen, while those in Langstroth hives were three only. This meant that use of Langstroth hives did not improve livelihood of beekeepers. Table 9 shows the number of farmers receiving variable honey yield (Kg) from the two technologies while table 10 shows number of farmers receiving variable incomes (Kshs) for traditional and Langstroth technologies per study site.

Table 9: The number of farmers receiving variable honey yield (Kgs) from the two technologies

Honey (Kgs)	Kyuso		Kasaala		Waita		Mulundi		Total
	T	L	T	L	T	L	T	L	
20 and below	5	3	3	0	5	0	2	1	19
21 - 50	4	1	8	0	0	1	0	0	14
51 - 100	3	0	6	0	1	0	0	0	10
101 - 150	2	0	3	0	1	0	0	0	6
151 - 300	0	0	3	0	1	1	0	0	5
Above 300	0	0	0	0	1	0	0	0	1
Total	14	4	23	0	9	2	2	1	55

T= Traditional,
L= Langstroth(Modern)

Table 10: The number of farmers receiving variable incomes (Kshs.)

Income (Kshs.)	Kyuso		Kasaala		Waita		Mulundi		Total
	T	L	T	L	T	L	T	L	
2,500 and below	4	0	11	0	0	0	2	1	18
2,501 – 5,000	2	1	4	0	1	0	0	0	8
5,001 – 10,000	2	2	8	0	0	0	0	0	12
10,001 – 20,000	1	0	0	0	1	1	0	0	3
Above 20,000	0	0	0	0	4	2	0	0	6
Total	9	3	23	0	6	3	2	1	47

T= Traditional,
L= Langstroth (Modern)

The results on binary regression analysis were used to test the influence of a number of variables on household beekeeping technology adoption or non-adoption. The Chi-square statistic was found to be significant at 5%, an indication that the model parameters were jointly significantly different from zero for the adoption of beekeeping technology. The results showed that age of household, and numbers of beehives were significant at 5% level as indicated in table 11. Age had a positive influence on adoption of beehive technology an indication that as farmers get old they are likely to adopt beekeeping technologies. The number of bee hives owned by a beekeeper, which had a positive influence, was hypothesized to be positively related to the adoption of bee technologies because it is a representation of wealth status (Freeman *et al.*, 1996). Well-endowed farmers have extra resources to invest in new ventures and to bear any risk that may occur. This observation was in line with the findings of Degu *et al.*, (2000) who carried out studies on the adoption of seed and fertilizer packages and the role of credit in smallholder maize production in Ethiopia.

Table 11: Maximum likelihood estimates for beekeeping technology adoption model for modern technology

Variable	B	SE	Wald	Exp(β)
Constant	-2.965	2.346	1.598*	0.052
Age of household head	0.649	0.287	5.111*	1.913
Gender of household head	0.077	0.796	0.009	1.080
Size of household	0.118	0.407	0.083	1.125
Size of land	-0.382	0.413	0.852	0.683
No. of bee hives	1.396	0.599	5.440*	0.247

Notes: *Significant at 5%, -2 Log likelihood=78,584, Model Chi-square= 18.435

Table12: Contingency table of values

Management Practices	None	Primary	Secondary/ Tertiary	Total
Routine colony inspection	7	33	6	46
Apiary management(clearing, shading)	23	54	8	85
Division making	2	9	4	15
Swarming control	6	24	4	34
Feeding	13	40	8	61
Pest control	18	40	8	66
Total	69	200	38	307

Degrees of freedom

DF = (r - 1) * (c - 1)

DF = (6 - 1) * (3 - 1)

DF = 10

Where

(r) Is the number of levels for one categorical variable, (c) is the number of levels for the other categorical variable.

Table 13: Contingency table of expected values

Management Practices	None	Primary	Secondary/Tertiary
Routine colony inspection	10.3388	29.9674	5.6938
Apiary management (clearing, shading)	19.1042	55.3746	10.5212
Division making	3.3713	9.7720	1.8567
Swarming control	7.6417	22.1498	4.2085
Feeding	13.7101	39.7394	7.5505
Pest control	14.8339	42.9967	8.1694

Formula for calculating Chi – square value,

Chi – square value as follows

$X^2 = \Sigma$ [(Or, c - Er, c) 2 / Er, c]

X^2 =7.3982

This is at DF 10

Tabulated X^2 value at 10 DF is 18.307

- The P-value is the probability that a chi-square statistic having 10 degrees of freedom is more extreme than 7.398

  We use the Chi-Square Distribution Calculator to find P (X2 > 7.389) = 0.31.
- Interpret results. Since the P-value (0.31) is greater than the significance level (0.05), we don't reject the null hypothesis. Thus, we conclude that education level and management practice undertaking are independent. Tables 12 and 13 showed contingency table of expected values.

Conclusion and Recommendations

The findings of the current study were that only a few beekeepers in Kitui County had invested in movable frame hives and even then they did not place much value on accessories. They were not in good conduct with extension agents who were supposed to train them in the use of such equipment and therefore followed traditional colony management, honey harvesting and processing methods after installation of frame hives. Technical support is essential for those who purchase this type of equipment to help them develop an appreciation of the added benefits of movable frame hive technology in comparison to traditional fixed comb hives and so that they can realize good returns on investment(Gichora et al, 2001).

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