Assessment of Beekeeping as an Adaptation Strategy to Climate Change in Iramba District

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ABSTRACT:

The effects of climate change in Tanzania affect rain fed agriculture and reduce the productivity in most parts of Tanzania. Indigenous knowledge and different agricultural strategies, on how to diversify to other agricultural activity like beekeeping has been adopted by different communities in Tanzania, especially in semi-arid areas. This paper focuses on assessing potentials of beekeeping as an adaptation strategy against impacts of climate change in Iramba District. The research used different methods in collecting information such as key informants' interviews, focus group discussions and observation methods. Secondary data were collected through documentary review, while the questionnaire was administered to 150 heads of households from four villages namely: Kyalosangi, Galangala, Mdonkolo and Songambele. The results show that over a period of 30 years, about 77% of respondents reported decrease in maize and 78% decrease in sunflower productivity. In interviews, the respondents indicated that they have shifted to beekeeping which contributes more to household's income than land tilling which is rain-fed. This is supported by 33.1% who were attracted in beekeeping for income purposes. The average honey production per hive ranges from 10 – 15 Lts/hive in top bar hives and frame hives, while traditional hives ranges between 5 – 10 Lts/hive. This study therefore recommends provision of appropriate capacity building and financial support to beekeepers in order to optimize production of bee products in the study area.

Keywords: climate change, adaptation strategy, agriculture, beekeeping, rain-fed agriculture

INTRODUCTION

Recently, Tanzania has experienced severe and recurring droughts with devastating effects to agriculture (IDRC, 2016). For the past decade, we have witnessed a number of climate related disasters in many parts of the

country such as widespread crop failures, flooding, extensive droughts, livestock deaths and intensification of climate sensitive diseases among others (Shemsanga*et al.,* 2010). Climate variability, a precursor of climate change, is already affecting Tanzania. Climatic patterns are becoming both less predictable and more severe. For instance, a 1997 drought was followed by a fivefold increase in rainfall in 1998, and then one of the worst droughts in four decades in 1999 (Shemsanga *et al.,* 2010). Rainfall patterns are expected to become increasingly variable across the country, with an increase in the north of 5 to 45 per cent and decreases of 5 to 15 per cent elsewhere (Mwandosya*et al.,* 1998).

Changes in rainfall reliability, onset and cessation can result in crop failure and hunger, exacerbated by other stresses such as land degradation and insecurity of land tenure. Agriculture is one of the human activities, mostly affected by the climatic change (Saria*et al.,* 2015). However, the impacts of climate change are not just of environmental concern, but will impede efforts to tackle poverty and promote national development. According to Saria *et al.* (2017) many human development systems have been affected by these changes, particularly agriculture, water resources, industry and human health. Yanda (2015), indicates that there is a positive correlation between climate change and crop yields under the rain-fed scenario. According to Ahmed *et al.* (2011), rainfall has significantly decreased in Tanzania, especially in the recent years, and is further expected to decrease by the middle of this century. It should also be noted that such climatic impacts will not affect the country like Tanzania uniformly due to diverse climatic patterns, from equatorial to semiarid and arid climates. Sawe*et al.* (2018) on assessment of the impacts of climate change and variability on crop farming systems in Singida region, found a decrease in rainfall, increase in temperature and increase in incidences of droughts. The crop yield for maize and ground nuts have shown a decreasing trend while that of millet has shown an increasing trend proving that the crop was indeed versatile enough for this type of climate regime (Mongi *et al.,* 2010). Where rainfall will be less, fewer crops and lower yields will be produced, thus negatively affecting household food security. Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (Dilley and Boudreau, 2001).

In Tanzania for example, in 2013/2014 the food requirement was 7,656,673 tons but only 5,613,221 tons were produced; which is only about 73%, making a food deficit of 2,043,452 tons (27%), leading to serious implications to food security and poverty (URT, 2014). Beekeeping is an efficacious tool in rural development as bees are omnipresent and the required equipment and tools namely: hives, smokers and protective clothing are locally made (Reddy*et al.,* 2012). Losses in the agricultural sector and spikes in food prices can push vulnerable consumers into poverty (Milder*et al.,* 2010). Vulnerability to climate change is seen to disproportionately affect the poor owing to a number of social, economic and physical factors that increases their exposure to the impact of climate change shocks but at the same time limits their capacity to cope and adapt (Pardey*et al.,* 2013). Climatechange has required farmers to change crop species/varieties and modified management of soils and sometimes application of water (Sacco *et al.,* 2014). In addition, farmers have developed strategies for pest management, including using of pesticides (Klein *et al.,* 2007).Due to expanding and emerging pests, farmers in most African countries have started using a number of agro chemicals (pesticides for crop pests, mosquitoes and household pests control, herbicides for weeds), which, if improperly used, cause honeybee colony losses and bring the real possibility of damaging the delicate equilibrium in the honeybee colony, as well as the contamination of hive products(Aynalem, 2017).

In spite of the existing beekeeping potential in Tanzania as a coping strategy to climate change, the opportunity remains unexploited by most of the people due to insufficient documentation on its profitability, performance and specific contribution to poor people basic needs (Mujuni*et al.,* 2012). Beekeeping is still marginal with only 10-15% of the households engaged in it (Kidd*et al.,* 2001). The sub-sector is basically accepted but subsistence in nature and it requires improvement or support by the Government to improve it (Msalilwa, 2016). Tutuba and Vanhaverbeke (2018) indicate that though honeybee contributes to the national economy by generating some US$ 19 million per annum and employing more than two million people, still this potential is not fully exploited, and the sector is still non-commercial. Beekeepers in rural areas still remain local and relatively poor (Msalilwa, 2016). The quality and quantity produced per hive is still below average (MMA, 2012). Moreover, exports of honey and beeswax have been declining despite the rise in global demand and increase in investment (ITC, 2015). This paper

aimed to assess the determinants of smallholder farmers in achieving food security due to climate change in Tanzania through beekeeping in Iramba District. Specifically, this paper examines the perception of farmers on status of crop production, factors that influence smallholder farmers to adopt beekeeping, establish the economic benefits of beekeeping to small beekeepers. It is anticipated that information gathered from this study will not only add knowledge to the existing literatures to address issues related to impacts of climate change and food security but will also provide an assessment of factors driving beekeepers in adoption and production in Iramba District along with conditions that would motivate rural farmers to take up beekeeping to enhance household food security.

METHODOLOGY

Study Areas

Iramba District (Fig. 1) lies between Latitudes 4º to 4º.3º S and Longitudes 34º to 35° E. Altitude ranges from 1,000 meters to 1,500 meters above the Sea level. Administratively, according to the GN, 2014 vol. V, the Council is divided into 4 divisions, 20 wards, 70 villages and 392 hamlets (URT, 2006).

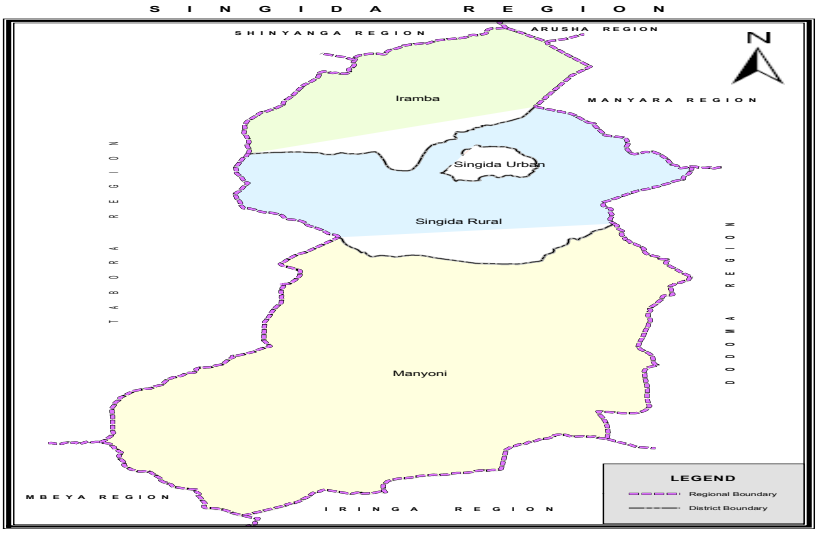

Figure 1: Map of Singida region showing administrative districts (URT, 2006)

In regard to climate there are two key features which are temperature and rainfall. The District forms part of the semi- arid central zone of Singida

which experiences monomial rainfall and the rain season interrupted by two notable dry spells in mid-February and mid-March. The total annual rainfall which is unimodal, it ranges from 500 mm to 850 mm per annum with high geographical, seasonal and annual variation. There are two well defined seasons, the short rainy season during the months of December to March or sometimes goes to April and the long dry season from April to November.

Methods

This study used a multistage sampling technique where three stages were involved (Kothari, 2004). In the first stage Iramba district was selected purposefully from the list of seven districts that constitute the beekeeping in Singida region. In the second stage, two wards (2) Ndago and Kinampanda out of 20 wardswere purposefully selected. The same approach was used to select the four (4) villages two from each ward. Ndago ward: Mdonkolo, Songambele and Kinampanda ward: Kyalosangi and Galangala.

Field surveys, informative interviews, physical observations, group discussions and literature reviews were the main approach of data collection in the study area, where purposive sampling was employed to sample beekeepers among the semi-arid districts of Tanzania mainly based on the frequency of food shortage and other physical aspects (FAO/UNESCO, 1988). Two types of data were collected which included primary and secondary data. Primary data were collected from beekeepers household heads or their respective representatives. Secondary data were collected from Ward Executive Office (WEO), Village Executive Office (VEOs), the District Beekeeping office (DBO), Extension Officers (EO), District Forest Office (DFO), and IRDP library. The sampling unit was households, and the sample size was 150 respondents (beekeepers) from four villages, they were obtained using a formula developed by Yamane (1967), that;

$$n = N/ [1+N (e)^2]$$

Where by: n = sample size, N = sampling frame, e = prediction error 0.1 (10%). The sample size of the household survey consisted of 10% of the total number of heads of households in each study ward. According to URT (2007), total number of household's beekeepers in Iramba district is 62,528. This gives; $n = 62,528/ [1+62,528(0.1)^2]$, where, n = 99.86. Therefore n = 100 respondents. Adding 15% we have 115 respondents

(Yamane, 1967). Table 1 shows calculation for the distribution of respondents per village.

Table 1: Calculation of Distribution of respondents per village

Ward	Village Name	Total HH	Estimation	Respondents
Ndago	Mdonkolo	477	115/2279× 477	24
	Songambele	615	115/2279 ×615	31
Kinampanda	Kyalosangi	651	115/2279 ×651	33
	Galangala	536	115/2279 ×536	27
TOTAL		**2,279**		**115**

Source: Iramba Beekeeping Officer

Table 2 shows the profile of respondents. Primary data sources includes focus group discussions (n=6 for each ward), interviews with key informants (n = 8) consisting of village elders and agricultural extension officers. Household survey (n=150) and direct field observation through transect walks were other sources of primary data. Field observation was deemed necessary in order to confirm some of the issues raised during focus group discussions and the household survey.

Table 2: Respondents Profile

Category	Number
Household Head (Beekeepers)	115
Villages executive officer (VEO)	4
Ward executive officer (WEO)	2
Village Community Development Offices	4

District Beekeeping Officer (DBO)	1
District Forest Officers (DFO)	1
Agriculture Extension Officers	8
Beekeeping NGO working in study area	5
Village leaders	10
Total	**150**

Formation of FGD involved a purposive selection of ten (10) members who represented households, where five (5) represented beekeepers households and village elders, while three (3) represented agricultural extension offices, two (2) represented extension officers, two (2) beekeeping NGO representative. Secondary data such as publication materials such as books, journal papers, original scientific work, government reports and academic dissertation were consulted during review to identify and bridge up the gap basing on the study's objective.

Quantitative data were gathered using structured questionnaires as the main tool. The structured questionnaire covered questions on main trends of crop production in five years, the factors influencing beekeeping practices, the quantity of honey produced, the implication of the financial obtained to food security, and the major constraints in beekeeping. Multiple response questions were analyzed so as to get frequencies and percentages. After being collected from the field using questionnaire, primary data were edited before punching them into the computer software Statistical Package for Social Sciences (SPSS 11.5). Data were analyzed mainly at univariate level where descriptive statistics and frequencies for study variable were computed. Analyzed data in this paper have been mainly presented in tables and graphs for meaningful interpretation and discussion.

FINDINGS AND DISCUSSION

Respondents' characteristics

Different characteristics have direct and indirect influence on the adoption of bee keeping among rural farmers. During the study, different parameters such as age, sex, gender of household head, education level

and marital status, of respondents were assessed. The results and responses are shown in Table 3. Out of the 150 total respondents, 70% were male. This agreed with what have been observed earlier (Mujuni *et al.*, 2012) in which they indicated that in most of African countries like Uganda, Kenya and Zambia beekeeping has often been considered a male-dominated enterprise. According to study conducted earlier (Qaiser *et al.*, 2013), African women often encounter social and cultural constraints that hinder them from performing apiary cultural practices.

Table 3: Socio Demographic Characteristics of Respondents (n = 150)

Respondents characteristics		**Frequency**	**Percent**
Age of respondent (Years)	31-40	18	12.0
	41-50	67	44.7
	51-60	57	38.0
	61 and above	8	5.3
	Total	**150**	**100.0**
Sex of respondent	Male	105	70.0
	Female	45	30.0
	Total	**150**	**100.0**
Marital status	Single	43	28.7
	Married	82	54.7
	Separated	10	6.7
	Divorced	5	3.3
	Widowed	10	6.7
	Total	**150**	**100.0**
Gender of household head	Male	118	78.7
	Female	32	21.3
	Total	**150**	**100.0**

Education level	Non-Primary education	22	14.7
	Complete primary	113	75.3
	Above primary education	15	10.0
	Total	**150**	**100.0**

These are bee-sting phobia, lack of time due to taking care of family matters, inability to raise and harvest from the traditional bee-hive. The small percentages of women practicing beekeeping could be those who are either separated, divorced or widowed, and hence were the sole breadwinners for their family. Namwata*et al.* (2013) indicate few women participate in beekeeping, their apiaries are located on farms nearby their homes, and beehives are sited on stands or short trees at reasonable height easy for women to manipulate the bee colonies. The majority of respondents (54.7 %) are married while the remaining are either single, divorced or widow. The majority of beekeepers (44.7%) are at the age ranges between 41-50 year. This is followed by 38% with the age range between 51 – 60 years. The lowest are those old people with the age above 60 (5.3%). The age between 40 – 60 years is known to be energetic and they have family responsibility. Therefore, being active in beekeeping makes more sense because traditional beekeeping in the area is a labour intensive activity usually undertaken in the forests which need energetic experienced people who are committed and able to bear life threatening risks.

The majority of respondents (75.3%) completed primary education while 15% have no formal education and 10% have secondary education. These results contrast with the results reported in Western Uganda where the majority had attained formal education with 17.5% being tertiary education graduates (Mujuni *et al.,* 2014). However, this result shows the majority of respondents have been exposed to education. Exposure to education will increase ability of the keepers to obtain, process, and use information relevant to the adoption of improved innovations of beekeeping at their disposal. Namwata *et al.* (2013) indicate that beekeepers with a minimum of basic education are more likely to adopt improved beekeeping innovations and hence increase productivity of bee

products. This is due to the fact that beekeeping is a self-employment opportunity available in the study area.

Status of Crop Production in the Study Area

Agriculture has a significant contribution to economy of beekeepers' households. Field surveys, and physical observations made show that the most important cash and food crops commonly cultivated in Iramba district were maize, sunflower (*Helianthus annuus*) beans, sunflower, sweet potatoes (*Ipomoea batatas*) and groundnuts. Table 4 summarizes the responses on the trends of crop productivity over the last 30 years (1989 to 2019 years). It is discernible that maize (*Zea mays L.*) is the main food crop, at both local and regional levels including countries like Kenya, Uganda, Burundi and Rwanda. In Tanzania, maize accounts for over 70% of the cereal food requirement (URT, 2013). Therefore, its production has a strong link to food security. Majority of respondents (77.3 %) indicated that maize production has declined for the past thirty years. This is followed by 19.3% who shows the production of maize is fluctuating.

Table 4: Trends of productivity of various agricultural crops over the last 30 years (1989 to 2019years)

Trend		**Frequency**	**Percent**
Maize productivity	Increasing	2	1.3
	Decreasing	116	77.3
	Fluctuating	30	20.0
	no change	2	1.3
	Total	**150**	**100.0**
Beans productivity	Increasing	3	52.0
	Decreasing	4	2.7
	Fluctuating	1	0.7
	do not know	142	44.6
	Total	**150**	**100.0**
Sorghum productivity	Decreasing	10	6.7
	do not know	140	93.3
	Total	**150**	**100.0**

Sunflower productivity	Increasing	2	1.3
	Decreasing	117	78.0
	Fluctuating	29	19.3
	no change	2	1.3
	Total	**150**	**100.0**
Sweet potato productivity	Decreasing	4	52.7
	Fluctuating	1	0.7
	do not know	145	46.6
	Total	**150**	**100.0**
Groundnut productivity	Decreasing	17	86.7
	Fluctuating	3	2.0
	do not know	130	11.3
	Total	**150**	**100.0**

Meteorological data trends (Table 5), show that the study area experienced eight dry seasons in a period of 14 years. The mean rainfall seasonal per season in this area is 777.4 mm in the period between 1994 and 2011. This is an insufficient amount for requirements of many crops, given inconsistency rainfall patterns demonstrated by higher standard deviations. For example, maize rainfall requirement ranges from 500 to 2,000 mm, sorghum 250 to 1,200 mm, paddy 1,200 to 1,800 mm and sunflower 600 to 1,000 mm per annum (TARO, 1987a).

Table 5: Measured Rainfall Variability during Growing Seasons in Iramba District from 1994 to 2008 (Kabote *et al.,* 2017)

Period	**November**	**December**	**January**	**February**	**March**	**April**
1994-1998	71.0±68.9	195.6±197.6	140.2±68.1	158.8±49.5	151.8±112.8	120.8±56.1
1999 - 2003	123.6±84.8	139.1±54.0	192.4±97.2	60.1±26.4	202.2±57.1	87.6±45.3
2004-2008	67.3±50.6	112.9±59.3	149.9±65.7	65.7±134.7	135.3±100.4	66.6±69.1

Similar trend was observed to other food crops (Table 4); sunflower 78% of respondents indicated the harvest was decreasing, groundnuts 86.7%. Sorghum is among the dominant crops in the study area (semi-arid) produced under smallholder farming (TARO, 1987b). It is among the most drought resistant crops and therefore its resilience to climate change impacts is a bit high. That's why 93.3% of respondents do not see the difference in production. Similar results were reported by Sawe*et al.*(2018) in the study conducted at Manyoni Singida district, there is a

crop damaging and persistent of low harvest. These results collaborated the results of Malley *et al.* (2009) who observed that productivity of crops in semi-arid areas of central Tanzania was increasingly becoming threatened by increasing drought frequency. According to Urassa (2016), this is probably due to climate change, drought, depletion of plant nutrients from the soil and infestation of crop pests and diseases. Information from both focus group discussion and in-depth interviews revealed that there is tremendous decline in crop production. The response from key informant (male, 67 years old) from Songambele village said:

> *My brother, since I moved to this village about 42 years ago, I have never experienced this life of buying everything. I have never bought maize, sorghum or beans for my family. Previously I could harvest 10 bags of maize in my 2acre farm, but recently I could hardly get a bag or two. The increases in temperature have accelerated the increase in drought in our village. Nowadays agriculture has become unpredictable because even the rainfall amount has decreased to the maximum.*

Farmers' perception on increasing rainfall unpredictability coincides with higher standard deviations in monthly rainfall from the results determined earlier (Kabote*et al.*, 2017). The higher standard deviations implying that rainfall patterns are inconsistent in each month during crop growing seasons, and some months receive much rain while others get considerably low rains. These results coincide with farmers' perceptions, which show extending back of the dry spell from February to January resulting into decreasing crop growing season. The rainfall in December and April also shows a clear decreasing trend for the period between 1994 and 2008 in Iramba district (Table 5). Sweet potatoes are short duration crops that are relatively drought tolerant therefore, the high in importance in food security in semi-arid areas. About 52% of respondents indicated that there is a decrease in production of sweet potatoes (Table 4). In focus group discussion at Ndago ward, one respondent indicated,

> *When we came to this farm about five year ago, we could harvest 10 bags or 8 bags of sweet potatoes. Now, I only harvest 3 or 4 bags. Now, there is less rain, they don't grow very well. I get a very poor harvest (45 years old man).*

Interview with respondents a 55-year-old female from Kyalosangi village indicated,

> *for almost 10 years now we are experiencing different pests who do not respond to any chemical. When I was young my mother used to use ashes to kill pests. These days, the new pests do not respond to any chemical. Probably, they are used to high temperature. They are the one responsible to decline of our harvest…*

The only crop which shows increasing trend is beans. About 52% of respondents indicated increase in yield of beans (Table 4). This is linked with the introduction of new type of seed which are heat tolerant and they are now commonly grown at the study area. In the survey made at different seed companies, four different varieties were found in the market. These were: *Uyole* 94, *Lyamungo* 90, *Jesca,*and *Kablanketi.*In the discussion with extension officers about the variety preferred by farmers they rank in the order of Jesca followed by Lyamungo 90 and the lowest was Kablanket, which was in line with another study conducted earlier (Hillocks*et al.*, 2006).

Different Reasons Motivating Small Holder Beekeepers

Figure 2 identifies difference reasons which motivate smallholder farmers to be beekeepers. The majority of respondents (33.1%) reported they were attracted in beekeeping for purpose of income generation, this is followed by 31.1% of respondents who reported that they adapted out of own motivation (personal interest) followed by 29.7% of respondents reported that they keep bees just for food security.

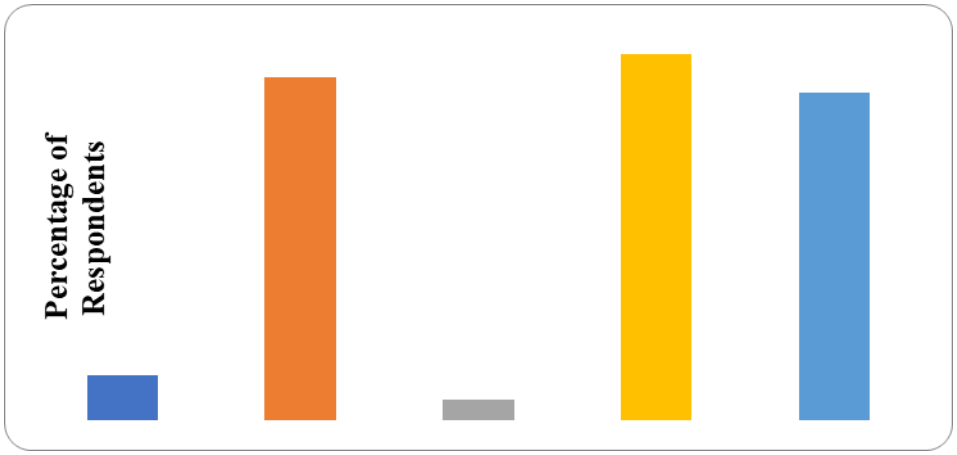

Figure 2: Different reasons motivate smallholder farmers to be bee keepers (n = 150)

These results agree with the report by Paji (2016) where 50% of the respondents were influenced by the need to increase the income, while only 16% of the respondents got engaged in bee keeping activities due to the fact that honey is medicinal and 6% of the respondents were influenced by the need to obtain food. According to Dadant, (1980), honey bees play a critical role in agriculture and beekeeping has many relative advantages and importance that help farmers to improve their livelihoods to ensure food security. Beekeeping conserves the natural resource and contributes to the globe through environmental protection, as beekeeping and agro-forestry are integrated activity. It also provides valuable products like honey, beewax, propolis, bee venom and royal jelly, which farmers use as source of income (Keralem, 2005; Doss, 2006).

Quantity of Honey Production

Under good management of beekeeping, harvested honey can reach up to 15 kg per hive per harvest. However, in Tanzania honey yield per hive is generally low due to several factors. The production ranges of honey per house hold in the study area are shown in Figure 3.

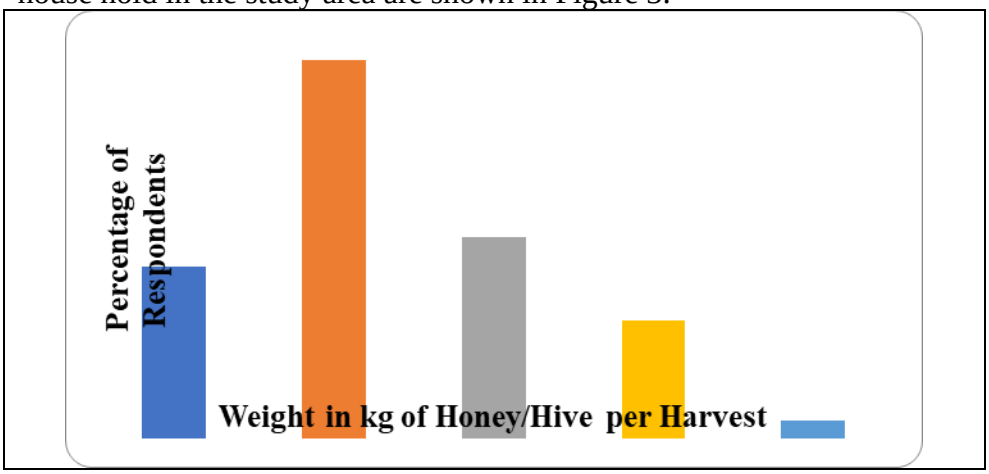

Figure 3: Honey Production per hive per Harvest per Household

Results in Figure 3 indicate that most respondents (42.7%) harvest 6 to 8 kg of honey per hive per harvest followed by 22.7% harvest 9 to12 kg per hive, 19.3% harvest less than 5 kg per hive, 13.3% harvest 13 to 15 kg and only 2% of respondents harvest more than 15 kg of honey per hive per harvest. In average, more than 60% of beekeepers in Iramba District

harvest less than 9 kg of honey per hive per harvest. According to the interview with Iramba District Beekeeping Officer (DBO) the total number of house hold beekeepers is 396 with total number of 1,475 hives, making an average of 3.7 hives per household. The hives are divided into three categories: Top bar hives (146 hives), frame hives (682 hives) and traditional hives (647 hives). The average honey production per hive varies as production in top hives and frame bar ranges from 10 – 15 Lts/hive while traditional hives ranges between 5 – 10 Lts /hive.

These values concur with traditional hive determined earlier by Gidey and Mekonen (2010), which is 8-15 kg/hive and 5-6 kg /hive. Tessega (2009) in the modern hive produces twice as much to the traditional hives which gave 15.6 kg per hive. The difference observed in honey yield between traditional (the common in Iramba district) and modern hive might be due to time of honey bees spent for building comb, while in the modern hive the foundation sheet is prepared and provided by the beekeepers. This might have enabled the honey bee colonies in modern beehives to spend their time and energy on collecting nectar for honey than building new combs.

Preference of Respondents to Beekeeping Compared to Crop Agriculture

According to Mujuni *et al.* (2012), beekeeping is emerging as a very successful agricultural practice for rural communities in less developed countries mainly due to its economic benefits from the products of this practice. Figure 4, indicates that the majority of respondents (63.4%) prefer beekeeping compared to crop agriculture. Only 33.3% said thatit is just like production of other crops and only 3.3% indicated it is less than other crops.

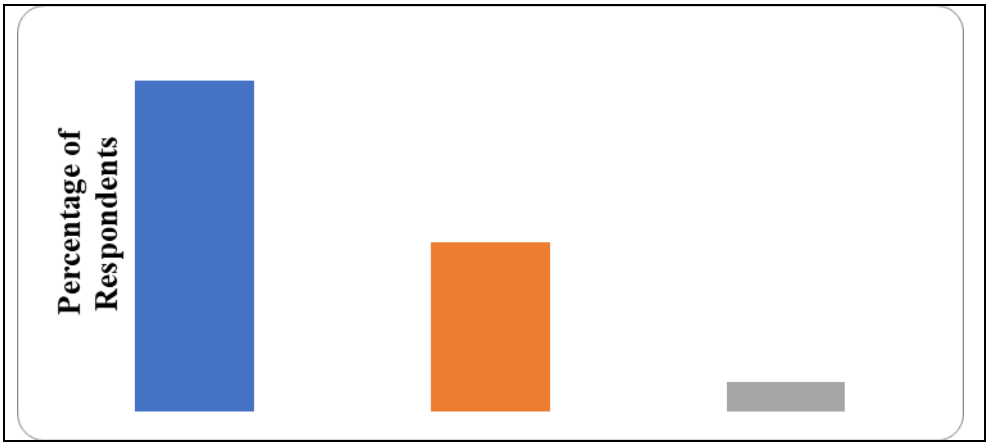

Figure 4: Preference of respondents to beekeeping compared to Agricultural crops

In the FGD the respondent indicated:

> *Beekeeping is the most profitable activity compared to maize and other crops. Also, the price of honey is usually very high compared to the labour it takes. Crops like maize need rainfall, but honey does not*

These findings agreed with Dalang (2001) who noted that on a comparative basis, apiculture stands out conspicuously as a high revenue-generating venture compared to arable cropping. The implication of the above results is that given beekeeping, livestock production and crop farming, beekeeping is a better enterprise to the study area community because it generates a higher income for smallholder farmers. It is estimated that 90% of honey produced in Tanzania is consumed as food in Tanzania. A significant amount of honey is used to make local beer in areas where honey is produced in huge volumes. In an interview with one village elder from Mdonkolo village who is also beekeeper he indicated:

> *"I normally sell my honey to traditional beer brewers, in an average of Tshs 8,0000 – 10,000 per liter. This is because it is easy to get cash to meet my personal requirements. I can get 60 Liter from my hives per harvest; therefore, I am sure of getting about Tshs 600,000" (1 $ = 2230 Tshs).*

This corresponds to another study in Tanzania (ITC, 2015) which indicated, beekeepers own more than 20 hives, they harvest honey twice a year and harvest 5-10litres per hive depending on the season. The price of honey was Tshs. 8,000 per litre. During the study, respondents reported various ways in which funds from beekeeping contributes to household socio-economic welfares. They reported benefits such as increased household's income, food security, poverty reduction, capital accumulation, source of medicine, payment for education and health expenses. Figure5, summarizes the responses on social economic benefits of beekeeping to household's economy. The majority of the respondents (30.5%) use the money they got from selling honey to cover medical expenses for family members (Fig. 5). According to Bright *et al.* (2017), financial barriers are a key limitation to access health services in low- and middle-income countries.

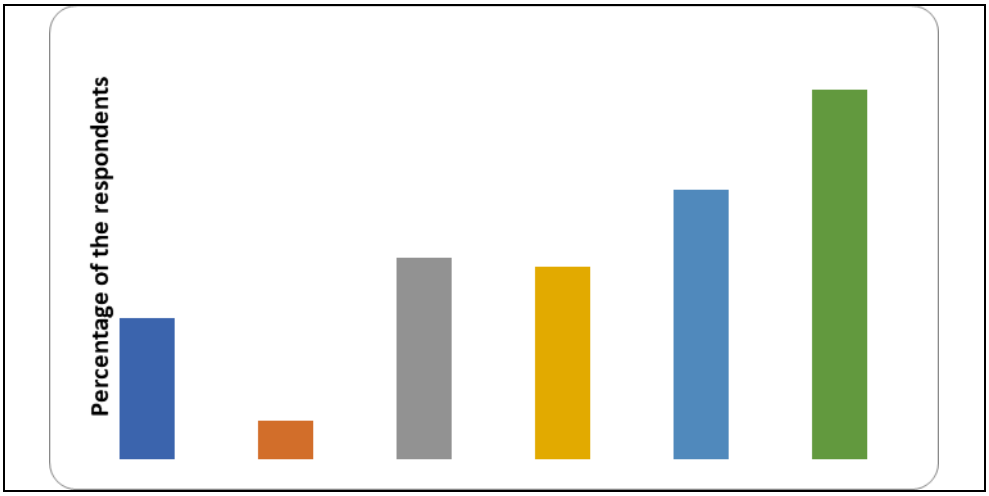

Figure 5: Social Economic Benefits of Beekeeping to Household's Economy

Due to financial barriers in study area, head of family often end up with out-of-pocket patient payments which impact on household budget. Education is an important component of human development. Parents have to pay for tuition fees, meals and accommodation for their children at various levels of education. About 22% of the respondents indicated that the revenue from beekeeping helps to pay for education expenses. These results correspond to those reported in western Tanzania where beekeepers spent revenue from selling bee products to pay school fees for their children, buy assets and clothing, and construct houses. (Ntalwila *et al.*, 2017).

Major Beekeeping Constraints Faced by Farmers in the Study Area

Based on the result of this study, the major constraints faced by beekeepers were: lack of reliable market, bush fire, theft of hive and products, drought, limited knowledge, pests and diseases, lack of common flowers and poor technologies as summarized in Table 6. When asked about the constraints that faces beekeepers, respondents reported several problems. Results in Table 6 show that 15.2% of the respondents reported drought as the major problem facing bee keepers in the study area. Due to drought few flowers bloom hence bees cannot access the honey. This is evident from a number of respondents (12.7%) who said that due to drought common flowers are not available these days.

Table 6: Problems facing Bbeekeeping in the Study Area (Multiple response)

Problems facing beekeepers	Frequency	Percentage
Aggressiveness of bees	11	1.2
Limited space	48	5.1
Limited market for bee products	135	14.2
Bush fire	146	15.4
Theft of hive and products	10	1.1
Drought	144	15.2
Limited knowledge	136	14.3
Pests and diseases	59	6.2
Lack of common flowers	121	12.7
Poor technology	140	14.7

Urassa *et al.* (2016) observed that in Iramba district, agricultural production is poorly performing, mainly due to low and erratic rainfall, which range between 500 and 800 mm per annum. As it is in Singida region as a whole, famine is a common phenomenon in the district due to lack of rainfall and droughts. Drought has caused many problems including bush fire rated by 15.4% of the respondents. Kumar *et al.* (2012) indicates that the use of fires may increase the risk of accidental wild fires especially during dry months. Markets for honey and other bee products in Tanzania are not fully established. Beekeepers in Iramba Districts are mainly smallholders who depend on local markets to sell the honey produced. The market is unstructured and unreliable due to inadequate customers, difficult transportation, lack of realization of the honey value and inadequate ability of beekeepers to search for markets.

Namwata*et al*. (2013) reported that bee keeping industry face a series of drawbacks namely technology, market, equipment, climate, transportation, credit accessibility, lack of training/skills and cultural practices.

This corresponds to findings by Tutuba and Vanhaverbeke, (2018) who established that commercialization of beekeeping in Tanzania is constrained by low market prices and poor, marketing systems and limited market information. These results also compare with Arse *et al.* (2010), who reported on the shortage of honeybee forages, shortage of honey bee colonies, poisoning by agro-chemicals, shortage of modern hives, prevalence of honeybee enemies and market problems, shortage of improved bee equipment, absconding and swarming problems, prevalence of honeybee diseases, lack of knowledge of the right harvest time and theft problems as the major beekeeping constraints. This is in line with the work of Kerealem *et al.* (2005) which stipulates that drought is the main constraint of bee keeping. These constraints have a direct and indirect effect on the reproduction and productivity of honeybees.

CONCLUSION AND RECOMMENDATIONS

This study provided information on the current status of beekeeping in two wards inIramba District as adaptation strategies against impacts of climate change in the district. Climate change is evident due to rainfall patterns inconsistent in each month during crop growing seasons, most of Iramba district receive considerably low rains. This situation has caused frequent food shortages and famine. In order to respond to the impact of climate change in Iramba district, smallholder farmers opt for beekeeping instead to crop production as the source of food and income to meet the family basic needs. The honey production has played a critical role in agriculture and beekeeping has many relative advantages and importance that help farmers to improve their livelihoods, and food security.

Since food security cannot be achieved without income security, beekeeping could be a useful tool for improving rural economy. It is hereby recommended to have the capacity building for beekeepers so that they can get knowledge about the various practices employed in beekeeping through a mixture of practical and theoretical sessions.