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BEEKEEPING AROUND UDZUNGWA MOUNTAINS NATIONAL PARK IN KILOMBERO DISTRICT, TANZANIA.

Katani[1], J.Z. and Ndelolia[2], D.

[1]Department of Forest Resources Assessment and Management,
Sokoine University of Agriculture – SUA,
P.O. Box 3013, Morogoro, Tanzania.

[2]Mkomazi National Park, TANAPA,
P.O. Box 41 Same, Kilimanjaro, Tanzania.

ABSTRACT

The study assessed the practices, productivity and contribution of beekeeping to household income of communities adjacent to UMNP in Kilombero District. Data were collected through administration of questionnaires to households practicing beekeeping and interview of key informants. Means and percentages were calculated for practices, productivity and income. The study revealed that more than 30% of respondents undertake beekeeping in order to earn income. Traditional beehives were mostly used by respondents in Ifakara (46%) and Kidatu (62%) divisions while many (67%) respondents in Mang'ula division used both modern and traditional beehives. Lack of equipment and extension services were mentioned as the main challenges to beekeeping. Many respondents in Ifakara and Mang'ula divisions admitted that modern beehives have double productivity of bee products compared to traditional beehives. Contribution of beekeeping to household income is generally low in all divisions of Ifakara (4%), Mang'ula (13%) and Kidatu (8%) as compared to farming, petty trade and formal employment. It was concluded that the contribution of beekeeping to household income is low in the study area. Increased productivity could increase the contribution to household income. This could be through ensuring availability of extension services, modern beehives and equipment for harvesting and packaging materials.

Keywords: Beekeeping, local community, practices, productivity, household income, Udzungwa Mountains

INTRODUCTION

Background information

Beekeeping has a long history across the African continent. Ethiopia presumably has the longest history in beekeeping and marketing (Tadesse and Phillips 2007). The long history of beekeeping in Africa is due to its role in providing products which are useful to mankind. Honey is the most known beekeeping product which is used as food, medicine, raw material for making local brew (Tedesse and Phillips 2007), and for several other traditional uses such as in festivities and ceremonies during births and marriages (traditional symbolic e.g. for good luck and love) and paying bride price in various tribes such as the Wamaasai (Bradbear, 2004; Bradbear, 2009; Hilmi *et al*. 2012). In Ethiopia, beekeeping has so far been regarded as a way of earning income for resource poor farmers in rural areas (Girma *et al.* 2008). In most of Africa countries, about 90% of the communities undertake beekeeping using traditional methods (Adjare 1990). The method is characterized by use of poor equipment and poor methods of harvesting, processing and packaging of products.

Tanzania is amongst the world's top 20 honey producing countries (Châtel 2017). In Tanzania, beekeeping was practiced in a

form of honey hunting until when Germans introduced the idea of keeping bee colonies by using beehives in 19th century (Hausser and Mpuya 2004). Traditional beehives dominate the beekeeping sector in Tanzania. The most common traditional hives (also called fixed comb hives) are log and bark hives. Beekeeping in Tanzania is mostly conducted in miombo woodlands, the major areas of honey production being Tabora, Dodoma, Singida, Iringa, Rukwa and Katavi regions (Ntalwila 2017). In the 1990s, beekeeping gained attention from the government and other stakeholders which led to adoption of Beekeeping Policy of 1998 and establishment of formal Beekeeping Section within the Forestry and Beekeeping Division (FBD) of the Ministry of Natural Resources and Tourism (MNRT). This was followed by development of National Beekeeping Programme of 2001 (MNRT, 2001) and enactment of Beekeeping Act of 2002 (URT, 2002) as instruments for implementing the National Beekeeping Policy. The main emphasis in the policy and these tools include stakeholders' participation in the planning, management, ownership and sustainable utilization of bee resources for poverty eradication, improved biodiversity development and environmental conservation, improvement of the quality and quantity of bee products and improvement of revenue collection.

Bees and trees are integral and interdependent components of forest ecosystems. Trees and other plants in the forest ecosystems provide habitat and food for bees. On the other hand, bees are important animal pollinators of plants as they accounts for half of all animal pollinators, leading to plant reproduction and maintenance of forest and plant biodiversity (Hilmi *et al*. 2012). Apart from pollinating plants, bees produce honey and wax which are valuable products used by human for domestic uses and sold to earn income. Income earned by local communities adjacent to protected areas is an incentive to conservation, which also contributes to thriving of forests (Bradbear 2009). If planned and implemented properly, beekeeping is expected to contribute to sustainable existence of forest ecosystems and ensure protection of biodiversity in protected areas of developing countries.

Although local communities living adjacent to protected areas are endowed with resources which can provide their day to day needs, their over dependence on natural resources with limited alternative source of income normally is the main cause of environmental degradation which further exacerbates poverty among the community in question and hence creating vicious circle of poverty.

Udzungwa Mountains National Park (UMNP) as part of Eastern Arc Mountains is a habitat of many endemic species of flora and fauna. The park is also a source of water for agriculture, edomestic use as well as hydro electricity generation which is important for the local communities' livelihood and the national economy. Land scarcity and high human population density around UMNP increases pressure to the forest and contribute to unsustainable and illegal practices such as timber harvesting and poaching of wild animals due to poverty and lack of alternative sources of income to local communities (EAMCEF, 2013). The collection of these resources has been the sources of wildfires which further put at risk the future of these resources within the park. Unsustainable use of resources jeopardises both the long –term livelihood of people living adjacent to park and its biodiversity.

Local communities adjacent to UMNP have no direct access to the forest resources in the park due to its protection legal status (URT, 2012; URT, 2009) which make them to concentrate much on agricultural crop production as their main economic activity. Beekeeping is one of major potential alternative sources of income to rural communities living adjacent to protected areas such as UMNP. Well established beekeeping in Tanzania is considered to be

both environmentally friendly and can contribute greater income to household than crop production such as tobacco and extractive activities such as charcoal production (Hausser and Mpuya 2004).

Many studies on contribution of beekeeping to household income have been conducted in the major areas of honey production in Tanzania including Tabora, Dodoma, Singida, Iringa, Rukwa and Katavi regions and mostly in miombo woodlands (Mwakatobe and Machumu, 2011; Ntalwila, *et al*., 2017; Omari, 2010; Lunyamadzo, 2016; Mwakatobe *et al*., 2016). However, few studies have been conducted to local communities' adjacent to montane forests (Mmasa, 2007) including UMNP. Vegetation types with different kinds of forage flowering at different times of the year and climate condition that ensure adequate water availability are among the key factors determining the quality and quantity of bees products such as honey and wax (Girma *et al*. 2008). Consequently this can have implications on the incomes of households adjacent to different types of forests.

For that matter this paper assessed the practices, productivity and contribution of beekeeping to income of households adjacent to UMNP so that to provide baseline information that can be used by different actors to improve the productivity in the study area while at the same time promote the best practices and upscale them.

Objectives

The main objective of the research was to assess the practices, productivity and contribution of beekeeping to household income of communities living adjacent to UMNP in Kilombero District.

Specifically, the study intended to:

i. Assess the practices of beekeeping by local communities around UMNP and their challenges in Kilombero district
ii. Assess the perception of local communities on productivity difference between traditional and modern beehives
iii. Assess benefits of beekeeping to local communities around UMNP and its contribution to household income.

METHODOLOGY

Location of study area

The study was conducted in seven villages which are adjacent to Udzungwa Mountains National Park (UMNP) in Kilombero District. The UMNP spans for an altitude from 200m to 2,576m above sea level. There are numerous rivers and streams which flow out of the park throughout the year. The area receives bimodal rains; short rains fall between October and December and long rains between March and May. The mean annual rainfall in the southeast of the park is around 2000mm per year while the northwest part receives only 600mm of rainfall per year. The major socio-economic activities in the study villages include agriculture which is mainly monoculture based on paddy and sugar cane. Other activities include artisan fishing and petty trading.

Research design and sampling procedure

The study used cross-sectional research design as recommended by de Vaus (1993). This design allows the collection of data from different groups of respondents at a time as well as determination of the relationship between variables. Purposive sampling procedure was used to select the seven villages (Machipi, Kirama, Mang'ula A, Mang'ula B, Msufini, Msolwa-Ujamaa and Sanje) in Kilombero District which are adjacent to UMNP. Selection of study villages was done by considering villages with relatively high number of beekeepers. Sampling units for this study were households involved in beekeeping and selected randomly from a list of beekeepers maintained by group leaders. The sample

size for household survey was 105. Selection of key informants for interview was purposively and these included District Executive Director, District Beekeeping Officer, Village Chairpersons, Village Executive Officer and beekeeping group leaders.

Data collection

Structured questionnaires containing both open and close ended questions were administered to households involved in beekeeping. The head of the household was the key person interviewed; other members of the households, in most cases the spouses, as well as children and relatives were occasionally involved in responding to questions. Checklist was used to collect data from key informants during interview to supplement and triangulate data collected through questionnaire administration. Field observation was used during the field visit to see physically what was going on in the study area and compare with what have been said by the respondents of the household survey and key informants interview as a means of cross checking the consistencies of the provided responses.

Data analysis

A content analysis was used to analyse qualitative data by breaking down the components of recorded dialogue with the respondents during key informants' interviews into themes that describe types, patterns and process of issues related to beekeeping. The quantitative data collected during household survey were analysed statistically using SPSS and descriptive statistics were used. Means and percentages were calculated for some variables related to practices, productivity and income and presented in the form of tables.

RESULTS

Practices of beekeeping around UMNP

The study assessed a number of issues related to beekeeping which included socio-economic characteristics of local communities practicing beekeeping, reasons for practicing beekeeping, organization of local communities in practicing beekeeping, types of beehives used by local communities, means of acquiring information on beekeeping, and challenges for practicing beekeeping.

Characteristics of respondents practicing beekeeping

The average age of respondents in the study area was 37, 53 and 43 years for Ifakara, Mang'ula and Kidatu divisions respectively. The results in Table 1 show that respondents in the three divisions of Ifakara, Mang'ula and Kidatu come from all age groups. However, many respondents from Ifakara division (56.4%) were young people while in Mang'ula (63%) and Kidatu (74.4%) divisions middle age people were found. From these results it is clear that beekeeping is done by all age classes depending on how people are organized in the village in terms of groups. The study revealed that the respondents have been in their respective residence for long period of time with an average number of years of 22, 31 and 24 for Ifakara, Mang'ula and Kidatu divisions respectively. This implies that many respondents are familiar with their environments and have adapted to them.

The results in Table 1 showed that there were both male and female respondents in the study village. These results imply that beekeeping is done by both male and female depending on the village context and the division of labour commonly practised by that particular community. Further, the married respondents were more involved in beekeeping in all divisions of Ifakara (92%), Mang'ula (70%) and Kidatu (82%) as compared to other category of marital status. These results imply that married couples are more flexible and well positioned to involve themselves in diverse economic activities as compared to other category of marital status due to availability of household labour.

Table 1. Characteristics of respondents

Criteria	Division		
	Ifakara	**Mang'ula**	**Kidatu**
Age class	**% Age class**	**% Age class**	**% Age class**
18-35	56.4	3.7	20.5
36-59	38.5	63.0	74.4
60≥	5.1	33.3	5.1
Sex of respondents	**% of sex of respondents**	**% of sex of respondents**	**% of sex of respondents**
Male	76.9	74.1	38.5
Female	23.1	25.9	61.5
Marital status	**% of marital status**	**% of marital status**	**% of marital status**
Single	7.7	7.4	10.3
Married	92.3	70.4	82.0
Widowed	0	18.5	7.7
Divorced	0	3.7	0
Education level	**% of education level**	**% of education level**	**% of education level**
No formal education	2.6	11.1	0
Primary education	71.8	51.9	100
Secondary education	15.3	14.8	0
Primary or secondary education with short courses	10.3	11.1	0
College education	0	11.1	0
Average HH size			
Number of persons	5	6	6
Average land size owned by household (ha)	1.4	3.3	1.9

More than half of respondents in the study area; Ifakara (72%), Mang'ula (51%) and Kidatu (100%) divisions acquired primary education level. This means most of these respondents can read and write which makes extension services through field manuals, posters and leaflet to be more convenient especially when there is limited availability of field officers. The respondents in the study area have a household size of 5, 6 and 6 for Ifakara, Mang'ula and Kidatu divisions respectively and in all the divisions the size ranged from 1-10 persons in the household. The size of household determines the labour force available at household level and how that household can play part in different economic activities. Further, the household size determines how much food and other resources are needed by that household to make a living.

The respondents in Ifakara, Mang'ula and Kidatu divisions owned an average land size of 1.4, 3.3 and 1.9 hectares respectively. However, it is not always that all the owned lands by households are cultivated. The mean land sizes cultivated by respondents in Ifakara, Mang'ula and Kidatu divisions were 1.1, 2.1 and 1.7 hectares respectively. Respondents in Ifakara division have the lowest both owned and cultivated lands which could be due to the fact that the villages in this division are located very close or within the Ifakara Township.

Reasons for practicing beekeeping by local communities around UMNP

The respondents identified several reasons that made them to practice beekeeping in their respective divisions. Many respondents in Ifakara (80%), Mang'ula (48%) and Kidatu (56%) practiced beekeeping as source of income generation. The other reasons were much more specific to certain divisions (Table 2). This implies that people in different locations might have different reasons contributing to adoption of new technology or economic activities depending on their context and exposure to those opportunities.

Table 2. Percentage of respondents against the reasons for practicing beekeeping

Reasons for practicing beekeeping	Ifakara (%)	Mang'ula (%)	Kidatu (%)
Sources of income generation	79.5	48.2	56.4
Learning from other people with success	10.3	11.1	15.4
Group influence	5.1	3.7	7.7
From trainings	5.1	3.7	12.8
Environmental conservation	0	11.1	5.1
News and advertisement	0	14.8	2.6
Used as means of protection of crops and human against wild animals e.g. elephants	0	7.4	0
Total	100	100	100

Organization of local communities in practicing beekeeping

Beekeeping was either done in groups or at household level or combination (Table 3). However, many respondents in Ifakara (72%), Mang'ula (89%) and Kidatu (97%) practiced beekeeping in groups. Some of these groups were not formed specifically for beekeeping but the existing ones like those for Savings and Credit Cooperative Society (SACCOS) were encouraged to incorporate beekeeping as additional economic activity. Beekeeping at household level is more practiced in Ifakara division as compared to other divisions of Mang'ula and Kidatu. Also it was observed that there was no association or cooperative of beekeepers in the study area to unite them and make their interests and problems be heard by decision makers at district and national levels.

Table 3. Percentage of respondents on the way are organized to practice beekeeping

Organization of local communities	Ifakara (%)	Mang'ula (%)	Kidatu (%)
In groups	71.8	88.9	97.4
Household level	5.1	3.7	0
Groups and household level	23.1	7.4	2.6
Total	100	100	100

Types of beehives used by respondents

Beekeeping in the study area was done using traditional and modern beehives (Plate 1 A and B). Many respondents in Ifakara (46%) and Kidatu (62%) used traditional beehives while many respondents in Mang'ula (67%) used both modern and traditional beehives (Table 4). However, generally the use of traditional beehives in all the divisions is still high. This could be due to the relatively high costs of construction or buying modern beehives or the low awareness of respondents on the high productivity of these modern beehives. Also, it was noted during key informant interview that there is a gradual shift toward use of modern beehives and some beekeepers tend to combine traditional and modern bee hives in order to reduce the risk of using only modern beehives due to the limited knowledge about them because of limited access to extension services in their respective villages.

Table 4. Distribution of respondents by the types of beehives they use

Types of beehives	Ifakara (%)	Mang'ula (%)	Kidatu (%)
Traditional beehives	46.2	14.8	61.5
Modern beehives	43.6	18.5	38.5
Both modern and traditional beehives	10.2	66.7	0
Total	100	100	100

Plate 1. (A) Modern beehive (B). Traditional beehive

Acquiring information for beekeeping

Respondents in the study area acquired beekeeping information from different sources (Table 5). The main sources of beekeeping information for many respondents in Ifakara (46%) and Kidatu (62%) divisions are friends from within or outside the village while for Mang'ula division are experts on beekeeping. The role of experts to provide information on beekeeping seems to be more common in Ifakara and Mang'ula divisions. This could be probably due to the presence of District Beekeeping officer at Ifakara which gives him time to visit villages nearby the district headquarters and the presence of Udzungwa National Park office at Mang'ula which supports beekeeping for the surrounding villages. Organizations of beekeeping in groups could be another reason for the friends to be considered as the main source of information on beekeeping. From these results it is evident that extension services on beekeeping are still low and individuals use their own initiatives and networks to secure information related to beekeeping.

Table 5. Percentage of respondents on their sources of information on beekeeping

Source of information	Ifakara (%)	Mang'ula (%)	Kidatu (%)
From friends	46.2	33.3	61.6
From parents	7.7	14.8	2.6
From experts	41.0	40.8	17.9
Could not tell	5.1	11.1	17.9

Challenges faced by local communities for practicing beekeeping in Kilombero District

The respondents identified several challenges they face in practicing beekeeping and ranked them (Table 6). However, the perceptions of respondents on these challenges greatly varied within and between the divisions. Also, many respondents in all divisions were unable to rank most of the identified challenges. The respondents in Ifakara division showed that unsecure market, lack of tools and equipment and lack of knowledge and skills were the main challenges.

In Mang'ula division, respondents mentioned lack of tools and equipment, lack of capital and lack of knowledge were the main challenges while in Kidatu division lack of tools and equipment, lack of knowledge and skills and lack of capital were the main challenges. Lack of equipment and tools and lack of knowledge and skills seem to be the crosscutting challenge in all the divisions.

Table 6 Percentage of respondents on their perceptions regarding the challenges of practicing beekeeping

Key issues	Division											
	Ifakara				Mang'ula				Kidatu			
	1st ranked (%)	2nd ranked (%)	3rd ranked (%)	Not ranked	1st ranked (%)	2nd ranked (%)	3rd ranked (%)	Not ranked	1st ranked (%)	2nd ranked (%)	3rd ranked (%)	Not ranked
Lack of capital	17.9	20.5	20.5	41.1	14.8	14.8	7.4	63.0	10.3	10.3	10.3	69.1
Lack of knowledge and skills	12.8	12.8	33.4	41.0	0	3.7	18.5	77.8	20.5	30.7	10.3	38.5
Wild animals	2.6	0	2.6	94.8	7.4	0	0	92.6	0	0	0	100
Forest/wild fires	0	0	2.6	97.4	0	0	0	100	0	0	0	100
Theft of honey	2.6	0	0	97.4	0	0	0	100	0	0	0	100
Unsecure market	25.6	17.9	18.0	38.5	7.4	11.1	18.5	63.0	0	7.7	7.7	84.6
Lack of tools and equipments	20.5	30.8	15.4	33.3	37.1	25.9	14.8	22.2	46.2	15.3	7.7	30.8
Presence of pests e.g., ants and birds	5.1	2.6	0	92.3	7.4	7.4	3.7	81.5	5.1	5.1	0	89.8
Low quality of beehives	0	2.6	2.6	94.8	0	3.7	0	96.3	0	0	0	100
Frequent bees abscondment	2.6	0	2.6	94.8	3.7	3.7	3.7	88.9	0	0	2.6	97.4
Falling down of beehives	0	0	0	100	0	0	11.1	88.9	0	0	0	100

Through the discussion with the District Beekeeping Officer, three main challenges were identified including lack of equipment and tools (protective gears and bees smoker), lack of packaging materials and lack of beekeeping experts in the district (currently there are 2 experts for 107 villages in the district). Other factors identified by beekeeping expert and village leaders included: Production of poor quality honey due to lack of equipment (modern bee hives, protective gears, queen catcher, and honey extractor). Some beekeeping group members are opportunistic; they join groups with the ambition of getting quick money. In some villages women are traditionally not given opportunity to join economic activities groups. Lack of loan facilities especially for groups that want to start big commercial beekeeping was also mentioned. Beekeeping groups lack the apex association that unite all these groups. Some of the villages lack places for hanging their beehives. Poor record keeping of produced honey, earned income and incurred costs were also mentioned.

Perception of local community on productivity difference between traditional and modern bee hives

The respondents had different knowledge on the productivity difference between traditional and modern beehives (Table 7). Many respondents in Ifakara (44%) and Mang'ula (44%) divisions acknowledged that modern beehives produce twice as compared to traditional beehives. Also many respondents in Kidatu division (92%) were not able to tell the productivity

difference between the two types of beehives. During the household survey and key informants interview it was clear that beekeeping is still new to most of the people in the study area especially using modern beehives and this could be one of the reasons for some respondents not being able to give the productivity differences between the two types of beehives.

Table 7. Distribution of respondents in percentages on perception of the productivity difference between modern and traditional beehives

Production difference between modern and traditional beehives	Ifakara (%)	Mang'ula (%)	Kidatu (%)
No difference	2.6	3.7	2.6
Double for modern	43.6	44.4	2.6
Triple for modern	5.1	14.8	2.6
Higher for traditional	0	3.8	0
Don't know	48.7	33.3	92.2
Total	100	100	100

Table 8. Ranking of the benefits obtained from beekeeping by respondents

Benefits from beekeeping	Division											
	Ifakara				Mang'ula				Kidatu			
	1st ranked (%)	2nd ranked (%)	3rd ranked (%)	Not ranked	1st ranked (%)	2nd ranked (%)	3rd ranked (%)	Not ranked	1st ranked (%)	2nd ranked (%)	3rd ranked (%)	Not ranked
Income	66.7	17.9	7.7	7.7	63.0	22.2	11.1	3.7	30.7	15.4	2.6	51.3
Food	25.6	38.5	5.1	30.8	22.2	48.1	3.7	25.9	25.7	17.9	7.7	48.7
Medicine	0	25.6	23.1	51.3	11.1	18.5	22.2	48.1	10.3	17.9	10.3	61.5
Protection against wild animal	0	0	0	100	3.7	0	0	96.3	0	0	0	100
Fire protection in forests	0	2.6	0	97.4	0	0	3.7	96.3	0	0	0	100

Benefits of beekeeping to local community and its contribution to household income

Benefits accrued from beekeeping by local communities

The study revealed that respondents were involved in beekeeping for different purposes including getting cash income, food, medicine and others (Table 8). Beekeeping as the source of income was ranked first by many respondents in Ifakara (67%), Mang'ula (63%) and Kidatu (31%) divisions. Food and medicine were ranked second and third benefits respectively by the respondents in the three divisions of Ifakara, Mang'ula and Kidatu.

However, about half of the respondents in all the divisions did not rank medicine as benefits from beekeeping which implies that this benefit is not common to these people. This could be partly explained by the presence of health centres and St. Francis Hospital in the study sites for disease treatments and hence they less depend on traditional medicines. Other benefits of beekeeping such as protection against wild animals and forest fires were not acknowledged by many respondents in Ifakara, Mang'ula and Kidatu divisions.

This implies that the strategy being promoted by some conservationists that hanging of beehives on the boundaries of national parks or game reserves and in forest reserves could be means of scaring dangerous wildlife to human and crops (e.g., elephant) or fire protection in forest has not been well understood by many local communities.

Contribution of beekeeping to household income

The household income is contributed by a number of economic activities in the study area (Table 9). The contribution of beekeeping to household income is generally low in all divisions of Ifakara (4%), Mang'ula (13%) and Kidatu (8%) as compared to other economic activities such as farming, petty trade and formal employment. Furthermore, the average incomes per year from beekeeping are TZS 326,703, 327,500 and 1,197,614 for Ifakara, Kidatu and Mang'ula divisions respectively. The highest household income observed in Mang'ula division could be due to Udzungwa National Park office at Mang'ula which supports beekeeping for the surrounding villages

Table 9. Mean household income from different economic activities and their contributions in terms of percentage

Economic activities	Division					
	Ifakara (TZS)	Contribution to total household income (%)	Mang'ula (TZS)	Contribution to total household income (%)	Kidatu (TZS)	Contribution to total household income (%)
Farming income	1,296,432	15	1,934,200	20	1,555,111	38
Fishing income	100,000	1	1,825,000	19	0	0
Petty trade	636,364	7	1,646,000	17	1,474,833	36
Beekeeping income	326,703	4	1,197,614	13	327,500	8
Livestock keeping income	450,000	5	574,667	6	473,000	12
Formal employment income	4,446,667	51	2,350,000	25	0	0
Other income (carpentry, tailoring, motor cycles transportation, masonry)	1,523,231	17	0	0	230,000	6
Average Total income	2,639,949	100	4,772,308	100	2,085,108	100

Farming has high household income contribution in all divisions as compared to beekeeping due to the fact that it is the main economic activity for many respondents and it involves paddy and sugar cane productions which are main cash crop in the area and are highly demanded. Beekeeping has been ranked by many respondents as the second or third economic activity (Table 3) which implies that it has the potential to be improved and contribute significantly to household income. The respondents in Mang'ula have the highest average total income (TZS 4,772,308) as compared to Ifakara (TZS 2,639,949) and Kidatu (TZS 2,085,108). This could be due to the biggest land size they own and cultivate and most of them are involved in paddy and sugarcane productions.

DISCUSSION

From the results it is clear that beekeeping is practiced by all age classes, both male and female. Also beekeeping is mostly practiced by married respondents and many beekeepers in the study villages have primary education. Beekeeping in the study villages is mainly practiced in groups. Organizations of beekeepers into groups and associations have been used or recommended in other parts of Tanzania as means to promote joint efforts in production and marketing of bee products and easily access credits facilities and training

(Warade, 2017; Mwakatobe et al. 2016; Mwakatobe and Machumu, 2011; Hausser and Mpuya, 2004). Also Warade (2017) argues that beekeeping can be done by all ages, gender and does not require daily attention but at the same time it provides more livelihood opportunities to women and youth.

The study has shown that not always that all the owned lands by households are cultivated. The difference between the owned and cultivated land imply low ability of the respondents to utilize land or they have surplus land which is left idle or rent to other people who have no land. Both land scarcity and surplus can be used efficiently through beekeeping. Households with land scarcity can increase income through beekeeping because it can be integrated with other land uses such as crop field and forest conservation. On the other hand, households with surplus land which is left idle can use it for planting trees and integrate with beekeeping to improve its value or protect it from wild fires instead of being considered as unused or unoccupied land. In Tanzania, the land held under customary right of occupancy is considered as abandoned when it lies unoccupied or unused for a period of more than five years (URT, 1999; 225) and for that case it can be allocated to other uses by the government.

Generally, the use of traditional beehives in all the divisions in the study area is still high. This could be due to the relatively high costs of construction or buying modern beehives or the low awareness of respondents on the high productivity of these modern beehives. Also, from interview of key informants it was clear that there is a gradual shift toward use of modern beehives. Some beekeepers tend to combine traditional and modern bee hives in order to reduce the risk of using only modern beehives due to the limited knowledge about them because of limited access to extension services in their respective villages. Mwakatobe and Machumu (2011) reported that 48.6% of beekeepers practised only traditional beekeeping, 38.9% practised both traditional and modern hive beekeeping and 11.1% only modern hive beekeeping.

The main sources of beekeeping information for many respondents in the study area are from friends within or outside the village. From these results it is evident that extension services on beekeeping are still low and individuals use their own initiatives and networks to secure information related to beekeeping. Other studies have reported the main source of information for many farmers is through sharing among them and is considered to be probably because of the trust they put in each other compared to trust in extension workers (Mujuni *et al*., 2012; Adereti, 2006).

The respondents identified several challenges they face in beekeeping and ranked them. Lack of equipments and tools and lack of knowledge and skills were the main crosscutting challenges in all the divisions. These challenges have been reported also in other studies (Lunyamadzo, 2016; Mwakatobe *et al*., 2016; Enos, 2013; Mmasa, 2007)

The perceptions of respondents on the productivity difference between modern and traditional beehives were variable. However, many respondents in Ifakara and Mang'ula considered that modern beehives produce twice as compared to traditional beehives. Other studies e.g. by Lunyamadzo (2016) have shown that there is a very big difference in productivity whereby one traditional beehive produces 2 litres per year while modern bee hive produces 15 litres per year. Also the high percentage of respondents in Kidatu division who were not able to tell the production difference between the two types of beehives could be linked with the argument made by Lunyamadzo (2016) that lack of extension services facing beekeepers make them to be unaware of the new technologies and hence continue using traditional bee hives which have low production of honey.

This study has indicated that the major benefits from beekeeping include cash income, food and medicine. Similar results have been observed in other studies (Ntalwila, *et al*., 2017; Hilmi, 2012; Mwakatobe *et al*. 2016; Mmasa 2007). The results have shown the contribution of beekeeping to household income is generally low as compared to other economic activities such as farming, petty trade and formal employment. This trend could be explained by a number of reasons. On one side commercial beekeeping is still new in the area as many of the respondents have only done it for about 4 years and hence they have not acquired sufficient experience and well established market. While on the other hand economic activities like formal employment and petty trade were done by few respondents and their incomes were stable and continuous (daily or monthly) as opposed to beekeeping income which is seasonal. The study in Manyoni, Singida by Mwakatobe and Machumu (2011) reported that beekeeping contributed to household income by 27% becoming the second while agriculture was the first contributor by 60%. Manyoni is more advanced in beekeeping because there are many local communities involved and there is also bee reserve under TFS which might have been used as a learning place for beekeepers on good practices. Also, similar results observed by Ngaga et al. (2005) in Chunya, Songea and Nachingwea Districts which showed that 30% of the households' economy subsidised by income derived from selling bee products. Furthermore, the average income per year from beekeeping observed in this study for Ifakara ward (TZS 326,703) and Kidatu ward (TZS 327,500) is similar to other studies e.g. in Songea district is TZS 342,474 and Hai district is TZS 215,659 (Lunyamadzo, 2016; Mmasa, 2007).

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Beekeeping is an economic activity that can be practiced by any person regardless of his or her age group, marital status, education level and sex. Both land scarcity and surplus can be used efficiently through beekeeping. Households with land scarcity can increase income through beekeeping by integrating with other land uses such as crop field and forest conservation. Households with surplus land can use it for planting trees and integrate with beekeeping to improve its value. Beekeeping especially using modern beehives in the study area is still under development and mostly done in groups at small scale. The knowledge and experiences of respondents on beekeeping aspects are still very low especially for Kidatu division. Lack of equipments and tools and extension services are among the main factors for the beekeeping having low contribution to the household income in the study area. The contribution of beekeeping to household income in the study area is generally low as compared to other economic activities such as farming, petty trade and formal employment. However, the results have shown that beekeeping is a potential economic activity for local people in the study area since it does not require extra land and it can be combined with other land uses.

Recommendations

In order for the beekeeping to contribute significantly to household income, this study recommends the extension services be improved in the district by employing more experts and distributing field manuals to guide beekeepers. Individuals in the groups of beekeeping should be encouraged to grab the key knowledge on beekeeping instead of leaving to few individuals doing most of things on their behalf. The District council should facilitate the availability of equipment and tools for beekeeping and

packaging materials for the bee products at affordable price to beekeepers.

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