CHAPTER THREE

Comparative Economic Analysis of Beekeeping Using Traditional and Improved Beehives in the Miombo Woodlands of Tabora and Katavi Regions, Tanzania

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Abstract: *The study was carried out in Tabora and Katavi regions in the miombo woodlands of Tanzania. The overall objective of the study was to undertake a comparative economic analysis of beekeeping using improved or traditional beehives. Data were collected from 198 beekeepers that were randomly selected from a sampling frame of 237 beekeepers using a structured questionnaire. Data were analyzed using descriptive statistics, Analysis of Variance (ANOVA) along with budgetary analysis and profitability ratios. The findings revealed that improved beehives were more productive than traditional beehives, although both beekeeping systems were profitable ventures. However, beekeepers who used traditional beehives realized higher net farm income than those who used improved beehives. Return on investment was estimated to be 3.7% per shilling for beekeepers using traditional beehives against 1.3, 0.3 and 0.8% for those using Tanzania Top Bar, Box and Langstroth (improved beehives), respectively. The lower gains associated with improved beehives that are more productive than traditional ones, are most likely to be a result of failures within the market system to value and reward quality. Earnings for adopters of these productivity enhancing beehives could increase if new mechanisms that allow fair pricing of high-quality honey extracted from such beehives are instituted in local markets. These endeavours could be pioneered by relevant institution including local government and non-governmental organizations in respective areas.*

Key words: beekeeping, beehives, budgetary analysis, profitability ratio analysis

INTRODUCTION

There has been a world-wide growing emphasis to accelerate the adoption of improved technologies in agriculture and related value chains owing to potential gains, especially with respect to resource use efficiency (Fan *et al.*, 2012; Godfray *et al.*, 2010; Pretty *et al.*, 2006). While there have been several sector-specific endeavours of this nature, many of such endeavours have been futile as the adoption rate has been disappointingly low (Langyintuo and Mekuria, 2005; Moser and Barrett, 2003). The literature identifies several factors underlying this low adoption rate including uncertainty among potential adopters with respect to potential gains vis-à-vis the cost of adoption (Pannell *et al.*, 2006; Koundouri *et al*., 2006); inability to afford the cost of adoption/use of a technology (Fisher and Kandiwa, 2014; Kurkalova and Zhao, 2006) and lack of/ inadequate knowledge on how to use it. Despite all these challenges, efforts to develop and upscale modern technologies for enhancing productivity as well as profit gains among small scale farmers are still in the wheel.

According to this presumption, the introduction of modern beekeeping technologies including the use of improved beehives has been considered as a hallmark of the sector to enhance resource use efficiency along with beekeepers' earnings and welfare in Tanzania (MNRT, 1998). Many of the small scale beekeepers in Tanzania (about 99%) rely on a beekeeping system that entails the use of traditional beehives such as logs, barks and guards and fires to protect beekeepers from bee sting. This practice is associated with low productivity, poor product quality and has been declared as environmentally unfriendly and a major threat to sustainability of bee colonies. Meanwhile, the demand for bees' products is expanding in both local and international markets (MMA, 2007; Hausser and Mpuya, 2004; MNRT, 1998). For instance, the driving force for the honey industry in Tanzania has been the existence of big companies which are involved in buying bee products. A good example is Fidahussein companies which buy honey for a conventional export market. Other exporters in the country include Mohamed Enterprises (T) Limited, Shamshudin Honey Care Africa (Tanzania) Limited and Dabaga Limited. In addition, there are Small and Medium Enterprises (SMEs) which supply local and sub region markets of honey.

Several studies have been undertaken by national and international development agencies to address the challenges in the bee keeping sector. For instance, TAWIRI (1997, 1998, 2002, 2004 and 2006), Mlingwa and Mwakatobe (2004) and Swai and Oduol (2003) conducted studies which addressed challenges related to value addition, design of bee beehives, economic value of bee products, marketing of bee products and beekeeping husbandry. Other studies were conducted to assess factors underlying women's and youth's participation in beekeeping and value chain activities (MMA, 2007; Mkamba, 2006; TAWIRI, 2004). All these studies had an overall objective of improving the sector's productivity as well as reducing poverty among beekeepers. Several interventions have been developed and implemented based on recommendations of these studies.

One of such interventions has been the introduction of modern beekeeping technologies including the use of improved beehives (transitional and commercial), protective gears and smokers. The improved production system has been proved to be more effective in conserving the environment and bee colonies. Thus, promotion efforts for the use of such technologies have centred more on apiculture as a means of conserving forestry and biodiversity. Despite the technical advantage of these technologies, studies have revealed that the adoption rate of such technologies by small scale beekeepers is still low (Nkojera, 2010). It is estimated that over 95% of the small scale beekeepers continue to use log beehives (Laila and Machangu, 2008) mainly because of the abundance of logs in Miombo woodlands that are perceived to be cheaper owing to the public nature of forests that are not

conserved. There are only few farmers who have been sensitized enough to adopt improved beehives following the national-wide promotion efforts by government, non-governmental organizations (NGOs) and donor-supported development projects. However, many of these farmers tend to maintain both traditional and improved beehives. It is unclear whether the perception about high investment cost is valid for all types of beehives that are likely to have different levels of productivity. Thus, there is a need to empirically test whether: i) there are differences in productivities of traditional and improved beehives and; ii) such differences translate into additional gains for beekeepers to outweigh investment costs. There is no empirical study which has examined these differences in Tanzania. The current study used household survey data from Tabora and Katavi regions to compare the economic performance of improved vis-à-vis traditional beehives and gains among small scale beekeepers.

METHODOLOGY

Study Area

This study was conducted in four districts, three in Tabora region (Urambo, Kaliua and Sikonge) and one district in Katavi region (Mlele) (Figure 1). All the four districts fall within the miombo ecosystem. The miombo ecosystem describes African woodlands that are dominated by tree species such as *Brachystegia spp, Julbernardia spp* and *Isoberlinia spp*. These woodlands cover approximately 2.7 million km^2, stretching across Angola, Democratic Republic of Congo, Malawi, Mozambique, Tanzania, Zambia and Zimbabwe. These woodlands are particularly suitable for beekeeping because they provide excellent bee forage along with several tree species that are good resources for making traditional bark and log beehives. In most areas, beekeepers are able to harvest twice a year, depending on the dominant tree species and their flowering patterns (Mickels-Kokwe, 2006). Tabora and Katavi regions form a potential habitant for bees in Tanzania. However, beekeeping is spreading quickly to other areas of Tanzania as people are convinced by its contribution to poverty reduction among rural communities.

Since 1999, government agencies, non-governmental organizations and development projects have intervened in the beekeeping industry in various ways to improve the production of bee products including the introduction of improved technologies. In Sikonge district, for example, improved beekeeping technologies were introduced and promoted by the District Council, Tabora regional office, Honey King Ltd and the Korea International Cooperation Agency (KOICA) (Sikonge District Council, 2012). In Urambo and Mpanda districts, improved beehives were introduced by the Tanzania Social Action Fund (TASAF) and the Association for Development of Protected Areas Project (ADAP) (Urambo District Council, 2012; Mpanda District Council, 2012). The majority of the rural population in these districts depend on agricultural production for their livelihood. Tobacco is the main cash crop for farmers in the area, although a significant number of farmers is also involved in beekeeping to generate extra income.

Sampling Techniques and Data Collection

For this study, four (4) districts were purposively selected from Tabora and Katavi regions, where beekeeping is one of the predominant economic activities among farmers. One hundred and ninety eight (198) beekeepers were randomly selected from the sampling frame of 237 beekeepers that were using improved beehives. Data were obtained from both primary and secondary sources. Primary data were collected using a structured questionnaire, focus group discussions and in-depth interviews were conducted with key informants, targeting village and ward leaders, extension officers (especially beekeeping officers) at the district level. Sources of secondary data included District

Council reports, journals, project reports and the Internet. Attempts were made to solicit all relevant information on socioeconomic variables of beekeepers including sex, experience in beekeeping, age, education status and household size. Other variables were number of beehives owned (both traditional and improved), size of improved beehives, production level and market prices of various inputs. Additional data on costs incurred in- and revenue realized from beekeeping were also collected during the survey.

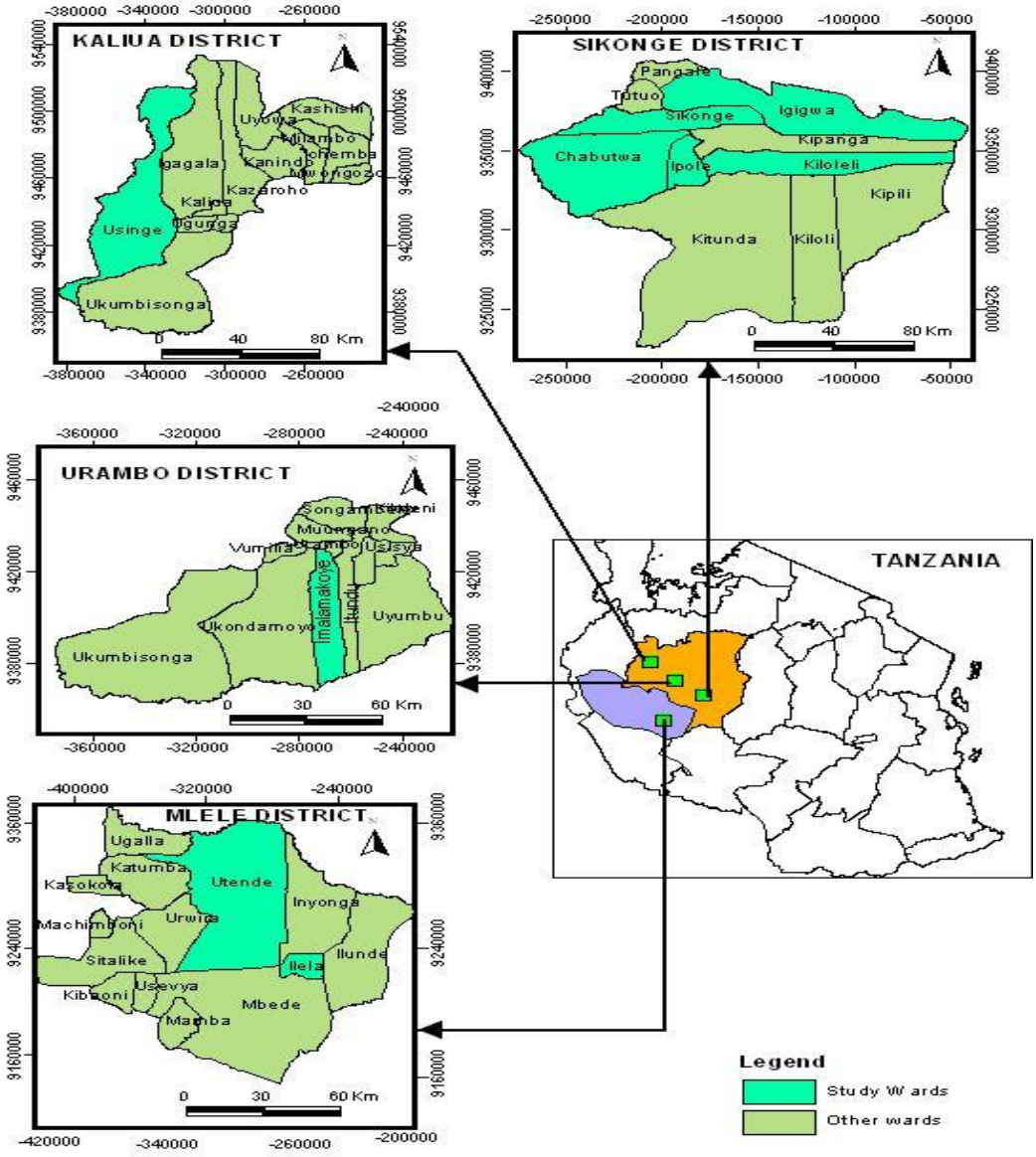

Figure 1: Map of the study area

Analytical Tools

The analytical tools employed in this study included descriptive statistics, analysis of variance (ANOVA), followed by budgetary analysis and profitability ratios. Descriptive statistics such as percentages and frequencies were used to analyze socio-economic variables of beekeepers while means were computed and compared across districts and technologies as preliminary analysis. This comparison was extended to ANOVA to allow multiple comparisons of such differences using Dunnett *t*-test. The thrust was to capture individual-specific differences for beekeepers using similar (within comparisons) and different (between comparisons) beehives. Budgetary technique, specifically the gross margin analysis, was used to estimate the cost and revenue associated with traditional and improved beekeeping systems. In the context of this study, improved beehives included transitional and commercial beehives. Transitional beehives comprised the Tanzania Top Bar and Box hives.

Comparing productivity of beehives

Dunnett's method was adopted to compare all the other beehives' means to the mean of a control group that was selected from the domain of beehives considered. To perform multiple comparisons for each of the possible pairs of beehives, the method requires the use of a special table to find hypothesis test of critical value (t_{cr}) for each pair of beehives being compared. This critical value is needed to calculate significant difference (d_s), which is mathematically given as shown in equation (1.0).

$$d_s = t_{cr} S_{\bar{d}} \quad \text{……………………………………………………………….….. (1.0)}$$

Where $S_{\bar{d}}$ is standard error of difference between means of productivity for a pair of beehives considered and is calculated as per details in equitation (2.0).

$$S_{\bar{d}} = \sqrt{\frac{2S^2}{n}} \quad \text{…………………………………………….....…………… (2.0)}$$

Note that S^2 represents mean square error from ANOVA.

Comparing gains from beehives

In computing the cost and return, the budgetary analysis method was used. The model was specified as shown in equation (3.0).

$$NFI = TR - TVC - TFC \quad \text{……………………………………………….………… (3.0)}$$

Where NFI net farm income (TZS) is, TR is total revenue from bee products (TZS), TVC is total variable cost and TFC is a total fixed cost. Equation (3.0) can be expanded to describe how each of the right-hand side variables is calculated (equation (4.0)).

$$NFI = \sum_{j=1}^{m} P_{ij} Q_{ij} - \sum_{g=1}^{n} p_{ig} X_{ig} - \sum_{k=1}^{r} p_{ik} q_{ik} \quad \text{……………………………………..……. (4.0)}$$

Where; Q_{ij} is quantity of j^{th} output ($j = 1,2,..,m$), P_{ij} is unit price of j^{th} outputs in relation to i^{th} respondent, X_{ig} is quantity of i^{th} variable input ($i = 1,2,3,...,n$), P_{ig} is unit price of i^{th} variable input in relation to i^{th} respondent, p_{ik} is unit price of k^{th} fixed input in relation to i^{th} respondent, q_{ik} is quantity of k^{th} fixed input for $k = 1,2$ and $\sum$ is summation sign.

To determine the economic performance of beekeeping using improved or traditional beehives, the profitability index for returns on sales (*PI*) for each bee keeper/enterprise was computed using the formula shown in equation (5.0):

$$PI = \frac{NI}{TR} \quad \text{..... (5.0)}$$

Other ratios that were computed are rate of return on investment (RR_I), rate of return on total variable cost (RR_{TVC}), rate of return on total fixed cost (RR_{TFC}) and operating ratio (*OR*) that are presented in equations (6.0), (7.0), (8.0) and (9.0), respectively.

$$RR_I = \frac{NI}{TC} * 100 \quad \text{..... (6.0)}$$

$$RR_{TVC} = \frac{TR - TFC}{TVC} * 100 \quad \text{..... (7.0)}$$

$$RR_{TFC} = \frac{TR - TVC}{TFC} * 100 \quad \text{... (8.0)}$$

$$OR = \frac{TVC}{TR} \quad \text{..... (9.0)}$$

RESULTS AND DISCUSSION

Respondents' Socio-Economic Characteristics

The socio-economic characteristics of the respondents consisted of age, sex, beekeeping experience, education level, major occupation, number of colonies as well as the number of improved and traditional beehives owned (Tables 1 and 2). The findings in Table 1 show that the majority (58.1%) of the beekeepers were within the age group of 35 - 64 years; followed by 21.2% of the beekeepers who were in the age group of 15 – 34 years. In the context of Tanzania, age groups between 35 – 64 years and 15 – 34 years are referred to as the working age group of the population, representing older and younger members, respectively. The rest of the beekeepers are in the dependant category (above 64 years) who accounted for 20.7% of the population. These findings imply that most of the beekeepers were in the productive age group.

This finding conforms to that of Mbah (2012) who found that many (93.3%) beekeepers in Nigeria were within the productive age ranging from 20 to 50 years. Similar findings were also reported by Abdullahi *et al.* (2014) and Onwumere *et al.* (2012) who found a large proportion of beekeepers in Nigeria being within the productive working age category. This might be due to the fact that the age of a farmer determines the type of agricultural activities undertaken. In Nigeria, for instance, younger

farmers spend more time on farm and tend to engage in labour intensive activities than older farmers (Tijani *et al.*, 2010). Furthermore, the finding suggests that beekeeping is a viable enterprise which can also be used as a source of income for the elders hence reducing their dependence.

Out of 198 respondents who were interviewed, only 9 were females, representing only 4.5% of the sample while the remaining 189 (95.5%) were males. This is due to the fact that beekeeping is mostly done in forest reserves which are far from the homesteads; females find it difficult to travel long distances; hence only few women venture in this activity. Also females were less involved in beekeeping probably because the activity involves tree climbing when hanging beehives and harvesting honey, which, according to African culture, is not suitable for females. Similar findings are reported by Abdullahi *et al.* (2014) who found the dominance of men in beekeeping enterprise in Kaduna state, Nigeria. However, they noted indirect involvement of women in field operations for honey production whereby women had to hire men to hang beehives and harvest honey. The findings of this study indicate further that 72.7% of the respondents had primary education, while 12.1% had no formal education. The proportion of beekeepers that had secondary and tertiary, college or university education levels was 7.6% for each category.

Table 1: Socio-economic characteristics of the respondents

Variable Name	***Frequency***	***Percent***
Experiences in beekeeping (years)		
0 – 5 years	78	39.4
Above 5 years	120	60.6
Total	198	100.0
Age groups		
15 – 34 [Youth]	42	21.2
35 – 64 [Elder]	115	58.1
Above 64 years [Dependants]	41	20.7
Total	198	100.0
Gender of the household head		
Male	189	95.5
Female	9	4.5
Total	198	100.0
Education levels		
Non formal education	24	12.1
Primary education	144	72.7
Secondary education	15	7.6
Tertiary/college/or university	15	7.6
Total	198	100.0
Main Occupation		
Beekeeping	42	21.2
Farming (crop production)	141	71.2
Petty trade	6	3

Variable Name	***Frequency***	***Percent***
Government employment	9	4.5
Total	198	100.0

The findings also revealed that 60.6% of the respondents had more than 5 years of experience in beekeeping, while 39.4% had less than 5 years of experience in beekeeping (Table 1). This implies that most of the beekeepers in the study areas had adequate beekeeping knowledge.

Ownership of Assets and use of Improved Beekeeping Practices among Beekeepers

About a half (48.5%) of the beekeepers owned 10 – 50 bee colonies. Those who owned 0 – 9 and 51 – 150 bee colonies were 22.7% and 25.8%, respectively. The findings also revealed that only 3% of the beekeepers owned more than 150 bee colonies (Table 2). A large proportion of beekeepers who owned both improved and traditional beehives were found in the group category of 10 – 50 beehives. Data revealed that 46.5% and 34.3% of the respondents owned improved and traditional beehives, respectively (Table 2). This reveals the small scale nature of the majority of the beekeepers in the study area.

Only 5.04% of 198 respondents had press for extraction of honey, and only 23% of these respondents had protective gears. These gears included smokers, overall and gloves. Further analysis was conducted to assess the use of improved beekeeping practices among beekeepers. The findings revealed that 37.9% used honey press for extracting honey whereas the rest (62.1%) used their own traditional methods such as dripping and squeezing honey using hands. It was also noted that despite the low rate of ownership of protective gears, 84.8% of the respondents used protective gears that were borrowed from fellow beekeepers. The remaining (15.2%) used other means including using smoke, fire or wire mesh to cover their heads during harvesting of honey.

Table 2: Number of colonies, improved and traditional beehives owned by respondents

Variable Name	***Frequency***	***Percent***
Number of bee colonies		
0 - 9	45	22.7
10 - 50	96	48.5
51 - 150	51	25.8
Above 150	6	3
Total	198	100
Number of improved bee hives		
0 – 9	73	36.9
10 - 50	92	46.5
51 - 150	27	13.6
151 - 300	3	1.5
Above 300	3	1.5
Total	198	100.0
Number of traditional bee hives		
0 – 9	48	24.2
10 - 50	68	34.3
51 - 150	55	27.8

Variable Name	*Frequency*	*Percent*
Number of bee colonies		
0 - 9	45	22.7
10 - 50	96	48.5
51 - 150	51	25.8
Above 150	6	3
Total	198	100
Number of improved bee hives		
0 – 9	73	36.9
10 - 50	92	46.5
51 - 150	27	13.6
151 - 300	3	1.5
Above 300	3	1.5
151 - 300	15	7.6
Above 300	12	6.1
Total	198	100.0

Comparative Analysis of Beekeeping using Improved or Traditional Beehives

Data show that 90.91% of the respondents were using transitional beehives and only 9.09% were using commercial beehives. Transitional beehives comprised the Tanzanian Top Bar beehives (56.1%) and box beehives (40.9%). In the study area most beekeepers used log traditional beehives while 56% of the respondents owned Top Bar beehives and 40.9% owned Box beehives. It was noted that almost all the respondents used log traditional beehives. Log and bark beehives are considered to be more convenient owing to the availability of trees.

Productivity of improved and traditional beehives

Productivity estimates of improved and traditional beehives are given in Table 3. The results show that productivity is generally higher for improved than for traditional hives; being highest for Box followed by Tanzania Top Bar and Langstroth beehives.

Table 3: Annual productivity of improved and traditional beehives

Annual productivity of hive (litres of honey/hive)	***Mean***	***N***	***Std. Deviation***	***Std. Error Mean***
Boxes beehives	13.24	81	5.63480	.62609
Tanzania Top Bar beehives	11.98	111	5.59000	.53058
Langstroth beehives	10.37	6	5.75036	2.34758
Log beehives (traditional)	7.90	120	4.01021	0.36608

A *Post hoc test* was performed in SPSS programme to compare all groups of beehive types with each other. The findings in Table 4 revealed significant differences between log traditional hives and Tanzania Top Bar as well as Box beehives ($p < 0.01$). The findings also revealed a non-significant difference between log traditional and Langstroth beehives ($p > 0.1$).

Table 4: Multiple comparison of annual honey productivity improved beehive types

Dependent Variable: Productivity (litres/hive)							
			Mean			95% Confidence Interval	
Test	(I) Beehive	(J) Beehive	Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Games-Howell	Box	Tanzania Top Bar	1.25936	.89485	.496	-1.0618	3.5805
		Langstroth	2.88004	2.44397	.661	-5.6476	11.4077
		Traditional	5.36474*	.76811	.000	3.3652	7.3643
	Tanzania Top Bar	Box	-1.25936	.89485	.496	-3.5805	1.0618
		Langstroth	1.62068	2.42206	.905	-6.9312	10.1726
		Traditional	4.10538*	.69525	.000	2.3031	5.9077
	Langstroth	Box	-2.88004	2.44397	.661	-11.4077	5.6476
		Tanzania Top Bar	-1.62068	2.42206	.905	-10.1726	6.9312
		Traditional	2.48470	2.37815	.733	-6.1307	11.1001
	Traditional	Box	-5.36474*	.76811	.000	-7.3643	-3.3652
		Tanzania Top Bar	-4.10538*	.69525	.000	-5.9077	-2.3031
		Langstroth	-2.48470	2.37815	.733	-11.1001	6.1307
Dunnett *t* (2-sided)[a]	Box	Traditional	5.36474*	.78217	.000	3.4969	7.2326
	Tanzania Top Bar	Traditional	4.10538*	.71629	.000	2.3949	5.8159
	Langstroth	Traditional	2.48470	2.27538	.599	-2.9489	7.9183

*. The mean difference is significant at the 0.05 level.
a. Dunnett t-tests treat one group as a control, and compare all other groups against it.

However, though productivity of improved beehives was higher than that of traditional beehives, its productivity was below its potential of approximately 20 litres of honey per beehive per annual (Mpanda District Council Annual report, 2012). Also this productivity was below the global recommendation, which is about an average of 40 litres of honey annually per beehive for commercial beekeepers using modern technologies (Muhammad and Abdulrahman, 2004). The observed differences in terms of annual productivity motivated the analysis of cost and benefit.

Cost and benefit

Analysis of cost and benefit associated with each of the two beekeeping systems revealed that beekeeping using improved and traditional beehives is a profitable business (Table 5). Beekeepers using improved beehives realized an average gross farm income ranging from TZS 286,708.10 to 656,599.60; with a total cost ranging from TZS 155,550.30 to 326,572.00 per annum. Thus, net annual farm income of TZS 376,733.50, TZS 131,157.80 and TZS 88,423.70 was realized from using Tanzania Top Bar, Langstroth and Box beehives; respectively. The findings reveal benefit-cost-ratios of 2.3, 1.3 and 1.8 for Tanzania Top Bar, Box and Langstroth beehives, respectively. These findings imply that, for every Tanzanian shilling invested in beekeeping using Tanzania Top

Bar, Box and Langstroth beehives in the study area, the profit realized is about TZS 1.3, 0.3 and 0.8; respectively. Meanwhile, the findings reveal that beekeepers using traditional beehives, on average, realized a gross farm income of TZS 1,138,151.60 while incurring a total cost of TZS 242,444.90 per annum. Thus, the net annual farm income was about TZS 895,706.80 with a benefit-cost ratio of 4.7. Therefore, for every one Tanzanian shilling invested in beekeeping using traditional beehives there is a profit of TZS 3.7. When compared, the net benefit from traditional beehives outweighed those from improved beehives as the investment in traditional beehives yields more profit than similar investment in improved beehives. These findings are in line with Attri *et al*. (2010) who found that traditional beekeeping with *Apis Cerana* was more profitable than modern beekeeping with *Apis Mellifera*. However, other studies conducted in Cameroon never revealed any significant differences in terms of total income, net profit or annual profit (Matsop *et al.* 2011 in Cristina and Anca, 2012).

Table 5: Comparative economic performance of beekeeping using traditional and improved beehives in Tabora and Katavi regions

Variables	Types of beehives used			
	Traditional	Improved		
	Log	Box	Tanzania Top Bar	Langstroth
Annual Average Gross Farm Income (GFI)	1,138,151.6	414,995.7	656,599.6	286,708.1
Total Cost (TC)	242,444.9	326,572.0	279,866.1	155,550.3
Net Annual Farm Income (NFI)	895,706.8	88,423.7	376,733.5	131,157.8
Benefit-Cost Ratio (B/C Ratio)	4.7	1.3	2.3	1.8
Return on Investment/TZS	3.7	0.3	1.3	0.8
Profitability Index (PI)	0.8	0.2	0.6	0.5
Rate of Return on Variable Costs (%)	469.5	127.4	236.6	186.6
Rate of Return on Investment (RRI) (%)	369.5	27.1	134.6	84.3
Operating Ratio (OR)	21.3	77.7	42.0	52.8

Source: Household survey data, 2013

However, contrasting findings were reported by Abdullahi *et al.* (2014) and Onwumere *et al.* (2012) in Nigeria where modern beekeeping generated more income than traditional beekeeping despite the high production costs of the former. The difference in profit level between beekeepers using either traditional or improved beehives can also be explained by the fact that buyers in the study area do not differentiate products from improved and traditional systems, although handling practices and possibly quality differ. It is important to note that respondents felt that honey from improved beehives had better quality than honey from traditional beehives but buyers of honey were not willing to offer a premium for the better quality honey. This discouraged beekeepers from using improved beehives that were perceived to be more capital intensive than the traditional ones.

Profitability ratio analysis

The findings in Table 5 reveal that the profitability indices (PIs) associated with the use of Tanzania Top Bar, Box, Langstroth and log hives were 0.6, 0.2, 0.5 and 0.8, respectively. The indices indicate that every one Tanzanian shilling (TZS) invested on Tanzania Top Bar, Box, Langstroth beehives yields TZS 0.6, 0.2 and 0.5 respectively as net income for beekeepers. The corresponding net return

from traditional beehives is TZS 0.8 per Tanzanian shilling. The operating ratio ranged from 42.0% to 77.7% for beekeeping enterprises using improved beehives while it was estimated to be 21.3% for those using traditional beehives. This implies that a range of 42.0% to 77.7% of the sales revenue would be used to cover operating expenses of beekeeping enterprise using improved beehives compared to only 21.3% of the traditional beehives. Note that a low operating ratio means high net profit ratio. Since the operating ratio for traditional beehives is less than that of improved beehives, then traditional beehives were more profitable than improved ones. Furthermore, the rate of return on variable costs was estimated to be 236.6% for Tanzania Top Bar, 127.4% for Box and 186.6% for Langstroth beehives against 469.5% for traditional beehives (Table 6). This signifies that for every shilling incurred on inputs generates more return when traditional bee hives are used instead of improved beehives.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Many beekeepers in the study area are male with primary education. Many of them are still using traditional technologies, especially log beehives as well as local methods to extract honey as there is little incentive to upgrade their production practices. Improved beehives are more productive than traditional beehives. Beekeeping has proven to be a profitable venture in the study area as all farmers are able to break-even. However, profitability for beekeepers using traditional beehives outweighs the profitability for those using improved beehives.

Recommendations

The adoption of beekeeping facilities among beekeepers such as honey press, protective gears and smokers could be accelerated if beekeepers had access to means that allow honey from improved beehives to be fairly valued and priced in the market. Where feasible, small holder beekeepers could be organized and supported to undertake collective action to participate and compete fairly in the market place. Other means to make their products unique and/ more appealing to buyers are worth pursuing. These means could be pioneered by relevant institutions including Local Government Authorities (LGAs) and NGOs in respective areas.

References

Abdullahi, A.,Isekenegbe,J. and Mohammed, U.S. (2014). Comparative economic analysis of modern and traditional bee-keeping in Lere and Zaria local government areas of Kaduna State, Nigeria

Attri, P.K., Verma, S. and Meenakshi, T. (2010). Mountain Hills Beekeeping and Its Economic Efficiency of District Chamba (Himachal Pradesh). ASIAN J. EXP. BIOL. SCI. 1 (1): 96-100

Cristina, B.P. and Anca, A.P. (2012). Types of Beekeeping Practiced in the North West Region of Romania: Advantages and Disadvantages. Bulletin UASVM Horticulture 69 (2):111-666

Fan, M., Shen, J., Yuan, L., Jiang, R., Chen, X., Davies, W. J. and Zhang, F. (2012). Improving crop productivity and resource use efficiency to ensure food security and environmental quality in China. Journal of Experimental Botany 63 (1): 13-24.

Fisher, M. and Kandiwa, V. (2014). Can agricultural input subsidies reduce the gender gap in modern maize adoption? Evidence from Malawi. Food Policy, 45, 101-111.

Godfray, H. C. J., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F. and Toulmin, C. (2010). Food security: the challenge of feeding 9 billion people. Science, 327(5967): 812-818.

Hausser, Y. and Mpuya, P. (2004). Beekeeping in Tanzania: when the bees get out of the woods… An innovative cross sectoral approach to community based natural resource management. Game and Wildlife Science, 21(3): 291-312.

Koundouri, P., Nauges, C. and Tzouvelekas, V. (2006). Technology adoption under production uncertainty: theory and application to irrigation technology. American Journal of Agricultural Economics, 88(3): 657-670.

Kurkalova, L., Kling, C. and Zhao, J. (2006). Green subsidies in agriculture: Estimating the adoption costs of conservation tillage from observed behavior. Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie, 54(2): 247-267.

Lalika, M. C. S.and Machangu, J. S. (2008). Beekeeping for income generation and coastal forest conservation in Tanzania. Bee for development journal No. 88.

Langyintuo, A. S. and Mekuria, M. (2005). Accounting for neighborhood influence in estimating factors determining the adoption of improved agricultural technologies. In A paper at American Agricultural Economics Association annual meeting, providence, Rode Island (pp. 1-28).

Mbah, S. O. (2012). Profitability of Honey production enterprise in Umuahia Agricultural Zone of Abia Satae, Nigeria. International Journal of agriculture and rural development, 15(3): 1268-1274.

Mickels-kokwe, G. (2006). Small scale woodland-based enterprises without standing economic potential: The case of honey in Zambia. Indonesia: Centre for International Forestry Research (CIFOR) 94pp

Mkamba, G.A. (2006). Analysis of Factors Affecting Marketing of Honey in Tabora and Dar es Salaam Regions

Mlingwa, C. and Mwakatobe, A. (2004). Bee Products Marketing in Tanzania

MMA (2007). Honey and Beeswax Value Chain Analysis in Tanzania

MNRT (1998). National Beekeeping policy. Ministry of Natural Resources and Tourism. Dar-es-Salaam

Mohammed, R.J.S. and Abdurrahman, Y.H.E. (2004). A comparative Analysis of Bee keeping and crop production in Nigeria. Available at: www.apiservice.com/apimandia/2revisedbeekeepingcrops2006.doc. (visted on 10th July, 2014).

Moser, C. M. and Barrett, C. B. (2003). The disappointing adoption dynamics of a yield-increasing, low external-input technology: the case of SRI in Madagascar. Agricultural Systems, 76(3): 1085-1100.

Mpanda District Council (2012). District Crops and Livestock production status Annual Report. Mpanda District council, Mpanda, Katavi. 89pp

Nkonjera, J.M. (2010). Adoption of Improved Beekeeping technologies and contribution to the income of local community in Mpanda district, Tanzania. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 72pp.

Onwumere, J., Onwukwe, F. and Alamba, C.S. (2012). Comparative Analyses of Modern and Traditional Bee Keeping Entrepreneurships in Abia State, Nigeria. Journal of Economics and Sustainable Development, 3 (13): 333-678

Pannell, D. J., Marshall, G. R., Barr, N., Curtis, A., Vanclay, F. and Wilkinson, R. (2006). Understanding and promoting adoption of conservation practices by rural landholders. Animal Production Science, 46(11): 1407-1424.

Pretty, J. N., Noble, A. D., Bossio, D., Dixon, J., Hine, R. E., Penning de Vries, F. W. and Morison, J. I. (2006). Resource-conserving agriculture increases yields in developing countries. Environmental science and technology, 40(4): 1114-1119.

Sikonge District Council (2012). District Crops and Livestock production status Annual Report. Sikonge District council, Sikonge, Tabora. 127pp

Swai, R.E. and Oduol, P.A. (2003). Apiculture and Agroforestry in the Miombos Western Tanzania: An Overview of the Bee Industry in Tanzania

TAWIRI (1997). Appropriate Design of Top Bar Hives

TAWIRI (1998). Surveys of Local and Economic Value of Bee Products in Same Tanzanian tribes

TAWIRI (2002). Market Awareness on bee Products

TAWIRI (2004). Participation of Women and Youth in Beekeeping activities in Manyoni district, Singida, Tanzania

TAWIRI (2006). Different Types of Bee Colonies in Seven Zones of Tanzania

Tijani, B.A., Iheanacho, A.C. and Shehu, H. (2010). Analysis of Scio-economic Factors Influencing the Intensity of Use of Integrated Weed Control Method for Selected Crops in Marte Local Government Area of Borno State, Nigeria. Journal of Sustainable Agriculture and the Environment 12(1): 1-11

Urambo District Council (2012). District Crops and Livestock production status Annual Report. Urambo District council, Urambo, Tabora. 156pp