BEEKEEPING IN MAGU DISTRICT, TANZANIA: STATUS, CONSTRAINTS AND CONTRIBUTIONS TO LIVELIHOODS

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN THE MANAGEMENT OF NATURAL RESOURCES FOR SUSTAINABLE AGRICULTURE OF SOKOINE UNIVERSITY OF AGRICULTURE, MOROGORO, TANZANIA

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ABSTRACT

This study was conducted in six villages of Magu district, namely: Igekemaja, Lugeye, Nyalikungu, Ng'haya, Manala and Mkula. The aim was to assess status, constraints and contributions of beekeeping to household income. Data were collected from 180 respondents included both beekeepers and non-beekeepers through household questionnaire surveys, direct observations, interviews with key informants and two PRA techniques. The level of beekeeping community knowledge was analyzed using index scale of awareness. The mean difference in incomes between beekeepers and non-beekeepers was tested using Z-test. The significance of the constraints to beekeeping was analyzed using χ^2. The relationship between beekeeping education and honey hunting was examined using Pearson correlation. The relationship between socio-economic factors, the beekeeping extent and beekeeping community knowledge was analyzed using multinomial regression. Of the 180 respondents, only 13 were beekeepers with 74 beehives, whereas 105were non-beekeepers, 62 were honey hunters and about 110 colonies were hunted in 2009. Respondents with beekeeping education were more likely to practice beekeeping and neither of them hunted honey. Four levels of beekeeping community knowledge were identified: 8 respondents (4.4%) were found with "high knowledge", 95 (52.8%) with "moderate knowledge", 70 (38.9%) with "low knowledge" and 7 (3.9%) with "no knowledge". Alternative sources of income attributed to low community participation in beekeeping. The annual household income for beekeepers was TAS 1 023 000±171 484.69 (Mean±Standard Deviation) and TAS 835 700±1 011 058.71for non-beekeepers. Eight constraints to beekeeping were identified with lack of beekeeping knowledge, fear of honeybee sting and shortage of bee-fodder being three top most. Others were lack of capital, alternative income sources and shortage of colonies.The study concludes that for honeybee resources to be utilized fully and sustainably, the community must be provided with beekeeping education and facilitated to obtain modern beekeeping equipment.

DECLARATION

I, Igunda John Selele, do hereby declare to the Senate of the Sokoine University of Agriculture that the work presented here is my own original work, and has neither been submitted nor being concurrently submitted for a higher degree at any other institution.

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This work is dedicated firstly to my wife Mecksensia Petro Igunda and our daughter Princess Dalahile Igunda who remained my unfaltering source of inspiration and encouragement throughout my work. Secondly, I dedicate the work to my parents, John Selele Igunda and Mwamini Ismail who laid down the foundation for my education. Thirdly, I dedicate this work to my brother Athuman and sisters Neema, Minza and Mwamvua for their material and moral support.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND SYMBOLS

CIFOR	Center for International Forestry Research
FAO	Food and Agriculture Organisation of the United Nations
FBD	Division of Forest and Beekeeping
FGD	Focused Group Discussion
MNRT	Ministry of Natural Resources and Tourism
MSEP	Mwanza Socio-Economic Profile
NGO	Non-Governmental Organization
NYULA	Nyuki – Lugeye "A"
PRA	Participatory Rural Appraisal
SNAL	Sokoine University National Agriculture Library
TAS	Tanzanian Shillings
TSEP	Tabora Socio-Economic Profile
URT	United Republic of Tanzania
VEOs	Village Executive Officers

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Beekeeping is the art and science of keeping honeybees by different cultures for purposes of harvesting honey, wax and other products (Muli *et al.*, 2008). The art of beekeeping in the world has been around for quite a long time and it is believed to be one of the oldest practices. Beekeeping has been practised since ancient times and honey has been considered by many cultures as a valuable and precious commodity that is used in traditional rituals, in healing or as food. Generally, Africa is blessed with numerous types of wild honeybee (Adjare, 1990), but the most widely used honeybees are *Apis mellifera* which are indigenous to Africa (Bradbear, 2004). In Ethiopia and many parts of the world, there is an ancient tradition for beekeeping (Deffar, 1998). However, beekeeping has advanced from honey hunting to traditional and now modern beekeeping practices due to its importance to the modern world.

Honeybees are a natural renewable resource of abundance that can be exploited fully without detrimental effects on environment if appropriate techniques are applied. Therefore, community knowledge and thus adoption of modern beekeeping, which allows greater but environmentally friendly exploitation of honeybee resource remains of crucial importance for sustainability of the resource. Honey hunting from feral colonies of bees is done by many people on an opportunistic basis due to low beekeeping awareness. Destruction of environment may have adverse effects on the existence of honeybees and bee-fodder (MNRT, 1998). However, in communities with much knowledge of beekeeping, the activity is often described as a 'specialist enterprise'.

Beekeeping plays a major role in socio-economic development and environmental conservation in Tanzania (MNRT, 1998). The economic value of honeybees results not only from the hive products, but also from their pollinating activity on crop plants (Williams, 1994). Pollination in flowering plants including crops is an important role played by bees and has special significance both environmentally and social-economically. About one third of all plants or plant products eaten by humans depend directly or indirectly on bees for their pollination (FAO, 2009). Honeybees can increase the yield of *Citrus sinensis* by 30%, water melon by 100% and tomatoes by 25% (Crane, 1990). Beekeeping contributes to income as well as food security through provision of honey and pollen as food, beeswax and propolis, bee venom and royal jelly in medicine. Tanzania produces about 138 000 tonnes of honey and 9200 tons of beeswax per year (MNRT, 1998). This high production is mainly due to presence of high population of bee colonies and vegetation that is preferred by bees (Mbuya *et al.*, 1994). Beekeeping gives local people and the government economic incentive for the retention of natural habitats, and is an ideal activity in any forest conservation programme (Mwakatobe, 2001).

1.2 Problem Statement and Justification

1.2.1 Problem statement

Over 75 percent of beekeeping activities in Mwanza region are carried out in Geita district, followed by Kwimba and Sengerema districts (MSEP, 1997). Furthermore, between 1993 and 1994 the entire region had an estimate of 31 209 traditional beehives and 64 modern beehives, out of which only 15 modern beehives and 39 traditional beehives were recorded in Magu district (MSEP, 1997). Despite the significance of beekeeping and the availability of the beekeeping potential in Magu, only few people practice beekeeping for income generation compared to other communities in various places in Tanzania. Tabora region for instance, was estimated to have a total of 839,875 traditional beehives and 10 modern

beehives in 1994 (TSEP, 1998). As there has been little effort in Magu district to document information on the interaction between honeybees and communities. As result, insufficient knowledge exists about the status of beekeeping, its limitations and financial significance of this resource to the livelihood of rural communities.

1.2.2 Study justification

There is always a need to manage honeybee resource for sustainability of the beekeeping where this resource exists. In this respect, this study is an attempt to fill gaps in knowledge with regard to beekeeping in Magu, Tanzania. Furthermore, information on economic benefits of beekeeping alongside other economic activities is envisaged to inspire Magu residents and other Tanzanians elsewhere not yet engaged in beekeeping to embark on this economic activity, which requires relatively less initial capital investment.

1.3 Study Objectives and Conceptual Framework

1.3.1 Overall Objective

The overall objective of this study was to assess status, constraints and contributions of beekeeping to communities' livelihood in Magu district.

1.3.2 Specific objectives

The specific objectives of this study were:

i. To examine beekeeping practices and assess extent of beekeeping in Magu.
ii. To assess community knowledge on beekeeping as an economic activity in Magu.
iii. To determine contribution of beekeeping to household income relative to other economic activities.
iv. To determine and assess current and potential constraints to beekeeping in Magu district.

1.3.3 Research questions

i. What are the beekeeping practices in Magu?

ii. What understanding do people in Magu have regarding the importance of beekeeping and bee products?

iii. Does beekeeping contribute significantly to annual household income of beekeepers in Magu district?

iv. What are the factors influencing beekeeping in Magu?

1.3.4 Conceptual framework

Community knowledge on the significance of beekeeping and other factors that may influence beekeeping development are important for sustainable development of the beekeeping industry. Increased community knowledge is expected to increase people's participation in beekeeping, hence improve their income. The conceptual framework is shown in Fig. 1.

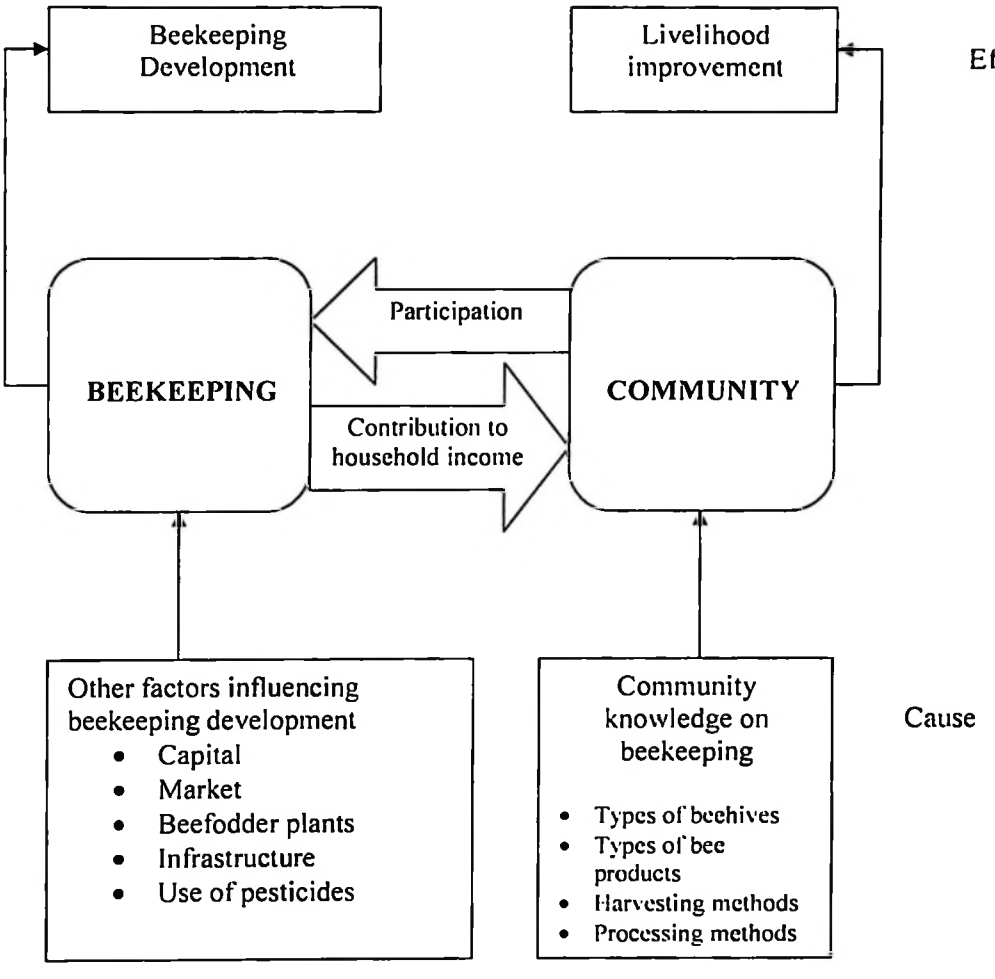

Figure 1: Conceptual framework underlying the study

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Beekeeping Practices in Tanzania

About 95% of all beehives in Tanzania are traditional and include log and bark hives which account for 99% of the total production of honey and beeswax in the country (Mwakatobe and Mlingwa, 2006). The indigenous knowledge some communities have regarding beekeeping has contributed to the success of traditional beekeeping in Tanzania as compared to modern beekeeping practice. Indigenous knowledge is defined as part of local knowledge which people in a given community have tested over centuries of use and adapted to local culture and environment (FAO. 2005). Traditional beekeeping is the oldest and the richest practice, which has been carried out by the people for thousands of years (Belie, 2009). In traditional beekeeping, honey and beeswax can be collected using simple materials and tools which are readily obtainable from the forests and homesteads (Ntenga and Mugongo, 1991). The production potential of bee products in Tanzania is estimated to be high, but this production potential is not attained even though materials and tools for traditional beekeeping are simple and readily available. The national production of bee products is less than 5% of the production potential (MNRT, 1998). Mwakatobe and Mlingwa (2006) classified production potentials in Tanzania into areas as high producing areas, medium producing areas and unexploited areas.

The high potential for beekeeping has given rise to various initiatives aimed at improving the efficiency and productivity of traditional methods (Fischer, 1993).

Introduction of manufactured equipment like the frame hive and transitional hive are among the initiatives for improving the efficiency and productivity of traditional methods in Tanzania. The improved beehives can house high populations of bees and so maximise the

beehive products each season (TVE, 2004). A study conducted by Yirga and Teferi (2010) in Northern Ethiopia revealed that the average yield of honey was higher from modern hives and low from traditional hives. The higher the yield obtained from improved beekeeping technology, the easier it is to convince the beekeepers to adopt the technology (Abebe *et al.*, 2008). The rate of adoption of the improved beekeeping technology by beekeepers is low, although the technology is more productive. Also social mobilization and training may increase the rate of adoption of improved beekeeping technology (Bhusal and Thapa, 2005).

2.2 Community Knowledge on Beekeeping

Traditional beekeeping has been relatively successful for so many years in Tanzania because traditional beekeepers are rich in the knowledge about the honeybees and their management, the phenology of the bee-fodder plants and the associated beekeeping calendar (Kihwele *et al.*, 1993). Despite the long-time success of beekeeping in Tanzania, some communities still lack knowledge on beekeeping that lead to underutilization or destruction of the high existing beekeeping potential in their areas. The habit of honeybee hunting for example is a result of lack of beekeeping awareness. This has adverse impact to the honeybee resource and the ecosystem at large (Lietaer, 2009). Honeybee hunting involves locating a natural colony of bee and setting the colony on fire in order to harvest the colony (Matanmi *et al.*, 2008).

Indigenous knowledge among beekeepers has an adverse impact on the quantity and quality of bee products (Lalika and Machangu, 2007). Lack of beekeeping knowledge among people affects their participation in beekeeping as an income generating activity. Low productivity and poor quality of bee products are the major economic impediments for beekeepers (Nuru, 1999). Knowledge in honey and beeswax handling to maintain quality and quantity is poor (MNRT, 2004). The production of bee products could increase by 50%,

if its potential could be optimally exploited (Mlay. 1997). The optimal exploitation of beekeeping potential is possible through raising beekeeping knowledge among communities and provides them with adequate extension services including improved beekeeping technology. The addition of a little technical information, however, can lead to greatly improved harvests of honey and beeswax (Bradbear, 2004).

2.3 Contribution of Beekeeping to Household Income

Non-timber forest products such as honey and beeswax are of important forest products especially in dry land areas where they form alternative sources of livelihood to the communities (FBD, 1999). They contribute to poverty alleviation through generation of income. Mwakatobe and Mlingwa (2005) revealed that beekeepers in Manyoni district for example, accrued an average income per beekeeper of TAS 574 403.20 which was pronounced to be the highest income as compared to other income generating activities such as farming, livestock keeping and petty business. Pokhrel (2004) reported that out of the total income of the beekeepers in Nepal, 78.35% was from beekeeping and rest from crop production. Research done in six communities in Tanzania found that farmers were deriving up to 58% of their cash income from the sale of honey, charcoal, fuel wood, wild fruits and vegetables (CIFOR, 1999). In India, beekeeping is a unique industry providing supplementary income to a large number of hilly rural tribal people as well as horticulturalists and agriculturalists (Tripathi, 1998).

2.4 Constraints to Beekeeping

2.4.1 Lack of initial capital

Indigenous knowledge enables beekeepers to carry out beekeeping activities at minimal cost, as it does not need heavy investment in terms of financial and human capital (Lalika and Machangu, 2007). Moreover, beekeeping does not require large area of land and water

and can be practised by both men and women. Unfortunately, there are still many people in rural areas unable to afford even a traditional beehive to start a beekeeping project.

2.4.2 Inadequate extension services

Lack of efficient beekeeping extension services is among the critical problems in East Africa resulting in low productivity (Masalu, 1997). Beekeepers and trainers often lack appropriate training materials (Bradbear, 2004). Insufficient extension materials and facilities are hampering extension work (MNRT, 1998). As a result beekeeping extension services are not effectively reaching the beekeeping stakeholders. Training is often theoretical rather than practical, placing emphasis on changing the type of hive used without providing practical guidance and follow up (Bradbear, 2004). The adequate extension services are essential for the betterment and sustainability of beekeeping because is of vital importance for its success and appropriate promotion of beekeeping in rural areas where beekeeping potential exists. Extension service is therefore crucial for successful promotion of beekeeping through the transfer of skills and knowledge from specialists (Saville, 2000).

2.4.3 Decline of bee-fodder and use of pesticides

Flowering plants and bees are interdependent because one cannot exist without the other (Bradbear, 2004). Flowering plants play great role in production of nectar and pollen as essential raw materials for beekeeping industry. Declining natural forest cover and the use of pesticides in vermin control are constantly affecting the industry's capability (MNRT, 1998). Activities such as charcoal making, shifting cultivation and mining activities are among the causes for the decline of natural forests which are the habitats and sources of nectar and pollen for bees. Pesticides are essential and frequently needed to produce profitable crops, but the excessive use of agricultural pesticides is harmful to honeybees either directly and indirectly. Indiscriminate application of pesticides in crop fields may

destroy the whole population of honeybees (Thapa and Wongsiri, 1996). Not only foragers visiting crops are exposed to pesticides; hive bees and larvae feeding on pollen and nectar stored in the combs are also exposed to the fatality (Pham-Delègue *et al.*, 2002).

2.4.4 Poor infrastructure and marketing

Development of beekeeping activities for income generation and forest management is hindered by poor transport, infrastructure and marketing systems for bee products (Ngaga *et al.*, 2005). The honeybee products may fail to reach the markets in time when the products are highly demanded because some of the rural areas in Tanzania are not easily accessible due to poor infrastructure. External factors such as industrial and infrastructure development efforts will have a major impact on the success or failure of the beekeeping sector (Husselman *et al.*, 2010).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

3.1.1 Geographical location and Size

The study was conducted in six villages namely Igekemaja, Lugeye, Nyalikungu, Ng'haya, Manala and Mkula located in six different wards known as Kisesa, Kitongo Sima, Magu Urban, Ng'haya, Badugu and Mkula respectively (Fig. 2). The six wards in which the study was conducted are located in six different divisions of Magu district. Geographically, Magu district is located between 33° 00′ and 34 ° 33′ longitude east of Greenwich and 2° 33′ and 3° 15′ latitude South of Equator. It borders Ukerewe district to the North, Mara region to the North-east, Shinyanga region to the South-east, Kwimba District to the South and Ilemela District to the West. Magu district occupies a total area of 4 795 km^2 of which 3 070 is landmass and Lake Victoria covers 1 725 m^2. The district covers 13.6% of the total area of Mwanza region.

3.1.2 Administration and population

Administratively, Magu district consists of 6 divisions, 27 wards and 125 villages.

According to URT (2002) the population in Magu district was estimated to be 416 113 whereby 202 077 were males and 214,036 were females. The population in the study villages is shown in Table 1.

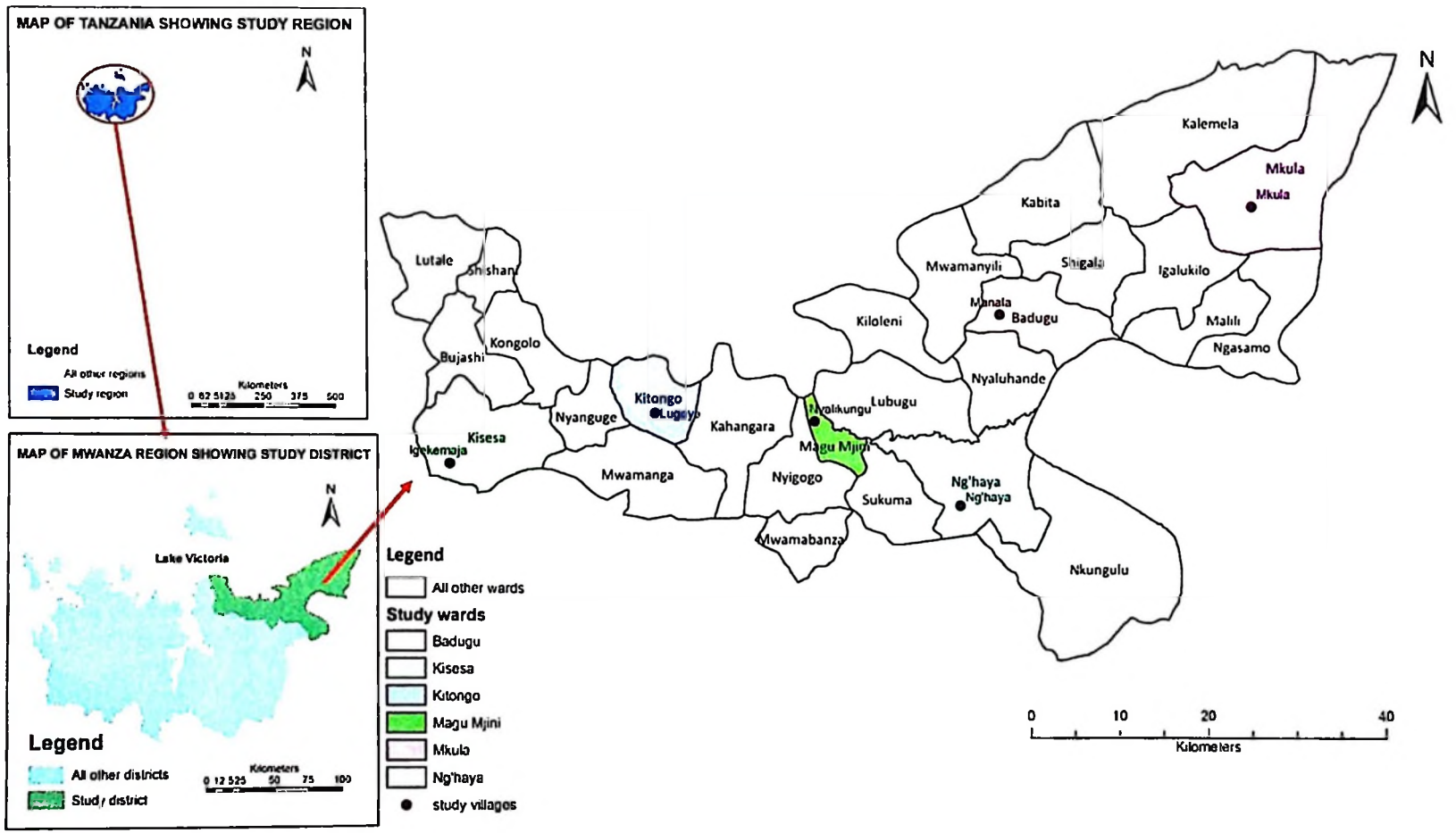

Figure 2: Map of Magu district showing study wards and villages

Table 1: Attributes of human population in the study area

S/N	Village	Female	Male	Total	Households
1.	Igekemaja	845	1 055	1 900	135
2.	Lugeye	1 350	1 256	2 606	550
3.	Nyalikungu	6 006	4 197	10203	2 420
4	Ng'haya	812	835	1 647	108
5	Manala	929	870	1 799	294
6	Mkula	3 321	6 783	10 104	1 008
Total		**40 151**	**13 263**	**28 259**	**14 996**

3.1.3 Socio-economic activities

The major economic activities of people in Magu are farming, livestock keeping, fishing and business. They cultivate both cash and subsistence crops. Main cash crops cultivated are cotton, rice, sweet potatoes and cassava, while the main food crops cultivated are cassava, sweet potatoes, rice, sorghum and millet. Animal kept include cattle, goats, sheep, pigs and poultry.

3.1.4 Topography, climate, soils and vegetation

Land in Magu district is generally flat with 80% lying between 0 and 35% slope. All drainage systems flow towards Lake Victoria. The climate for Magu is described as tropical humid to tropical semi-arid in some seasons. There is a bimodal rainfall pattern with short rain season from October to December and the long rain season from March to May. Maximum mean annual rainfall is about 800 mm. In the upper parts of the landscape the soil type is mostly sandy with poor fertility, low moisture holding capacity. Soil texture changes down slope towards the valley bottoms, becoming more clay with higher fertility than either hill sands or hardpan soils. The main natural vegetation type found in Magu district is *acacia* woodland.

3.2 Study Design

Data collection session was preceded by a reconnaissance survey, which was conducted for the purpose of providing a general picture of the study area and pre-test data collection methods. During data collection, a cross–sectional research design as suggested by Casley and Kumar (1998) was adopted. This design allows collection of information at one point in time without repetition. The design was preferred in this study because it is effective and economical both in terms of time and resources, also it provides quick results.

3.3 Sampling procedures

Six villages from all six divisions of Magu district were sampled purposively based on accessibility and beekeeping records obtained from the District Beekeeping Office. Also, all known households of beekeepers were first identified in each village of study hence sampled purposively. This purposive sampling was conducted in order to increase chances for beekeepers to be sampled since they were very few. Consequently, each village sampled had at least one beekeeper and a household was the sampling unit. In order to make a total of 30 households in each village of study (Bailey, 1994), remaining names were picked randomly from village register books. This procedure optimised opportunity to collect enough information from both beekeepers and non-beekeepers.

3.4 Data Collection

The study involved collection of both primary and secondary data. Primary data were collected using variety of data collection tools including key informants' interviews, focus group discussion, questionnaire survey, and direct observation (Appendix I). Secondary data were collected from relevant publications, journal articles, books, various government reports, electronic sources on the internet and both published and unpublished related

documents. Sources of information include Magu District Natural Resource Office, Village offices in the study area and Sokoine University National Agriculture library (SNAL).

Focus group discussions (FGD) and pair-wise ranking were the main PRA techniques employed. FGD was used for the purpose of identifying constraints on development of beekeeping and to verify answers on community knowledge on beekeeping with the aid of structured household questionnaires (above) through opening up discussions with villagers. Respondents in FGD and pair-wise ranking were left free to brainstorm and come out with a list of beekeeping constraints. Thereafter, pair-wise ranking method was used to compare the importance of each single constraint with each other through discussion in order to get to a final ranking. Pairwise ranking is a structured method for ranking a small list of items in priority order (Appendix 2). A total of 90 respondents from the six villages participated in six different PRA meetings. In each village of study, 15 respondents made the PRA group. The selection of people to participate in PRA was assisted by Village Executive Officers (VEOs). Each group included four elders, five middle aged, five youth and one village government leader. Gender sensitivity was given priority to remove the traditional notion that beekeeping is only for men, and this case five females were among the 15 PRA group members.

A total of 180 structured household questionnaires were administered to heads of households (Appendix 3). The questionnaires consisted of both open-ended and close-ended questions and were conducted in Swahili language. The open–ended questions helped to get the respondents' views regarding the problem under the study while with closed-ended questions; respondents were provided with alternative answers. Information on beekeeping practices and extent, community knowledge on beekeeping, contribution of

beekeeping to the average annual household income relative to other income generating activities and the constraints of beekeeping industry were captured. Also, a Checklist was used to guide discussions with key informants (Appendix 4). According to Mettrick, (1993) key informants are individuals who are accessible, willing to talk and have a great depth of knowledge about issues in question. Key informants interviewed included six Village Government leaders, 12 village elders two from each village, two honey sellers at Magu district market and one District Beekeeping Officer. These discussions were focused on beekeeping potentials, community knowledge on beekeeping, benefits of beekeeping, main sources of nectar and pollen, availability of markets for beehive products, and potential constraints of beekeeping.

Since Mettrick (1993) emphasise on the need for research to keep eyes open when visiting a study, the researcher had an opportunity to compare what the respondents reported against really on the ground through direct observation method.

3.5 Data Analysis

3.5.1 Determination of the relationship between beekeeping and socio-economic factors

The relationship between dependent variables and independent variables were analysed using two multinomial regression models. The community knowledge on beekeeping and the extent of beekeeping practice were used as dependent variables. Meanwhile education level of respondents, initial capital to start beekeeping, beekeeping education, availability of good markets for beehive products and availability of other sources of income were used as independent variables.

Independent variables

X_1 = Education level of respondent (years of schooling). It is assumed that increase in educational level of local communities tend to have positive effect on increasing beekeeping awareness, and the extent of beekeeping by enhancing people's participation in beekeeping activities.

X_2= Initial capital to start beekeeping. To start beekeeping activities, an individual requires an initial capital. It is assumed that capital may have positive effect to beekeeping development because an individual with capital is likely to invest in beekeeping. This variable has positive or negative sign of estimate β and was coded with a value of 1 if respondent had initial capital and a value of 0 if otherwise.

X_3= Beekeeping education. Provision of beekeeping education to the local community will increase community knowledge on beekeeping and the extent of beekeeping. It is assumed that Individuals provided with beekeeping education will be involved in beekeeping activities. This variable has positive sign of estimate β and was coded with value 1 if respondent had beekeeping education and 0 if otherwise.

X_4= Availability of good markets for beehive products. Availability of good markets for beehive products will have positive effect to development of beekeeping industry by encouraging more participation of people in beekeeping. The assumption is that good markets will increase community knowledge on beekeeping and the extent of beekeeping practice. This was coded with value of 1 if good markets are available and 0 if unavailable.

X_5= Availability of other sources of income. It is assumed that availability of other sources of income that are even more productive than beekeeping in a particular area will have negative effect on development of beekeeping industry through discouraging people to participation in beekeeping and hence lower the knowledge on beekeeping and the extent of beekeeping. Respondent was asked to indicate his/her main sources of incomes.

Multinomial regression equation

The combined multinomial regression model equation is presented below:

$$Z_{1-2} = \beta_0 + \beta_1 X_{1} + \beta_2 X_2 + \cdots \beta_n X_n \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where;

Z_1 = community knowledge on beekeeping

Z_2 = the extent of beekeeping practice

β_0= a constant showing intercepts for regression equation

$\beta_1 - \beta_n$= independent variables coefficients

$\chi_1 - \chi_n$= independent variables

e = error term

The hypotheses to be tested:

H_0: Independent variables have no significant contribution on the extent of beekeeping practice and community knowledge on beekeeping ($p>0.05$).

H_a: Independent variables have significant contribution on the extent of beekeeping practice and community knowledge on beekeeping ($p<0.05$).

3.5.2 Determination of community knowledge on beekeeping

Determination of community knowledge on beekeeping was based on types of beehives, importance of beekeeping, types of beehives products, proper honey harvesting method, uses of honey and beeswax and finally proper honey processing method. The index scale

method in line with the method employed by Poucher (2001) was used to analyse data on determination of the respondents' levels of awareness on beekeeping. Six test questions weighing 24 points in total, of which each question carrying four points were designed and administered through questionnaire (Appendix 3). The levels of beekeeping knowledge were determined by dividing the scores into four (4) different categories namely no beekeeping knowledge, low beekeeping knowledge, average beekeeping knowledge and high beekeeping knowledge. Determination of the level of beekeeping knowledge of an individual group was made by using the mean score of an individual group of respondents i.e. by adding total number of points and then dividing by the total number of respondents in that group assigned. Percentiles were used to denote the various levels of beekeeping knowledge and the ranks for level of knowledge (Table 2). Thus, the levels of beekeeping knowledgewere determined using percentile or mean calculation.

Table 2: Percentiles and their ranks for levels of beekeeping knowledge

S/N	Percentiles	Ranks for level of awareness
1	0% ≤ 25%	No beekeeping knowledge
2	26% ≤ 50%	Low beekeeping knowledge
3	51% ≤ 75%	Average beekeeping knowledge
4	76% ≤ 100%	High beekeeping knowledge

3.5.3 Determination of the mean annual income differences

Z–statistic was used to test if there was any significant difference between the mean annual incomes of beekeepers and non-beekeepers and also if beekeeping contribute significantly to the mean annual household income (Equation 2).

$$Z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(S_1)^2}{n_1} \times \frac{(S_2)^2}{n_2}}} \quad \text{..... (2)}$$

Where;

$\bar{X}_1$ = mean annual household income of beekeepers

$\bar{X}_2$ = mean annual household income of non-beekeepers

S_1 = standard deviation of beekeepers

S_2 = standard deviation of non-beekeepers

n_1 = sample size of beekeepers

n_2 = sample size of non-beekeepers

3.5.4 Determination of constraints of beekeeping

The importance of each beekeeping constraint brought forward through a PRA technique (i.e. focus group discussions) was determined in the field with the help of participants by pair-wise ranking, and the results were acknowledged by the members. Also, through the questionnaire Surveys, each respondent was asked to list down constraints of beekeeping and then highlight only one that he/she thought was most influencing. The total scores obtained for each listed constraint were used as observed frequencies. Expected frequencies were calculated by dividing the total number of respondents to the total number of constraints that were listed. The hypothesis tested was that all the constraints had equal influence on beekeeping.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Beekeeping Practices and the Extent of Beekeeping in Magu

4.1.1 Beekeeping Status in Magu

Out of the 180 respondents interviewed, majority 167 (92.8 %) were non-beekeepers and only 13 (7.2%) were found to practice beekeeping. It was further observed that all beekeepers in the study area were men at the age ranging between 34 and 74 years old, and eight of them were elders over 60 years of age. Similarly a study by Hassan and Ndibalema (2002) in Lake Rukwa Basin revealed that younger men take little or no interest in beekeeping due to perception that the activity is of less profit to them. Among the 13 beekeepers, five respondents were involved with traditional beekeeping using traditional beehives, while the rest were practicing modern beekeeping using improved beehives of the type Tanzanian Top Bar Hive. In five households, seven honeybee colonies were left on nearby trees without being provided with any beehive (Plate 1). Also in other three households, three colonies were left indoors either dwelling up on the roof or inside cupboards (Plate 2). The honey from 'free' colonies is harvested very occasionally and sometimes the colonies are left without being harvested for some years due to the traditional belief that the honeybees are relatives of humans especially the indoors bee colonies. This is similar to observations in India where traditionally certain cliffs were venerated and marked as sacred by the bee hunters and there was no harvesting of honey from bees nesting on those cliffs (Sharma, 2008). Furthermore, the relationship between people and bees was also reported in the study by Leo (2008) that Toda people greet the bees before they inspect the honey store.

Plate 1: A honeybee colony hanging on top of a mango tree at Igekemaja village (Shown within a red oval)

Plate 2: A honeybee colony left indoors inside cupboard in Mkula village

4.1.2 Number and type of beehives

A total of 74 traditional and modern beehives occupied with honeybees were recorded in the study area (Plates 3, 4 & 5).Three types of traditional beehives were observed, namely: barrel type, bucket type and gourd type in which 31 were barrel type, two (2) were bucket type and four (4) were gourd type. The barrel type was more preferred among the traditional beehives because of their higher honey production, durability and availability. These were the biggest in size and could accommodate larger honeybee colonies compared to other types of traditional beehives found in the study area.

Plate 3: A Transitional Beehive of the type Tanzanian Top Bar Hive at Lugeye Village

Plate 4: A traditional beehive of a gourd type at Manala village

Plate 5: A traditional beehive of a barrel type hanged on a tree at Ng'haya village

Variation was observed in the number of beekeepers and type and number of beehives among the villages studied. While the highest number of beekeepers and beehives were recorded in Lugeye, the lowest number of beehives was recorded in Mkula village (Table 3).

Table 3: Number of beekeepers, type and number of beehives in the study area

Village	No. of beekeepers	No. of beehives		Total No. of beehives
		Traditional	Transitional	
Igekemaja	1	18	0	18
Lugeye	7	2	21	23
Nyalikungu	1	0	10	10
Ng'haya	1	13	0	13
Manala	2	2	6	8
Mkula	1	2	0	2
Total	**13**	**37**	**37**	**74**

The high number of beekeepers and beehives especially transitional type in Lugeye village was probably due to beekeeping awareness created to some residents by Vi–Agroforestry, a Non-Governmental Organization (NGO). Beekeeping education that was provided in Lugeye raised people's interest in beekeeping and probably was the reason for the high number of beekeepers and beehives as well. Furthermore, focus group discussions in Lugeye village revealed that beekeeping education was given twice in that particular village by the NGO, and there was an established beekeeping group namely Nyuki – Lugeye "A" (NYULA). The group was in process of establishing an apiary. A total of 12 respondents from Lugeye village had received beekeeping training from the NGO, and of these seven were active beekeepers and members of the beekeeping group. Moreover, the study observed a beekeeping expert from Vi–Agroforestry providing beekeeping education to members and non–members of the beekeeping group in Lugeye (Figure 8). As a result

beekeepers in the remaining villages acquired traditional knowledge of beekeeping from friends, their parents and grandparents.

Plate 6: Non-members and members of NYULA beekeeping group on a beekeeping training at Lugeye village

4.1.3 Sources of nectar and pollen

The interviewed beekeepers responded that *Mangifera indica*, *Acacia* trees ("Mihale in Sukuma"), *Eucalyptus* trees, *Azadirachtin indica*, *Ficus spp*, *Moringa oleifera*, cultivated crops, shrubs and herbs were the main sources of nectar and pollen. Similarly a study conducted by Deffar (1998) showed that *Eucalyptus* plantations were good honey plants in Ethiopia. The average distance one can travel from home to find areas suitable for hives to be sited was 1.47 km. Majority (52 respondents, 28.9%) had their houses within a distance of 1 km away from areas rich in bee-fodder, 46 (25.6%) within 2 km, 32 (17.8%) within 0.5 km and 22 (12.2%) within 1.5 km. The distance from homesteads to areas rich with bee-fodder in the study area was not a limiting factor for respondents to practice

beekeeping if compared to other areas. A study conducted by Hassan and Ndibalema (2002) in Lake Rukwa basin found that beekeepers spent a minimum average walking time of 3 hours from homestead to apiary and a maximum walking time of 11.5 hours.

4.1.4 Honey and beeswax production and their uses

In the study area, 77% of beekeepers started beekeeping in 2009 and had not harvested any bee products by the time of this study. Those found in production started beekeeping activities between 1994 and 2006. A total harvest of honey recorded in 2009 in the study area was 225 litres with an average of 64 litres per year per beekeeper. There was no record of harvest of beeswax in the study area because it was considered as a waste product. After honey extraction, the beeswax is discarded due to lack of knowledge about its value, lack of processing skill and equipment/materials. As result no beekeeper had benefited from the product.

Almost all honey harvested was sold to local consumers though at least 2-3 litres would be retained for home use. The honey was sold at a price ranging between TAS 3000 to 8000 per litre. The honey was used for food, medicine and local beer ("wanzuki" in Sukuma). About 95% of the amount of honey bought in the study area was used for local beer making. This result was similar to what Hartmann (2004) found in Ethiopia where about 80% of the total Ethiopian honey production goes in to the local Tej-preparation, a honey wine, which is consumed as national drink in large quantities. Also Mwakatobe and Mlingwa (2006) found that about 50% of honey produced in Tanzania is sold locally for honey beer production.

In the study area, honey was found to be used as medicine either by itself or in mixture with other herbal medicine. For instance, a mixture of honey and herbal medicine (name

was withheld by respondents) commonly used by many traditional healers in the study area was believed to remove misfortune to people. The treatment is locally known as "samba" in Sukuma and the medicine is administered through small cuts that are normally made on skin at various parts of the body using razor blade. Also most respondents used honey to treat burns, wounds, abdominal ulcers, cough, and skin diseases. Similarly Bradbear (2004), and Lalika and Machangu (2007) reported that honey was used for healing wounds, stomach ulcers, burns, anaemia in children and for skin treatment.

4.1.5 Honey hunting

Honey hunting is an activity that is widely practiced in some forest areas where honeybees are abundant. A total of 62 respondents (34.4%) were involved with honey hunting using fire. As result, in 2009a total of 110 honeybee colonies were hunted in all six villages (Table 4). This is similar to observations in Nigeria in Oyo State where about 20% of the bee hunters used fire to kill bees (Matanmi *et al.*, 2008). The number of bee colonies per hunter ranged between one and four, but on average was two honeybee colonies per hunter. Lugeye and Mkula reported the highest number of honey hunters as well as number of hunted bee colonies (Table 4). The high number of honey hunters hence high number of bee colonies hunted was interpreted in two ways: -probably it signifies high beekeeping potentials or high demand for honey in those particular areas, meaning that the honey produced does not meet the demand. About 37% and 53% of respondents in Lugeye and Mkula respectively had low awareness on beekeeping. Similarly, the high number of honey hunters may be attributable to low beekeeping knowledge since none of the 62 honey hunters was reported to receive any beekeeping training. Respondents who had received beekeeping education were less likely to hunt honey than those who had not received beekeeping education ($r = -0.224$, $df=178$ $P=0.003$).

Table 4: Number of honey hunters and number of honeybee colonies hunted in 2009

Village	Manala	Ng'haya	Igekemaja	Nyalikungu	Mkula	Lugeye
Honey hunters	9	9	7	9	13	15
Honeybee colonies hunted	13	15	16	14	23	29

4.1.6 Relationship between extent of beekeeping and socio-economic factors

Respondents with beekeeping education were more likely to practice beekeeping than those without (Table 5). The contribution of other independent variables namely other sources of income, initial capital, availability of markets and respondent's education to the extent of beekeeping were not statistically significant (Table 5).

Table 5: Likelihood Ratio Test between the extent of beekeeping and socio-economic factors

Socio-economic factors	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	χ^2	df	P
Intercept	17.69	<0.01	0	
Other sources of income	23.28	5.59	4	0.232^{ns}
Initial capital	19.63	1.95	2	0.378^{ns}
Availability of market	19.75	2.06	2	0.356^{ns}
Beekeeping education	60.74	43.05	2	<0.001***
Respondent's education level	19.62	1.93	4	0.749^{ns}

***Statistically significant at P< 0.001, ^{ns} = not statistically significant at P<0.05

4.2 Community Knowledge on Beekeeping in Magu District

4.2.1 Levels of community knowledge on beekeeping

Four levels of beekeeping knowledge were identified among 180 respondents in which majority indicated a moderate level of beekeeping knowledge (Table 6). Three out of

seven respondents that were reported to have no knowledge on beekeeping were recorded in Nyalikungu village. However, 70 respondents were reported to have low level of beekeeping knowledge and out of them 32 were recorded in Mkula and Igekemaja. Five out of eight respondents that were reported to have high level of beekeeping knowledge were recorded in Lugeye village. This could be attributed to the fact that in the five villages other than Lugeye village there was no beekeeping education that was provided to the communities.

Table 6: Levels of community knowledge on beekeeping in the study area

S/N	Level of beekeeping knowledge	Number of respondents	Mean score (%)
1	No beekeeping knowledge	7	18.5
2	Low beekeeping knowledge	70	41.2
3	Moderate beekeeping knowledge	95	60.2
5	High beekeeping knowledge	8	80.7
Total		**180**	

Based on all 180 respondents per each attribute of beekeeping knowledge, the general results indicated that, respondents showed high level of knowledge on the method of harvesting honey with a mean score of 89.4% and moderate level of beekeeping knowledge on the types of beehives and method of extracting honey with a mean score of 60.8% and 56.1% respectively. Also respondents showed a level of low beekeeping knowledge on the importance of beekeeping and uses of honey with a mean score of 43.6% and 48.2% respectively, while on the use of beeswax respondents indicated a level of no beekeeping knowledge with a mean score of 7.9%.

4.2.1.1 Knowledge on types of beehives

A level of no beekeeping knowledge on the types of beehives was observed among eight respondents; these were unable to list a single type of beehive. On the other hand, 125 respondents were found to have low level of beekeeping knowledge because were only familiar with either one or two types of traditional beehives such as pots, gourds, logs, barrel and baskets. Traditional beehives made up of pots, gourds and barrels were the most listed probably because these were the only common available of materials for hive construction in the study area. High level of beekeeping knowledge was observed among 47 respondents; these were aware of both traditional and modern types of beehives. But most of respondents who scored high knowledge on types of beehives reported that they observed modern type of beehives away from the study district. This is an indicator that modern types of beehives are not very common in the study area.

4.2.1.2 Knowledge on the importance of beekeeping

A total of 70 respondents were recorded with a level of no beekeeping knowledge since were able to list only one importance of beekeeping out of four that were asked. These were capable of listing honey and beeswax production as the only importance of beekeeping. Low beekeeping knowledge was observed among 88 respondents who were able to list down only two out of four the importance of beekeeping; they listed honey production and income generation. This high percent indicate that knowledge on the importance of beekeeping is not known among many people and this could probably be the reason why only few people were involved in beekeeping in the study area. Meanwhile, 20 respondents showed a moderate level of beekeeping knowledge and were capable of listing three out of four the importance of beekeeping, namely, honey and beeswax production, income generation, and pollination service. The rest two respondents were

recorded to have high level of beekeeping knowledge because they managed to list more than three the importance of beekeeping which included honey and beeswax production, income generation, pollination service and environmental conservation. The high knowledge that was observed among the two respondents was due to beekeeping education provided in Lugeye village.

4.2.1.3 Knowledge on beehive products

A level of no beekeeping knowledge on the type of beehive products was recorded to118respondents; hey managed to list down honey as the only beehive product out of four bee products that were asked. The other 55 respondents were able to list two out of four beehive products, these include honey and beeswax, and therefore the results suggested low knowledge at a mean score of 50%. Moderate beekeeping knowledge at a mean score of 75% was observed among six (6) respondents who were able to list three out of four beehive products i.e. honey, beeswax and propolis. High beekeeping knowledge at a mean score of 100% was observed to only one respondent who was able to list all the four common types of beehive products namely honey, beeswax, propolis and pollen. Respondents that showed moderate and high knowledge on types of beehive products all were from Lugeye village and had already received beekeeping education.

4.2.1.4 Knowledge on honey harvesting methods

A level of no beekeeping knowledge was observed among 19 respondents on the use of bee smoker in honey harvesting. Burning honeybee colonies before collecting honey was the only best known method of honey harvesting for them. However, majority of respondents 161 (89.4%) were aware of use of bee smoker. Furthermore, they showed knowledge on various local bee smoker fuel materials such as dry cow dung, dry *Aloe vera*

leaves and cotton. Similarly, Lalika and Machangu (2007) found that smallholder beekeepers in Lindi and Kilwa had good knowledge of different types of hives, bee smokers and honey containers. Alternatively, respondents used a mixture of water and grounded leaves of the herbs locally known as "Makonda" in Sukuma to spray on the hanging honeybee colonies to calm the bees during honey harvesting.

4.2.1.5 Knowledge on honey extraction methods

Of 180 interviewed respondents 78 were recorded with a level of no beekeeping knowledge on proper method for honey extraction. To them, the proper honey extraction method was either boiling honeycombs without adding water or adding water into honeycombs before boiling. This kind of honey extraction method was familiar to these respondents because most of them had observed this from honey hunters. The method resulted into production of low quality honey but still was the most common honey extraction method to the honey hunters in the study area. Contrary, majority 102 indicated high level of beekeeping knowledge on proper honey extracting method and responded that the method of breaking the honeycombs into small pieces and then placing them on top of a sieve for honey to flow down into collection container by gravity or squeezing the honey combs without addition of water or something else were the proper method since the procedure result to honey of high quality compared to other traditional method of honey extraction. The respondents claimed that the best and suitable honey for medicinal use must be pure meaning that neither mixed with water nor boiled during extraction process. Furthermore, it was also stated by respondents that honey extracted through boiling honey combs was suitable for other uses rather than medicinal purposes because the honey became contaminated with liquid beeswax.

4.2.1.6 Knowledge on the uses of honey and beeswax

A total of 34 respondents had a mean score of 0% and the result indicated a level of no beekeeping knowledge on the uses of honey because were unable to list even a single use of honey, while 124 respondents showed low level of beekeeping knowledge at a mean score of 50% because they managed to list two out of four uses of honey were asked, the uses of honey listed were food and medicine. The other 22 respondents were recorded to have moderate level of beekeeping knowledge at a mean score of 75% by listing three out of four uses of honey, these included food, local beer making and medicinal use for treatment of peptic ulcers, burns and skin diseases, while none of respondents indicated high level of beekeeping knowledge because not even a single respondent listed all the four uses of honey asked. In the case of beeswax uses, majority 170 respondents had a mean score of 0% hence indicated a level of no beekeeping knowledge on the use of beeswax, not even one was able to list a single use of beeswax out of four uses asked. Low beekeeping knowledge at a mean score of 50% was observed among 10respondents who were able to list two out of four uses that were asked, the uses listed included candle making and baiting in the beehives. None of the respondents scored a level of moderate and high knowledge because neither of them listed three or four uses of beeswax. This was probably attributed by lack of beekeeping education. Generally, there was preference of using honey harvested from indoor colonies due to its quality, which is perceived to be suitable for medicinal purposes. The good quality of indoor honey is linked to use of bee smoker to calm bees during harvesting instead of flames that not only destroy colonies but also cause contamination of honey with bee parts such as legs and wings, hence reduced honey quality. The need for quality honey probably has been the motive for increased knowledge on proper honey harvesting methods and honey extracting methods.

4.2.2 Relationship between community beekeeping knowledge and socio-economic factors

Table 7 indicates that independent variables namely other sources of income and beekeeping education depicted correlation with the dependent variable namely community knowledge on beekeeping. The availability of different sources of income generating activities other than beekeeping limited most people to participate in beekeeping activities, as a result low knowledge on beekeeping among the community (χ^2=2134, df=62, P<0.001). However, beekeeping education enhanced community knowledge on beekeeping (χ^2=97.11, df=31, P<0.001). On the other hand, the socio-economic factors namely, availability of markets for beehive products and education level of respondents had no effect on community knowledge on beekeeping.

Table 7: Likelihood Ratio Tests between community beekeeping knowledge and socio-economic factors

Socio-economic factors	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	P
Intercept	210.3	0	0	.
Other sources of income	2345	2134	62	<0.001***
Availability of markets	216.1	5.75	31	1.00^{ns}
Beekeeping education	307.4	97.11	31	<0.001***
Respondent's education level	247.8	37.43	62	0.994^{ns}

***Statistically significant at P<0.001, ^{ns} = not statistically significant at P<0.05).

4.3 Contributions of Beekeeping to Household Income

4.3.1 Major sources of income

Four income generating activities were identified in the study area, namely, farming (crop production), livestock keeping, business and beekeeping. Most of respondents (76%) were involved with more than one activity; though in combination the majority, 178 (50.0%) were involved with farming followed by livestock keeping (103; 28.9%), petty business (62; 17.4%) and beekeeping (13, 3.7%).

4.3.2 Household income for beekeepers and non-beekeepers

The mean annual household income for households involved with beekeeping based on records of beekeepers that had already sold their bee products was TAS 1 023 000±171 484.69 whereas that for non-beekeeping households was TAS 835 700±1 011 058.71 (Mean±Standard Deviation). Though the mean annual household income for beekeepers was higher than for non-beekeepers, the difference was not statistically significant, (Z = 1.500, v_1=3, v_2=177, P=0.133). Results of this study are similar to results reported for Lindi by Lalika and Machangu (2007) that income for beekeepers was higher than for non-beekeepers.

4.3.3 Percentage contribution per income generating activity

Percent contribution of each activity to the mean household income of both beekeepers and non-beekeepers varied. The mean annual income for non-beekeepers was highly contributed by farming (39.7%) followed by petty business (39.2%) and finally 21.1% from livestock keeping (Fig. 4). Majority of respondents (98%) were engaged in farming activities especially in rice and cotton as cash crops, whereby 18.9% and 13.7% of the mean annual income are generated, respectively.

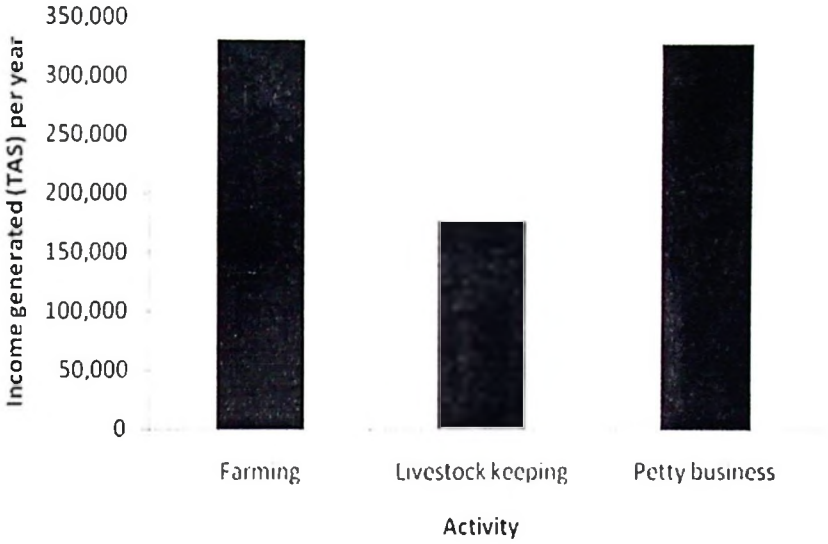

Figure 3: Contribution of income generating activities to annual household income for non-beekeepers

The mean annual income for beekeepers was highly derived from beekeeping (31.7%) followed by petty business (27.4%), then farming (24.8) and finally 16.1% from livestock keeping (Fig. 4). The contribution of beekeeping to the annual household income would probably have been higher than it is if all beekeepers in the study area were producing and finding market for their honey and beeswax. Farming being a third contributor of the mean annual income of beekeepers, 18% of the mean annual income was derived from selling rice crop only.

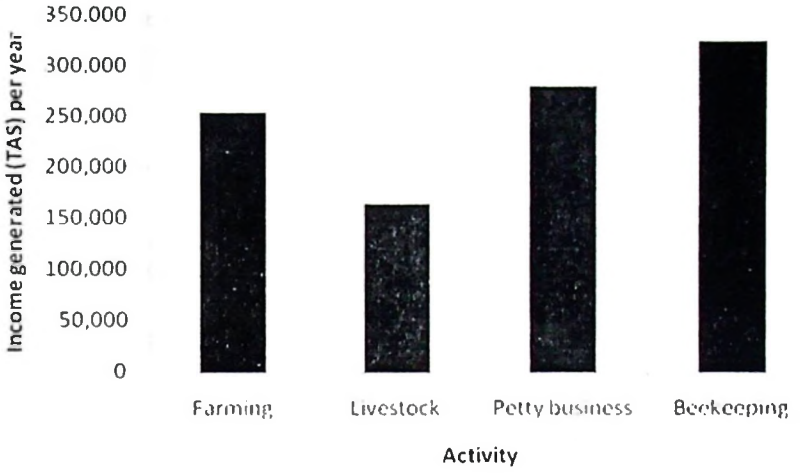

Figure 4: Contribution of income generating activities to annual household income of beekeepers

4.4 Constraints to Beekeeping Development in Magu

The hypothesis that all the constraints had equal influence on beekeeping development was statistically tested and the results found that the influence of the constraints to beekeeping development was not equal; some constraints were more significant than others in influencing beekeeping development in Magu (χ^2=306.44, df=6, P<0.001) (Table 8)

Table 8: Chi-square test on significance of the constraints influencing beekeeping

S/N	Factors	Observed Number	Expected Number	Residual
1	Lack of beekeeping knowledge/skill	97	25.7	71.3
2	Fear of honeybee sting	49	25.7	23.3
3	Shortage of beefodder/beeplants	26	25.7	0.3
4	Alternative activities	3	25.7	-22.7
5	Shortage of honeybee colonies	2	25.7	-23.7
6	Lack of capital	2	25.7	-23.7
7	Lack of markets for beehive products	1	25.7	-24.7
	Total	**180**	**180**	

This study identified eight main constraints facing development of beekeeping in Magu (Fig. 5). Similar constraints, order and ranks of the constraints were identified through pair-wise raking procedure (Table 9).

Table 9: Summary of pair-wise ranking results in the six villages of study

S/N	Village name	Beekeeping constraints and their number of counts per each							
		Lack of beekeeping knowledge	Fear of honeybee sting	Lack of beefodder	Lack of capital	Alternative activities	Shortage of honeybee colonies	Theft	Lack of markets for beehive products
1	Igekemaja	7	5	4	3	3	3	2	1
2	Mkula	7	6	5	4	2	2	1	1
3	Nyalikungu	7	5	5	4	4	2	1	0
4	Ng'haya	7	4	5	5	3	2	1	1
5	Manala	7	6	5	3	2	3	1	1
6	Lugeye	7	5	4	4	3	4	1	0
Total Counts		42	31	28	23	17	16	7	4
Rank		1st	2nd	3rd	4th	5th	6th	7th	8th

Based on significance of each constraint on beekeeping development in Magu, lack of beekeeping knowledge/skill, people's fear of bee sting and shortage of bee-fodder/bee-plants were recorded as the top three constraints (Fig. 5). Lack of capital to start beekeeping and availability of alternative activities were considered to have moderate influence on beekeeping development, while shortage of honeybee colonies, lack of markets and beehives theft were regarded as minor constraints. The study further revealed that the constraints acted either independent of each other or in combination.

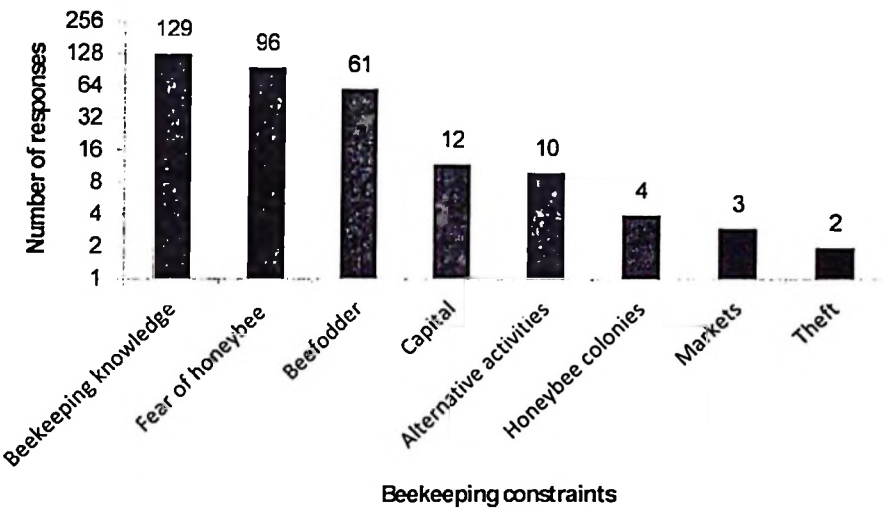

Figure 5: Number of responses on constraints to beekeeping in Magu district

Based on percent of influence how significant each constraint influenced beekeeping development in Magu, it was observed that the topmost three constraints were lack of beekeeping knowledge/skill followed by people's fear of honeybee sting and the third constraint was shortage of bee-fodder/beeplants (Table 10). Although shortage of bee-fodder was found to be among the top three beekeeping constraints; but through direct observation this study noticed that the study area had enough bee-fodder mostly located within two kilometres from the houses of the respondents. The high number of responses on lack of bee-fodder could probably be due the fact that most of respondents thought that beekeeping is only possible in dense forests. Lack of beekeeping knowledge was the major constraints to beekeeping in Magu. Similarly, Deffar (1998) reported that lack of beekeeping knowledge is among the major constraints that affect apiculture in Ethiopia. Also Ebojei *et al.*, (2008) found that lack of finance, deforestation, inadequate beekeeping equipment and theft were among the constraints to beekeeping in Nigeria.

Table 10: Significance of constraints to beekeeping development

S/N	Factors	Number of respondents	% of influence	Ranking
1	Lack of beekeeping knowledge/skill	97	54	1st
2	Fear of honeybee sting	49	27	2nd
3	Shortage of bee-fodder/bee-plants	26	14	3rd
4	Alternative activities	3	1.7	4th
5	Shortage of honeybee colonies	2	1.1	5th
6	Lack of capital to start beekeeping	2	1.1	5th
7	Lack of markets for beehive products	1	0.6	6th
	Total	**180**	**100**	

Out of five socio-economic factors, only two factors namely beekeeping education and the availability of alternative income generating activities were found statistically to have correlation of with the levels of community beekeeping knowledge.

Although annual household income for beekeepers was higher than for non-beekeepers, statistically the result was not significant. Therefore beekeeping was found only as a side-line activity to increase the mean annual income of beekeepers. The amount of honey produced per year in 2009 was found low due to small number of beekeepers in production. The demand for honey in the study was high because almost all the honey harvested was sold in the local markets and used locally for medicine and local beer making.

The eight constraints that were identified in the present study had significant effect on development of beekeeping in Magu. The study found that some constraints had much effect than others, but lack of beekeeping knowledge, fear of honeybee sting and shortage of beefodder were the topmost constraints. Lack of beekeeping knowledge /skill was statistically shown to hinder development of beekeeping in Magu. For the honeybee resources to be utilized fully and sustainably, the community as main stakeholder of beekeeping that lives in proximity to the resource must be provided with beekeeping extension services.

5.2. Recommendations

The effect caused by lack of beekeeping education to the community is very intense and cuts across many aspects that contribute to the development of beekeeping. This applies not only to Magu but to most parts of Tanzania where beekeeping forms an important

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The study found that the number of beekeepers was definitely small compared to the number of non-beekeepers in the core study area. Further observation showed that all beekeepers were men and most of them were of old age rather than young age. Therefore beekeeping was regarded as an old activity for old men. Moreover, this study identified the availability of free honeybee colonies hanging on trees and some were kept indoors. However, availability of nectar and pollen at an average distance of 1.47 km away from the residential areas is the evidence that currently there is sufficient honeybee resource in Magu district and that there is great potential for beekeeping industry in the district.

The study noted that some of respondents were only honey hunters rather than beekeepers and the number of honey hunters was about five times the number of beekeepers. Also the number of honeybee colonies hunted was large indicating high unmanaged beekeeping resource. There was correlation between beekeeping education and honey hunting meaning that the more beekeeping education is provided to community the less the number of honey hunters. Furthermore, only beekeeping education as one of the socio-economic factors found to correlate positively with the extent of beekeeping practice in Magu.

High level of community beekeeping knowledge was observed on the method of honey harvesting and moderate level of knowledge on the types of beehives and method of extracting honey. The high and moderate levels of knowledge on the uses of honey were attributed by indigenous knowledge respondents had on such hive product. Also low level of knowledge was recorded on the importance of beekeeping and uses of beehive products.

source of livelihood. The government and other beekeeping stakeholders such as NGOs should join hands and provide beekeeping education and other extension services to communities in order to exploit fully and sustainably the resource available through increasing number of modern beekeepers. Beekeeping education will also reduce honey hunting pressure through converting honey hunters into modern beekeepers and will help to remove notion in most communities that beekeeping is an activity suitable for only men and aged people.

Establishment of bee reserves whether private or public is encouraged in the National Beekeeping Policy, but only few bee reserves currently exist in our country. These bee reserves are very important in conservation of both forests and honeybee resource. Alongside with beekeeping education the community should also be instructed on the procedures for establishment of bee reserves so as to increase their number as well as to improve beekeeping.

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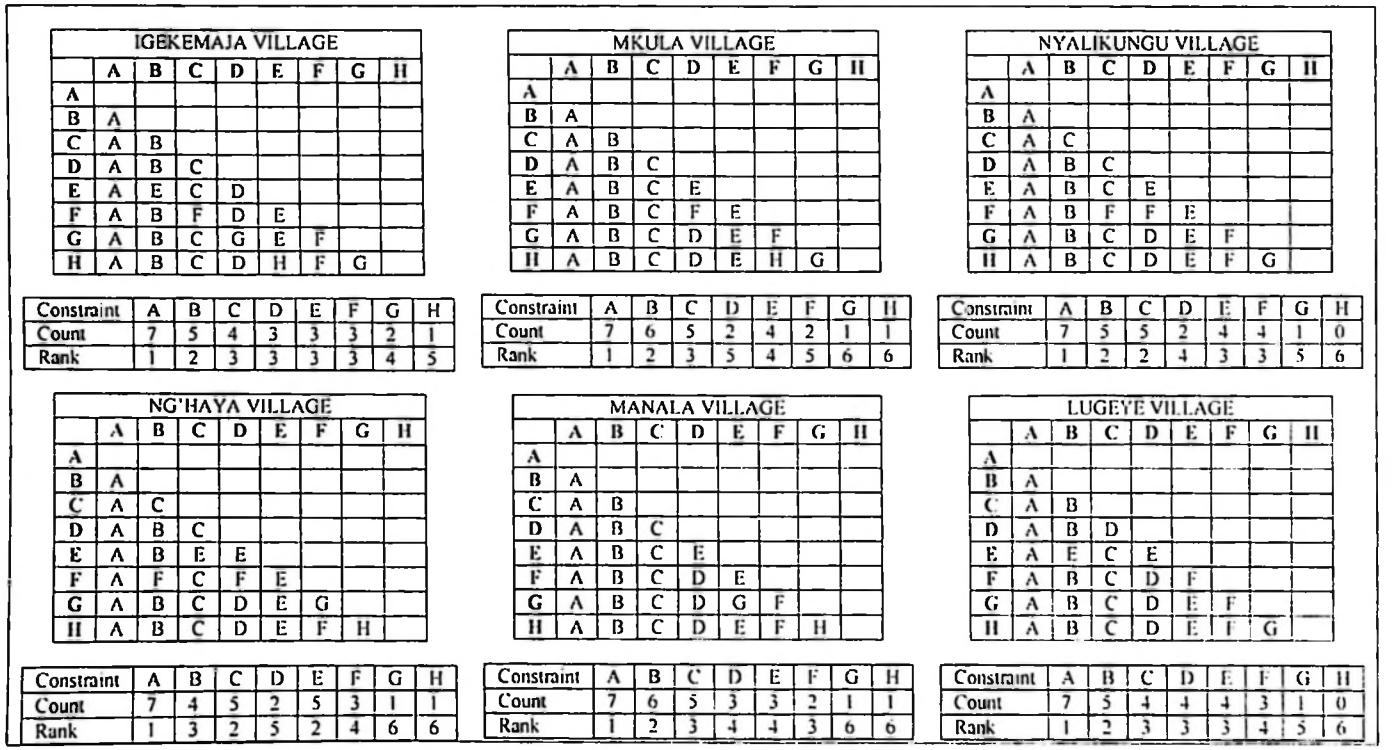
APPENDICES

Appendix 1: Summary of methods of data acquisition and analysis for each specific objective

No	Specific Objective	Data collected	Method of Data collection	Technique of data analysis
1	To determine beekeeping practices and assess extent of beekeeping in Magu district	Number of beekeepers and non-beekeepers number and types of beehives available.	Questionnaire survey and Direct observation.	Multinomial regression model. Pearson correlation and percentages
2	To assess community knowledge on beekeeping as an economic activity in Magu district	Understanding of respondents on the importance of beekeeping. types and importance of beehive products, types of beehives. harvesting methods. processing methods, and honey hunting habits.	Focus group discussion. Questionnaire survey and Direct observation.	knowledge index scale method. percentages and multinomial regression model descriptive statistical analysis (percentages)
3	To determine contribution of beekeeping to household income relative to other economic activities	Yields of honey and beeswax. selling prices. annual household income from beekeeping and from other socio-economic activities.	Questionnaire survey and direct observation	Descriptive statistical analysis (percentages and average and Z-statistic
4	To determine and assess current and potential factors of beekeeping in Magu district	Various socio-economic factors including education level of respondents. initial capital to start beekeeping, extension services. market prices of beehive products. source of income and other constraints influencing development of beekeeping.	Focus group discussions (PRA). Questionnaire survey and Direct observation	Pairwise ranking method and Chi Square analysis

Appendix 2: Pair-wise Ranking Matrix for all six (6) villages of study



IGEKEMAJA VILLAGE

	A	B	C	D	E	F	G	H
A								
B	A							
C	A	B						
D	A	B	C					
E	A	E	C	D				
F	A	B	F	D	E			
G	A	B	C	G	E	F		
H	A	B	C	D	H	F	G	

Constraint	A	B	C	D	E	F	G	H
Count	7	5	4	3	3	3	2	1
Rank	1	2	3	3	3	3	4	5

MKULA VILLAGE

	A	B	C	D	E	F	G	H
A								
B	A							
C	A	B						
D	A	B	C					
E	A	B	C	E				
F	A	B	C	F	E			
G	A	B	C	D	E	F		
H	A	B	C	D	E	H	G	

Constraint	A	B	C	D	E	F	G	H
Count	7	6	5	2	4	2	1	1
Rank	1	2	3	5	4	5	6	6

NYALIKUNGU VILLAGE

	A	B	C	D	E	F	G	H
A								
B	A							
C	A	C						
D	A	B	C					
E	A	B	C	E				
F	A	B	F	F	E			
G	A	B	C	D	E	F		
H	A	B	C	D	E	F	G	

Constraint	A	B	C	D	E	F	G	H
Count	7	5	5	2	4	4	1	0
Rank	1	2	2	4	3	3	5	6

NG'HAYA VILLAGE

	A	B	C	D	E	F	G	H
A								
B	A							
C	A	C						
D	A	B	C					
E	A	B	E	E				
F	A	F	C	F	E			
G	A	B	C	D	E	G		
H	A	B	C	D	E	F	H	

Constraint	A	B	C	D	E	F	G	H
Count	7	4	5	2	5	3	1	1
Rank	1	3	2	5	2	4	6	6

MANALA VILLAGE

	A	B	C	D	E	F	G	H
A								
B	A							
C	A	B						
D	A	B	C					
E	A	B	C	E				
F	A	B	C	D	E			
G	A	B	C	D	G	F		
H	A	B	C	D	E	F	H	

Constraint	A	B	C	D	E	F	G	H
Count	7	6	5	3	3	2	1	1
Rank	1	2	3	4	4	3	6	6

LUGEYE VILLAGE

	A	B	C	D	E	F	G	H
A								
B	A							
C	A	B						
D	A	B	D					
E	A	E	C	E				
F	A	B	C	D	F			
G	A	B	C	D	E	F		
H	A	B	C	D	E	F	G	

Constraint	A	B	C	D	E	F	G	H
Count	7	5	4	4	4	3	1	0
Rank	1	2	3	3	3	4	5	6

Key:

Constraints to beekeeping

A. Lack of beekeeping knowledge/skill
B. Fear of honeybee sting
C. Lack of beefodder
D. Shortage of honeybee colonies

E. Lack of capital
F. Alternative activities
G. Theft
H. Lack of markets for beehive product

Appendix 3: Questionnaire for households in Magu district

The questionnaire collected information on beekeeping status, socio-economics, community knowledge on beekeeping and factors influencing development of beekeeping.

Date of interview.....

District ..... Division.....

Ward..... Village.....

Village registration number.....

Name of enumerator.....

1.0. Household particulars

1.1. Questionnaire number .....

1.2. Respondent's name.....

1.3. Sex of respondent (Tick appropriate answer).

1. Male ☐ 2. Female ☐

1.4. Age of respondent: .....years

1.5. Education level (Tick appropriate answer).

S/n	Education level	Years of schooling	Code
i	informal education		1
ii	Primary education		2
iii	Secondary education		3
iv	Others (specify)		4

1.6. Main occupation *(Please fill in the space provided below)*

.....

2.0. Community knowledge on beekeeping

2.1. Are you aware that honeybees can be kept / managed?

1. Yes		2. No	

2.2. Honeybees are kept or managed in beehives that are mainly classified into two main types; mention these two types of beehives.

a. .....
b. .....

2.3. Is beekeeping important to you?

1. Yes		2. No		3. Don't know	

2.4. Why do you think that beekeeping is important? Mention at least four importance of beekeeping you know

a. .....
b. .....
c. .....
d. .....

2.5. If no, explain why?

.....
.....

2.6. Various beehive products are produced by honeybees, mention at least four beehive products you know

a..... b.....
c ..... d.....

2.7. Which of the following statements describe the best way of harvesting honey from a beehive? *(Cycle the best answer)*

A. Burn the honeybees with fire to kill them, and then start collecting honey peacefully

B. Use bee smoker to smoke the bees and wait for a while for bees to calm down, and then start collecting honey

C. Wait at night when all honeybees are falling asleep, and then start harvesting honey from a hive without any use of fire or smoke

D. Wait during the day when all honeybees are away collecting for nectar and pollen, and then start harvesting honey from a hive without any use of fire or smoke

2.8. Mention at least four uses of honey and four uses of beeswax you know

Uses of honey:

a. .....
b. .....
c. .....
d. .....

Uses of beeswax:

a. .....
.....
b. .....
c. .....
d. .....

2.9. Which of the following statements describe the proper method of extracting honey after harvesting? *(Cycle the best answer)*

A. Boiling the honeycombs without adding anything and then sieve to extract honey

B. Add other substances e.g. water to the honeycombs, boil and sieve to extract honey

C. Break the honeycombs into small pieces and then sieve to extract honey

D. Add other substances e.g. water to the honeycombs and sieve to extract honey

3.0. Factors influencing development of beekeeping

3.1. Have you ever been taught anything about beekeeping? (*Circle the number corresponding to your answer*)

1. Yes 2. No

3.2. If Yes: Who taught you about beekeeping?

1. Extension officer(s) 2. The NGO's

3. A friend 4. Other

(Specify).....

3.3. Have you ever tried practice beekeeping?

1. Yes 2. No

3.4. If no, explain why?

.....

.....

3.5. Do you hunt honey from unmanaged honeybee colonies?

1. Yes 2. No

3.6. If yes, how many times have you hunted this year? .....

3.7. What are the uses of honey in your home? (list and explain where possible)

.....

.....

.....

.....

3.8. What constraints threaten/hinder beekeeping development currently?

a. .....
b. .....
c. .....
d. .....
e. .....
f. .....
g. .....

3.9. What constraints are likely to threaten/hinder beekeeping development in future?

.....

.....

.....

3.10. From the constraints you mentioned above (3.8) which constraint (s) influence(s) most?

.....

3.11. How far do you travel to find areas rich with beeplants (km or hrs)

.....

4.0. The extent and type of beekeeping

4.1. Are you currently a beekeeper?

1. Yes 2. No

4.2. If yes, when did you start practice beekeeping? *(year)*.....

4.3. What type of honeybees do you keep?

1. Stinging honeybees 2. Stingless honeybees 3. Both

4.4. What type of beehives do you use?

1. Traditional beehives 2. Modern beehives 3. Both

Reason.....
.....

4.5. How many beehives do you have? *(fill in the table below)*

Traditional beehives					**Modern beehives**		
Log	Grass	Bark	Clay	Other (specify)	Tanzanian TBH	Kenyan TBH	Commercial beehive

4.6. Which tree species that are commonly used for construction of log beehives?
.....
.....

4.7. How many beehives are currently occupied with honeybee colonies?

1. Stinging honeybees..... 2. Stingless honeybees.....

4.8. Do you ware bee protective gears during honey harvesting process?

1. Yes 2. No

4.9. If no, Explain why?

.....

4.10. Do you use bee smoker during harvesting?

1. Yes 2. No

4.11. If no, why?

.....

4.12. How do you protect yourself from honeybees and how do you calm honeybees during honey harvesting process? *Explain.*

.....

.....

5.0. Contribution of beekeeping and other sources of income to household income

5.1. Since you started beekeeping practice have you ever harvested?

1. Yes 2. No

5.2. Approximately how much do you harvest per hive?

1. .....litres of honey 2. .....kilograms of beeswax

5.3. Which tree species are the main sources of nectar and pollen for production of beehive products?

.....

.....

5.4. How much in total did you harvest in the last season?

1. .....litres of honey 2. .....kilograms of beeswax

5.5. Do you have good markets for selling your beehive products?

1. Yes 2. No

5.6. To whom do you sell your beehive products? .....

1. Local consumers 2.Companies 3. Middlemen

5.7. At which price do you sell your product?

1. .....per litres of honey 2. .....per kilo of beeswax

5.8. How much did you earn in the last season after selling all of your beehive products? .....TAS.

5.9. What are the major sources of your household income?

S/n	Sources of household income	Tick	Code
i	Farming (Crop production)		1
ii	Livestock production		2
iii	Fishing		3
iv	Beekeeping		4
v	Business		5
vi	Others (specify)		6

5.10. Cash crops grown this season. *(Fill particulars in the table below)*

s/n	Crop cultivated	Tick	Amount harvested (kg or bags)	Amount sold (kg or bags)	Price per kg or bag	Income generated (TAS)
1	Cotton					
2	Rice					
3	Sweet potatoes					
4	Cassava					
5	Other (specify)					
Total income						

5.11. Income generated from selling livestock. *(Fill particulars in the table below)*

s/n	animal	Tick	No. of animals sold	Income generated (TAS)
1	Cattle			
2	Goat			
3	Sheep			
4	Poultry			
5	Other (specify)			
Total income				

5.12. If you are involving with fishing activities, how much does it contribute to your household income?

1. .....TAS per month 2. .....TAS per year

5.13. If you are involving with business, which type of business are you involving with?

.....

5.14. How much does the business contribute to your household income?

1. .....TAS per month 2. .....TAS per year

5.15. What is your total household income from all your sources of income?

1. .....TAS per month 2. .....TAS per year

Appendix 4: Check List for Key informants

1. General information
    a. Name .....
    b. Title .....
    c. Organization.....
    d. Respondent. No. .....
2. Do you find any beekeeping potential in your area?
3. If yes, what are they?
4. Is your community aware of beekeeping?
5. Why do you think your community is aware or unaware of beekeeping?
6. Do you involve yourself in beekeeping activities?
7. If no, why? *(explain)*
8. If yes, what benefits do you receive from beekeeping?
9. Which tree species are the main sources of nectar and pollen for beekeeping production?
10. If you involve with beekeeping, how much do you harvest per hive?
11. Do you have good markets in your area for selling the honeybee products?
12. Do you remember a time when there was more honey/beekeeping/beekeepers?
13. What are the main constraints influencing development of the beekeeping in your place?
14. From the constraints you mentioned above, which factor (s) hinders/threatens development of beekeeping most in your place?
15. What constraints are likely to threaten/hinder beekeeping development in Magu district?