EXAMINATION OF FACTORS AFFECTING THE ADOPTION OF APICULTURE: THE CASE OF TRADITIONAL AUTHORITY NTHIRAMANJA, MULANJE DISTRICT, MALAWI

MSc. (Environmental Science) Thesis

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DECLARATION

I the undersigned hereby declare that this thesis is my own original work which has not been submitted to any other institution for similar purposes. Where other people's work has been used acknowledgements have been made.

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CERTIFICATE OF APPROVAL

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DEDICATION

To my wife Martha and daughters Victoria and Catherine, I am proud of you. Special dedications go to my mother Victoria, father Willard and brother Mark for your moral support.

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ABSTRACT

The study examined factors affecting the adoption of Apiculture in Traditional Authority (TA) Nthiramanja, Mulanje District in Malawi. Units of analysis were household heads in TA Nthiramanja, TA Chimaliro in Thyolo District, TA Chikumbu and TA Mabuka in Mulanje District. They were stratified as beekeeping and non-beekeeping household heads. Random sampling was used to select 60 household heads for each of the three categories: beekeepers from main study site, beekeepers from control sites and non-beekeepers.

A questionnaire was administered to characterise the socio-economic information of household heads. Key informant interviews and focus group discussions (FGDs) were used to triangulate data. Exploratory data analysis and logistic regression model were employed to determine factors affecting adoption of Apiculture. Statistical tests were conducted at 5% significance level using Statistical Package for Social Scientists (SPSS) and Excel.

The study showed that adopters and non-adopters had some similarities and differences in socio-economic characteristics. The study also revealed that the majority of hives for beekeepers [97.5% (233)] were constructed through environmentally friendly technologies.

Results also showed that harvesting technologies used by the majority of beekeepers [100.0 % (60)] were environmentally friendly. The total economic returns from Apiculture ranked second after crop farming.

A logistic regression model for adopters and non-adopters revealed that factors significantly affecting adoption of Apiculture in TA Nthiramanja were age (p=0.014), nature of secondary economic activities (p=0.000) and membership in cooperative organisations (p=0.001). Older household heads (50-59 years) were 1.399 (95% CI: 0.210, 9.319) more likely to adopt Apiculture than younger ones (20-29 years) and those aged 60 years and above were 1.113 (95% CI: 0.165, 7.515) times more likely to adopt than younger ones (20-29 years). Household heads whose secondary economic activities were on-farm in nature were 18.614 (95% CI: 4.754, 72.879) times more likely to adopt Apiculture than the rest. Household heads that subscribed to cooperative organisations were 13.349 (95% CI: 2.744, 64.993) times more likely to adopt than those who did not subscribe.

The study recommends that younger household heads, those whose secondary economic activities are off-farm, and household heads that do not subscribe to cooperative organisations should be encouraged to start Apiculture. Future studies should concentrate on consolidating the positive impact of Apiculture on forest cover in the study site. Other studies should concentrate on the quality of honey produced and harvested through environmentally friendly and unfriendly technologies.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAEDC	Assistant Agriculture Extension Development Coordinator
AIDS	Acquired Immune Deficiency Syndrome
ADRA	Adventist Development and Relief Agency
COMPASS	Community Partnerships for Sustainable Resource Management
ELDS	Evangelical Lutheran Development Services
EPA	Extension Planning Area
EU	European Union
FGDs	Focus Group Discussions
GOM	Government of Malawi
GTZ	German Technical Cooperation
HIV	Human Immuno Deficiency Virus
IGA	Income Generating Activities
IFSP	Integrated Food Security Programme
MEET	Malawi Environment Endowment Trust
MK	Malawi Kwacha
NAPHAM	National Association of People Living with HIV/AIDS in Malawi
NASME	National Association of Small and Medium Enterprises
NGO	Non Governmental Organisation
NSO	National Statistical Office
NEAP	National Environmental Action Plan
NWFP	Non-wood Forest Products
PROBEC	Programme for Biomass Energy Conservation

PRA	Participatory Rural Appraisal
SBDARA	Small Beekeepers Development and Research Association
SPSS	Statistical Package for Social Scientists
TA	Traditional Authority
USA	United States of America
USAID	United States Agency for International Development

CHAPTER 1

INTRODUCTION TO THE PROBLEM

1.1 Background and History

Natural resources in Malawi such as soil, water, flora, fauna and minerals are necessary for socio-economic development. The majority of people in the rural areas depend on these natural resources to sustain their livelihoods (Community Partnerships for Sustainable Resource Management, 2001). Consequently, numerous environmental problems such as soil erosion, deforestation, water resources degradation and depletion, threat to fish resources and biodiversity, air pollution and climate change arise (Government of Malawi, 1994). One mitigating measure to these environmental problems is engaging people in income generating activities (IGAs) like Apiculture.

Apiculture is derived from Latin name apis and the English word culture. It is defined as the science and art of raising honey bees (Smith, 2002). Apiculture is also known as beekeeping (Crystal, 1999). The two terms 'beekeeping' and 'Apiculture' can be used interchangeably. However, the term 'beekeeping' will be used throughout the paper.

Beekeeping started a long time ago when man learned to get honey by robbing the bees' nests in hollow trees or rock crevices (Grout, 1986). Later people learned to safeguard colonies of bees they found in hollow tree trunks or elsewhere by care and supervision.

This led to construction of beehives based on local materials and skills of the local communities. Initially, beehives were logs from fallen trees in which wild honey bees nested. Later, cork barks and planks were used. Earliest centres of cultures were in the Middle East where pottery vessels were made during most of the Neolithic Period from 5000 BC (Grout, 1986). Beekeeping was well developed in Egypt where pipe hives made from clay and other materials were used (Grout, 1986). Recorded European evidence shows that beekeeping in Southern Africa began in Angola in 1594 (Illgner, Nel, Robertson, 1998).

Beekeeping is a practice that plays an important role in promoting economic status of individuals and also serves as a means of environmental conservation. Illgner *et al.*, (1998) found that beekeeping is an ecologically and technically appropriate IGA for communities in some of the most economically and environmentally poor areas of Africa. Conservation of the environment through beekeeping happens in different ways. Firstly, being an IGA, beekeeping reduces pressure on other natural resources. Chimwaza (2005) documents that the poor and unemployed people solely depend on natural resources for a living because they do not have an alternative source of income. Dohse (2003) found that in Southern Africa, timber products and Non-wood Forest Products (NWFP) are exploited often illegally in order to satisfy the need for daily household food and income. This results into accelerated decline of forest cover which threatens the very source of people's livelihoods. Therefore, by practising beekeeping, the poor have alternative livelihoods which reduce their dependence on natural resources.

Secondly, beekeeping depends upon the availability of certain tree species that are associated with bees (Chanyenga, 2000). Therefore, beekeepers develop an interest to conserve local nectar and pollen producing vegetation (Illgner *et al*., 1998). Eventually, beekeepers become advocates of conserving forest resources (Gentry, 2001). Beekeeping is also a passive form of Agriculture for it does not require clearing of indigenous vegetation to make way for crops (Murless, 1995). Bees also facilitate pollination while gathering nectar from vegetation. This is beneficial for crops, orchards and wildlife habitats. According to Greer (1999), some of the crops pollinated by bees include almonds, apples, avocados, blue berries, cantaloupes, cherries, cranberries, cucumbers, sunflower and watermelons. Thirdly, beekeepers discourage the use of pesticides on crops because these kill the honey bees (Illgner *et al.*, 1998). The pesticides contaminate many foods and have been found in many body tissues even in remote areas of the world indicating that pesticides are globally distributed (Chiras, 1988).

Several studies have shown that beekeeping helps to conserve the environment. Iddi (2004) noted that, in Tanzania, beekeeping has helped to improve the environment and biodiversity in those areas reserved for the practice. Furthermore, beekeeping on communal forests located far away from villages in Ethiopia has helped to guarantee preservation of wide forest areas (Harmatan, 2004). Atkins (2003) also noted that the success of the massive tree planting scheme in Cape Verde in the year 2000 depended on bee pollination. In Taiwan, hived bees are brought to farms, greenhouses and glasshouses to facilitate pollination (Hwa Hu, 2005).

Total Transformation Agribusiness Ltd (2006) noted that beekeeping is an environmental protector in Mozambique. According to Total Transformation Agribusiness (2006) [1]southern region of Africa has vast potential for honey production through beekeeping. However, this potential is under-exploited. All the countries in the region except Zambia are net honey importers.

In Malawi, beekeeping is also regarded as one of the sustainable means of utilising forests (Total Transformation Agribusiness, 2006). Morris (2004) noted that honey from beekeeping remains a vital source of food as well as a useful supplement to household income if marketed. Government of Malawi (GOM, 2006) launched the Malawi Gold Standard Beekeeping Hidden Treasure Series on 28th April, 2006 whose aim is to encourage Malawians to take up beekeeping as a business and as a means to improve the environment. The Minister of Trade and Industry, in 2008, encouraged people in Phalombe District to conserve trees in order to boost up honey production and consumption (Chimpweya, 2008).

Currently, beekeeping in Malawi is practised at three different levels, namely: small-scale, medium-scale and large-scale. Small-scale beekeeping involves households who operate individually or under beekeeping associations. Some of them are found in Chitipa, Mchinji, Mwanza, Blantyre, Mulanje, Phalombe and Chikwawa (Total Transformation Agribusiness Limited, 2006).

[1] southern region of Africa includes South Africa, Zimbabwe, Botswana, Malawi, Swaziland, Zambia, Lesotho and Mozambique

The report further indicated that in 2006 there were a total of 3500 small scale beekeepers in Malawi with over half of them in the Northern Region. Medium and large-scale beekeeping is practised by private companies who produce honey at their respective estates and plantations. These include Kawalazi Estate in Nkhatabay, Chimpeni Estate in Zomba, Satemwa Estate in Thyolo and Chiwogoro Apiaries in Mzuzu (Total Transformation Agribusiness, 2006). A number of organisations have intervened to boost up production by training small-scale beekeepers in modern methods, namely: The Department of Forestry, Parks and Wildlife, National Herbarium and Botanical Gardens of Malawi, German Technical Cooperation (GTZ) and United States Agency for International Development (USAID). Other stakeholders involved in the promotion of beekeeping are National Association of Small and Medium Enterprises (NASME), Malawi Environment Endowment Trust (MEET), ECO products and Small Beekeepers Development and Research Association (SBDARA). At one point, honey from beekeeping was the only product out of all the NWFP that was doing well in Malawi (Nyirenda, 1993). Despite being a profitable business, the Minister of Trade and Industry, in 2008, noted that many people in Malawi are not interested in beekeeping (Chimpweya, 2008). Consequently, most of the honey consumed in Malawi was imported from Mozambique. Therefore, the research endeavored to find out factors affecting the adoption of beekeeping in TA Nthiramanja in Mulanje District.

1.2 Statement of the Problem

Beekeeping was promoted in TA Nthiramanja through Integrated Food Security Programme (IFSP). The IFSP was implemented by GTZ and European Union (EU) between August 1996 and September 2004 (Brinkmann, 2005). The major objective of the IFSP was to stabilise food security through Agriculture, forestry, family planning, income generation, food for work, health, water, household technology and food preparation (Brinkmann, 2005). The Programme targeted three of the six TAs in Mulanje District, namely: Juma, Nkanda and Nthiramanja which, at that time, were deemed food insecure (Gomonda, 2001). Beekeeping was introduced towards the end of the IFSP, precisely, between 2003 and 2004 (Manda, 2004), after realising that the trees planted during the Programme could yield other benefits. The objectives of the Beekeeping Programme were to provide households with nutritious food through honey, generation of income through sales of honey and bee wax and as a management tool for trees and forests which the communities had planted and established (Manda, 2004). Among the three TAs, Nthiramanja registered the highest number of participants in beekeeping (437) during the Beekeeping Programme (Manda, 2004). However, in 2007 the number of active beekeepers or adopters in TA Nthiramanja was 81 (personal communication with extension worker in TA Nthiramanja). Some abandoned beekeeping after some time, while others chose never to participate in beekeeping: these are non-adopters. However, factors affecting the adoption of beekeeping have not been systematically examined in the area.

1.3 Purpose of the Study

The purpose of the study was to examine the extent to which socio-economic factors affect adoption of beekeeping while promoting environmental conservation in TA Nthiramanja, Mulanje District, Malawi. Specifically, the study intended to:

(a) identify similarities and differences in socio-economic characteristics among adopters and non-adopters of beekeeping in TA Nthiramanja,

(b) investigate whether the production and harvesting methods used by beekeepers in TA Nthiramanja were environmentally friendly,

(c) compare the economic returns from beekeeping with the rest of other economic activities in TA Nthiramanja.

1.4 Research Hypotheses

The research was based on the following hypotheses:

(a) There were no significant differences in socio-economic characteristics among adopters and non-adopters of beekeeping in TA Nthiramanja,

(b) The production and harvesting methods used by beekeepers in TA Nthiramanja were not environmentally friendly,

(c) The value of economic returns from beekeeping was not different from the rest of the other economic activities in TA Nthiramanja.

1.5 Significance of the Study

By studying the factors affecting adoption of beekeeping, this research would become a means of promotion of the industry. This is so because many farming technologies that are introduced for adoption by individuals are affected by various socio-economic characteristics of the households which dictate what new innovations the farmers can possibly adopt (Kapanda, 2004). The results would advise organisations and other individuals concerned with beekeeping on strategies that would encourage its adoption in the study site. Eventually, this would contribute towards the conservation of trees in the study site because experience by beekeepers shows that individuals including non-adopters of beekeeping tend to avoid logging trees on which beehives have been set (Khoromana, K., personal communication). They do so due to fear of the bee stings and conflicts with the owner of beehives. Promoting beekeeping would contribute towards the achievement of the National Forestry Policy of Malawi which aims at sustaining the contribution of the national forest resources to the upliftment of the quality of life in the country by conserving the resources for the benefit of the nation (GOM, 1996).

Studying methods employed in the production of beehives and harvesting products from beekeeping helped to establish whether the methods were environmentally friendly or not. For example, construction of hives from barks and logs of trees can result in the loss of trees and sometimes in the demise of valuable bee forage plants (Towry-Coker, 1995) hence unfriendly production technologies. Therefore, this research provided the basis for recommending change or promoting methods that were being employed by the beekeepers for environmental sustainability.

A study of economic returns from beekeeping in relation to other economic activities helped to establish the relevance of beekeeping in the economic empowerment of beekeepers. In turn, this helped to formulate recommendation for adjusting the selling price of honey to help the beekeepers obtain more benefit from the practice. If the price adjustment was more favourable, more individuals would be encouraged to start beekeeping.

1.6 Definitions of Terms

Acre	A unit of area used in land measurement and equal to 0.013 km^2
Adoption	Decision to use an innovation
Agro-forestry	The cultivation of tree or bush crops sometimes alternating with annual food crops
Apiculture	Science of raising honey bees
Arthritis	Inflammation of a joint
Control	A parallel experiment used to verify an experiment
Demographic	Any aspect associated with human population as used in government, marketing and research
Diffusion	The process of spreading or dispersion of information, ideas and technology
Economics	Science that deals with the production, distribution and consumption of commodities
Economic returns	Profits realised from investments
Environment	The sum total of physical, biological, social, economic, political, aesthetic and structural surroundings of human beings

Extension officer	A person employed to communicate information to farmers, the public or any relevant people
Fibromyalgia	A disease characterised by pain in the muscles and connective tissues
Hectare	A metric unit of area equal to 100 ares or 2.471 acres
Innovation	A new idea or technology
Investment	Creation of productive assets
Sclerosis	Hardening of the artery or spinal cord
Technology	The use of tools, machines, materials, techniques and some power to make work easier and more productive
Tendonitis	A condition that causes significant pain on the tendon

1.7 Organisation of Work

This work has been presented in five chapters. Chapter one introduces the problem. It contains background and history, statement of the problem, purpose of the study, objectives and significance of the study. Chapter two reviews related literature and research on the factors affecting adoption of farming technologies including beekeeping. It also reveals production and harvesting techniques used elsewhere including their environmental effects. Furthermore, the chapter documents how beekeeping contributes economically to family income based on studies conducted elsewhere. Chapter three presents research design and methodology.

Specifically, it describes the study site, research methods, sources of data, sampling techniques, data collection techniques and methods for data analysis. The chapter also presents species of vegetation that were commonly found in the main study and control sites. It also describes limitations of the study. Chapter four presents and discusses research findings. It describes socio-economic characteristics of adopters and non-adopters of beekeeping. It also compares economic returns from beekeeping with the rest of the other economic activities among the different categories of respondents. The chapter explains the status of beekeeping especially when it started in both the main study and control sites, where hives are set, reasons for beekeeping, types of hives and harvesting techniques used, re-investments in beekeeping, reasons cited by non-beekeepers for not embarking on beekeeping and the relationship between beekeeping and forest conservation. The chapter presents and discusses the factors affecting adoption of beekeeping based on logistic regression model results. A comparison of results from the model with findings from other studies conducted elsewhere has been presented. Chapter five concludes the study findings, makes suggested recommendations and describes the implications the study has for future research.

CHAPTER 2

REVIEW OF RELATED LITERATURE AND RESEARCH

2.1 Theoretical Framework of Adoption of Technologies and Research Assumptions

Rogers (1995) defines adoption as the decision to make full use of an innovation. Chinangwa (2006) documents that farmers make decisions about adopting new technologies as part of the overall strategy for ensuring subsistence and cash income needs. The innovation-decision process involves five stages. These are: knowledge of an innovation, attitude towards the innovation, decision to adopt or reject, implementation and finally, confirmation of the decision (Rogers, 1995). Duvel (1994) reiterates that adoption behaviour is a mental process governed by a set of intervening variables, namely: individual needs, knowledge about the technology and individual perceptions about methods used in meeting those needs in a specific environment.

Technology adoption has been studied at different levels, namely: firm or household, industry and national level (Rubas, 2004). Some studies focus on how adoption of the technology spreads, others examine characteristics of technologies that tend to be adopted quickly, while other studies focus on characteristics of individuals, firms or industries that relate to adoption of the technology.

Consequently, Negatu and Parikh (1999) documented three theories to explain farmers' tendency to adopt farming technologies: the economic constraint model, the innovation-diffusion model and the technology characteristic model. The economic constraint model explains that a household's access to resources influences its willingness and ability to adopt a technological innovation (Vedeld, 1990). The innovation–diffusion model stipulates that a technology must be transmitted from researchers to farmers through extension service because farmers lack information and knowledge about the innovation (Rogers, 1995). The technology characteristic model explains that characteristics of the innovation influence decision making of the adoption and diffusion process (Vedeld and Krough, 2001).

Tolman (1967) echoes that the adoption behaviour of an individual is a function of socio-economic and environmental factors and that adoption is endogenous to the sum of the interacting forces in their situation. Vedeld (1990) documents that socio-economic characteristics affect decision making related to preferences and utility of resources. Chinangwa (2006) states that factors affecting adoption of farming technologies are physical, technological and socio-economic. Rogers and Stanfield (1968) found that some of the factors influencing adoption of innovations are socio-economic and technological. Kapanda (2004) reiterates that socio-economic factors differ from location to location and can either be positively or negatively related to the adoption of new innovations. All these studies clearly show that among the many factors affecting adoption of technologies are socio-economic factors. Therefore, this research focused on socio-economic factors affecting adoption of beekeeping. The study assumed that beekeeping is environmentally sustainable, especially in forest conservation.

It also assumed that beekeeping is economically valuable in TA Nthiramanja. Those who practise beekeeping are adopters while the rest are non-adopters.

2.2 Socio-economic Factors Affecting Adoption of Farming Technologies: An Empirical Analysis

Some of the socio-economic factors affecting adoption of farming technologies include: sex of an individual, age, marital status, education level, access to agricultural information, household size and labour, land tenure, land size, nature of income sources, income level, access to credit, membership in cooperative societies, number of months households experience food shortage, cropping pattern, livestock ownership and socio-cultural values.

The sex of an individual plays a role on adoption of farming technologies. Different societies have different roles for men and women (Lwesya, 2004). The roles are often acquired through socialization. Studies conducted by Wiyo, Lunduka and Nalivata (2002) in Malawi show that 77.0 % of the treadle pump adopters are male headed households with relatively high literacy level. Wiyo *et al.*, (2002) noted that, in some societies, women do not feel comfortable in using the pumps as they feel exposed and undignified.

Iddi (2004) found that in Tanzania, traditionally, beekeeping is men's work. Women are not involved because, by tradition, they are not allowed to gather around the evening fire where old men pass the skills to the younger generation.

Furthermore, women are not involved in beekeeping because of the nature of the job which involves sitting hives up in the trees, deep in the forest and sometimes at night, which seems to be dangerous and sometimes difficult for them. Harmatan (2004) also observed that in Ethiopia, beekeeping is traditionally men's job. Atkins (2003) also found that beekeeping in Mali is frequently almost exclusively a male occupation but the products are often used by women. In Nyumbani, a self sustaining village of Kenya, women engage themselves in basket weaving while men practise beekeeping (Sheffy, 2006). Total Transformation Agribusiness Ltd (2006) observed that the majority of beekeepers in Mozambique are men. On a different note, women in Lesotho are exceptionally very active in beekeeping. Retired professional women formed an association whose primary objective is to contribute to economic development through beekeeping and other activities (Total Transformation Agribusiness Ltd, 2006). Illgner, Nel and Robertson (1998) also found that in Zimbabwe, the chairperson and treasurer of the successful Bondolfi beekeeper's association are women. Furthermore, beekeeping is traditionally a male dominated activity in Kasempha District of Zambia. However, in recent years, female household heads have practised beekeeping because of the other economic constraints they face. However, most of the beekeepers in Malawi are males (Total Transformation Agribusiness Ltd, 2006).

Lwesya (2004) documented that the age of a farmer can influence the type of technology to adopt. For example, the youth may be more willing to use innovations that demand a lot of energy.

Ja'Far-Furo (2007) observed that in Nigeria the ages between 40 and 49 are within the category Banmeke and Olowu (2005) termed as eager to learn new innovations. Similarly, Thangata and Alavalapati (2003) found that the adoption of agro-forestry technology on Domasi Valley Farming System in Zomba is high on household heads whose ages are below 35. Studies conducted by Farinde, Oyedokun, and Soyeb (2005) in Oyo state, Nigeria, showed that the age of the majority of beekeepers ranges from 51 to 60 years while a minority is aged between 31 and 40 years. Saner, Cukur, Engindeniz, and Tollon (2004) in Turkey observed that the average age of beekeepers in their study was 43. Total Transformation Agribusiness Ltd (2006) found that the age of the majority of male and female beekeepers in Manica province of Mozambique ranges from 40 to 60 and 30 to 45, respectively.

The marital status of individuals seems to affect the way people make decisions in life, including adoption of new innovations. In some cases, married people have been regarded as more responsible than their counterparts. Studies conducted by Farinde *et al*. (2005) in Oyo State, Nigeria, show that the majority of beekeepers are married men.

Some researchers have noted that the level of education effects the adoption of some farming technologies. Lwesya (2004) is of the view that education attainment provides farmers with the basic skills that facilitate the transmission of technical knowledge, enhancing keeping farm records and making simple calculations required for deciding on the economic benefits of proposed innovations.

Ja' Far-Furo (2007) documented that formal education ranging from adult literacy classes to tertiary education provides flexibility of society towards change. Nelson and Phelps (1996) indicate that education enhances one's ability to receive, decode and understand information and educated people make good innovators. Education, therefore, speeds the process of technological diffusion. Lin (1991) echoes that though imperfect information causes new technologies to be risky, better educated people are more prepared to manage the risk. Chinangwa (2006) also found that farmers with a high level of education in Machinga and Zomba have access to off-farm jobs and credit to support business. Therefore, they are capable of using inorganic fertilizer as an option to improve soil fertility. However, Thangata and Alavalapati (2003) noted that educational attainment has no impact on adoption of agro-forestry on Domasi Valley Farming System. Dorfman (1996) also observed that education has a negative effect on adoption of new technology by apple growers in USA. Harper, Drees, Mjelde, Rister, and Way (1990) also found that education negatively affects adoption of an integrated pest management technology by apple growers in USA. Studies by Chinangwa (2006) in Zomba and Machinga show that increase in education level reduces adoption of agro-forestry because farmers with high education level have access to off-farm jobs and credit. Such farmers go for inorganic fertilizer because they can afford it.

Access to agricultural information is one of the factors that enhance the adoption of farming technologies. Chinangwa (2006) indicates that farmers get agricultural information through Agricultural Research and Extension Service, Non governmental organisations (NGOs) and friends.

Vedeld, Krough, and Moulton (1998) documented that extension workers tend to have good knowledge about farmers' social background knowledge, values, practical problems and opinions. Therefore, extension workers have a concise approach to farmers on what messages to convey, how to communicate and when to address the farmers. Studies conducted by Thangata and Alavalapati (2003) on Domasi Valley Farming System in Zomba show that farmers who adopt agro-forestry technologies have contacts with extension workers. On a similar note, Lwesya (2004) found that 87.0 % of treadle pump adopters in Kasungu District have contacts with extension workers while 81.0 % of non-adopters have no extension worker visiting them. Ja' Far-Furo (2007) in Adamawa State, Nigeria, noted that people got information about beekeeping through radio, television, fellow farmers, extension agents and literature. Studies conducted by Farinde *et al.* (2005) in Oyo state, Nigeria show that the majority of beekeepers gained the knowledge and skills through training, seminar and textbooks, but none of them had traditional or indigenous knowledge. Beekeepers around Mpatsa Hill in Phalombe District of Malawi stated that they learnt about beekeeping through Evangelical Lutheran Development Services (ELDS) and extension workers (Kumwenda, 2007).

Household size and labour availability can speed up or impede adoption of some farming technologies because some of the new technologies reduce the need for labour, whereas others increase it. Therefore when facing labour shortages, farmers may be less likely to adopt labour increasing technologies and more likely to adopt labour saving technologies (Feder and Umali, 1993).

Batz, Peters, and Janssen (1999) observed that Kenyan dairy farmers, who face labour shortages, are unlikely to adopt technologies that require more labour. Chinangwa (2006) documents that management practices for agro-forestry technologies depend on labour availability for successful use. Thangata and Alavalapati (2003) observed that an additional working member in a household increases the likelihood for agro-forestry adoption on Domasi Valley Farming System in Zomba. Studies conducted by Saner *et al.* (2004) in Turkey indicate that on average beekeeper families have an average of four persons. On the other hand, Kumwenda (2007) found that farmers around Mpatsa Hill in Phalombe manage beekeeping because they expressed that it does not require much labour, among other reasons.

Another important factor affecting adoption of farming technologies is land tenure. This is backed by Chinangwa (2006) who noted that the maximum yield potential for using some agro- forestry technologies takes a number of growing seasons. For example, renting land is usually done on annual basis. Therefore, farmers will prefer to use alternative technologies that can yield immediate results on rented land. Feder and Umali (1993) concluded that renters are less likely to adopt conservation practices than landowners. However, Polson and Spencer (1997) found that migrant farmers in Nigeria are more likely to adopt improved cassava varieties than landowners. This is because migrant farmers are less privileged in terms of access to land and other farming resources. Consequently, they are more aggressive in their adoption of improved varieties. Studies conducted by Saner *et al.* (2004) in Turkey show that 90.6% of the total land used for beekeeping was on own property.

Land size can affect adoption of farming technologies too. Households with smaller land holdings tend to be more risk averse due to uncertainties related to the technology (Thangata and Alavalapati, 2003). On the other hand, households that possess large land acreage have a higher potential of increased production, which enable them to invest and gain more from the technology. Negatu and Parikh (1999) found that farm size is an important component in determining adoption rates of farming technologies in Ethiopia. Since some agro-forestry technologies require a substantial amount of land, reduction of land size reduces the adoption of such agro-forestry technologies in an area (Chinangwa, 2006). Thangata and Alavalapati (2003) found that adopter and non-adopter households of agro-forestry technology on Domasi Valley Farming System have mean plot sizes of 6.2 and 4.4 hectares respectively. However, Illgner *et al.* (1998) found that in southern Africa beekeeping can be done even in those areas where little or no arable land exists.

Another important factor affecting adoption of farming technologies is nature of labour for income in a household. Chinangwa (2006) found that increase in off-farm labour income reduces use of livestock manure because the farmers can afford inorganic fertilizers. On the other hand, increase in trade income such as vegetable sales increases the use of livestock manure. This is the case because farmers who rely on trade income try to maximize profits by choosing livestock manure as opposed to inorganic fertiliser.

Income level and access to credit can influence decision making for adoption of farming technologies. Studies conducted by Chinangwa (2006) in Machinga and Zomba districts show that adoption of inorganic fertilizers as input for soil fertility improvement is high among farmers with high incomes because they can afford the fertilizer.

However, Mensing (1993) indicates that at its most basic level, beekeeping commands relatively minimal financial investment unlike production of many cash crops that require purchase of seeds, seedlings, pesticides and fertilizer. In addition, beekeepers can construct beehives from locally available materials that may not require expenditure of hard cash. However, Total Transformation Agribusiness Ltd (2006) observed that most farmers in Malawi cannot afford materials for beekeeping hence the need for provision of soft loans.

Membership in cooperative societies affects the adoption of farming technologies because it promotes farmer's knowledge and understanding of a particular technology (Chinangwa, 2006). Farinde *et al.* (2005) in Oyo State, Nigeria observed that 76.0% of beekeepers belonged to cooperative organizations. Kumwenda (2007) also noted that beekeepers around Mpatsa Hill in Phalombe District affiliated to an association that facilitates pricing and marketing of honey. Furthermore, through the association beekeepers pay less for packing bottles because they purchase in bulk. Illgner *et al.* (1998) observed that in Zimbabwe, Bondolfi Beekeeping Association has overcome the constraints that individuals encounter when transporting their goods to the closest major urban centres. Mutude (1997) states that beekeeping associations facilitate bulk sales of honey to traders who market the honey on their behalf. In due course, this enables beekeepers to penetrate urban retail markets ensuring a competitive price for their honey.

The number of months a household experiences food shortage affects adoption of farming technologies. This happens because food shortage tends to reduce the amount of time households spend in their own gardens.

Chinangwa (2006) found that households that have enough food harvest for the whole year are more likely to adopt agro-forestry than those that experience food shortage in Machinga and Zomba.

Cropping pattern seems to affect the adoption of certain farming technologies too. Chinangwa (2006) found that adoption rate of agro-forestry in Machinga and Zomba districts is higher among farmers that grow tobacco for cash than the rest of the farmers because they have access to information, capacity to mobilize labour resources and they are relatively less risk averse and more innovative than the rest. In the same study, Chinangwa (2006) observed that increase in groundnut growing increases the use of compost manure while increase in common bean intercropping with maize reduces the use of compost manure. However, beekeeping usefully complements crop production and may lead to increased yields and cash income if enough honey bees are present for pollination (Ntenga and Mugongo, 1991).

Livestock ownership seems to affect adoption of some farming technologies too. Studies conducted by Chinangwa (2006) in Machinga and Zomba reveal that farmers that have livestock are rich and therefore adopt inorganic fertilizer for soil fertility improvement. Apart from that, livestock owners access manures more easily and, therefore, use them in their fields.

Socio-cultural values such as consumption preferences, taboos and religious beliefs affect farmer's participation in adoption of farming technologies. New technologies that are introduced without addressing socio-cultural needs may not be sustainable (Kapanda, 2004).

Lwesya (2004) observed that the use of treadle pumps in groups of 10 or 20 promoted its adoption because it improves social security. Illgner *et al.* (1998) noted that beekeeping as a practice is culturally accepted in most of the parts of southern Africa.

2.3 Economic Importance of Beekeeping

Beekeeping has a considerable merit as a self-reliance strategy that can augment the income of small scale farmers with only a minimal financial expenditure (Illgner *et al.*, 1998). Studies conducted in Turkey by Saner *et al*. (2004) show that 72.7% of beekeepers obtain their income solely from beekeeping. This is evident among those who, on average, own more than 150 colonies. However, those who have less than 100 colonies earn 46.0 % of their total income from beekeeping. Iddi (2004) noted that, in Tanzania, beekeeping has helped to improve the socio-economic conditions and well being of farmers in Mwanagemebe, Sasilo and Kayui villages. Harmatan (2004) also noted that beekeeping is the main source of income in Ethiopian highlands, especially in the forests of Manjo and Shekacho. Ogaba (2005) found that beekeeping in Uganda provides a good opportunity for women to contribute towards reduction of household poverty as this enterprise has no significant requirement of land which women have no direct control over. Total Transformation Agribusiness Ltd (2006) found that beekeeping is an IGA that complements other activities mainly among small scale farmers in Mozambique. In Botswana, beekeeping is of vital importance in rebuilding and kick starting rural economic activity, especially that of women and youth (Total Transformation Agribusiness Ltd, 2006).

Beekeeping also creates employment opportunities for craftsmen who manufacture hives, smokers and other pieces of beekeeping equipment (Sosu, 1991). In Malawi, the government has adopted poverty reduction as one of its development strategies and beekeeping is a means for achieving that (Total Transformation Agribusiness Ltd, 2006).

2.4 Production and Harvesting Technologies Used in Beekeeping

Different methods are used when making beehives and when harvesting products from beekeeping. Methods used when making beehives are categorised as traditional and modern methods. Traditional methods involve use of local materials such as logs, barks of trees, bamboos, reeds, grass and clay. Traditional methods especially use of logs and barks encourage deforestation. This has resulted into overexploitation of trees in Babati District of Tanzania where shortage of traditional materials obliged some beekeepers to abandon beekeeping altogether (Ntenga and Mugongo, 1991). In North-Western Zambia, traditional beekeepers have recognised that increased beekeeping in Kabulamema has resulted in the absence of bark resources within an 8 kilometre radius of the settlement (Clauss, 1992). Bark hives are also used by majority of beekeepers in Zimbabwe and Mozambique (Illgner *et al*., 1998). On the other hand modern methods of making beehives involve use of planks especially those from trees such as gmelina and pine. Modern methods are environmentally sustainable because they involve use of fast growing and renewable plants. Unlike bark hives, modern methods do not encourage ring barking that kill trees. Some types of beehives made through this method are; box hives, Malawi standard hives, Kenya top bar hives and Langstroth (Total Transformation Agribusiness Ltd, 2006).

Different techniques are used during honey harvesting. The traditional beekeeper starts a smoky fire below the hive to scatter and pacify the bees (Crane, 1999). Lewis, 1992 documents that American Indians used fire torches for ecosystem management and honey harvesting. However, smoking of hives to collect honey inadvertently causes frequent bush fires (Guy, 1971). In Mozambique, traditional grass torches used as smokers are responsible for occasional bush fires (Total Transformation Agribusiness Ltd, 2006). Harmatan (2004) also found that in South-West Ethiopia, honey harvesting by knife damages brood and larvae of bees. Bees also attack human beings during harvesting. Tropical honeybees are known to be very aggressive (Illgner *et al*., 1998). The sting detaches from the bee and remains in the flesh of the person stung where it continues to pump in venom and attracts more bees to sting (Visscher, 2007).

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Study Areas

Study areas were categorised as main study site and control sites.

3.1.1 Main Study Site

The main study site was TA Nthiramanja in Mulanje District where beekeeping was promoted through the Integrated Food Security Programme (IFSP). Geographically, TA Nthiramanja is in the Southern Region of Malawi (Figure 1 and 2). It is located 35^{0} 18' East and 16^{0} 03' South. The northern part is in Thuchira Extension Planning Area (EPA) while the southern part is in Msikawanjala EPA. The total area for TA Nthiramanja is 111.5 km^{2}. A total of fifteen villages were included for the study, namely: Nthiramanja, Mtambo, Nakoma, Sambatiyao, Chonde, Mzinganyama, Majiya, Gumulira, Komwa, Chiuta, Mwamadi, Abunu, Kayano, Kamtunda and Kululira (Figure 2).

The total population of TA Nthiramanja is 41, 900 (GOM, 2008). The average elevation for the area is 67.2 meters. On average, 80% of the soil is loamy while 20% is sandy. Temperatures are generally warm and hot at times, but very cold during the cold season. Rainfall ranges from moderate to heavy.

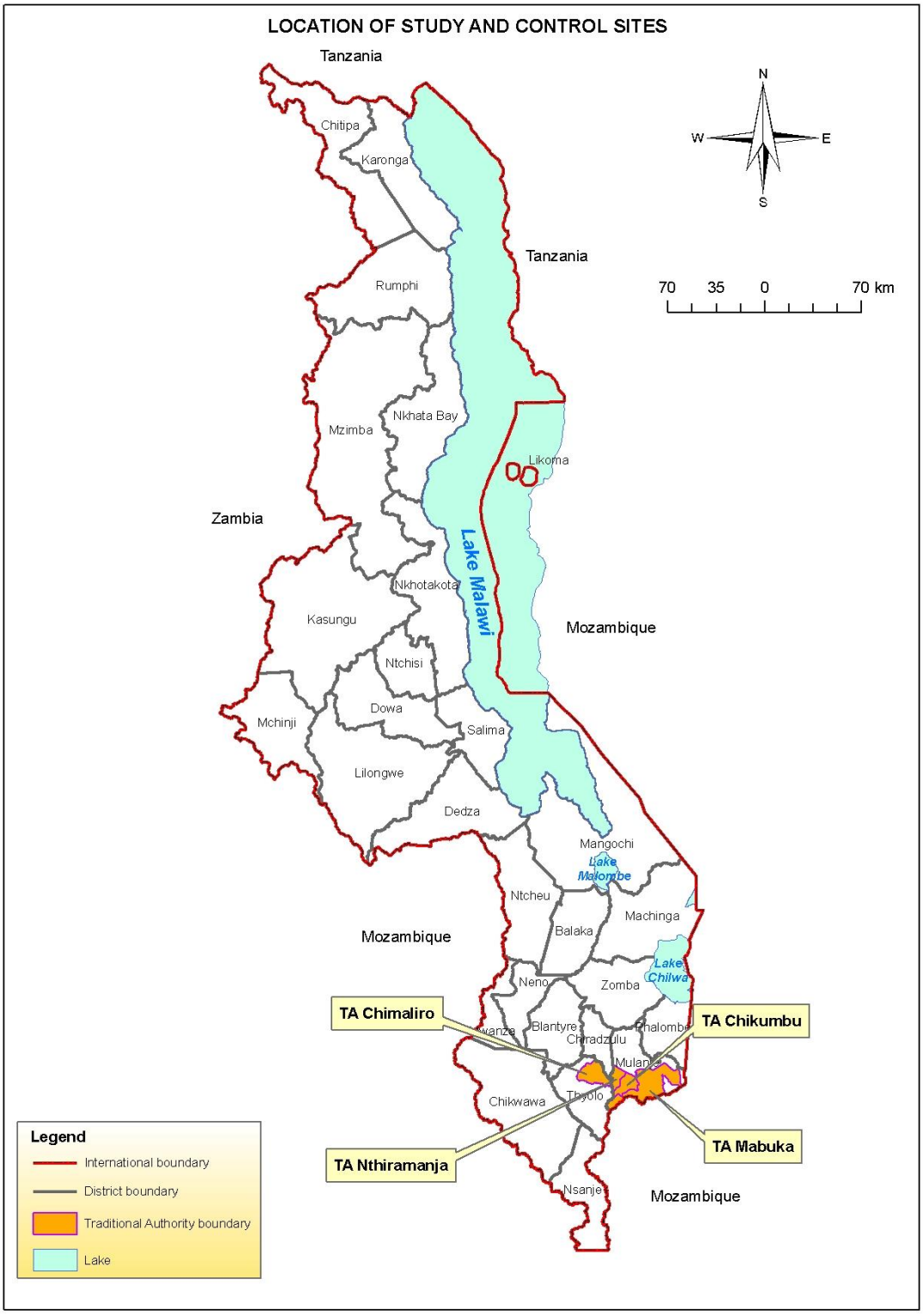

Figure 1: Map of Malawi Showing Location of Main Study and Control Sites

(Source: National Spatial Data Centre)

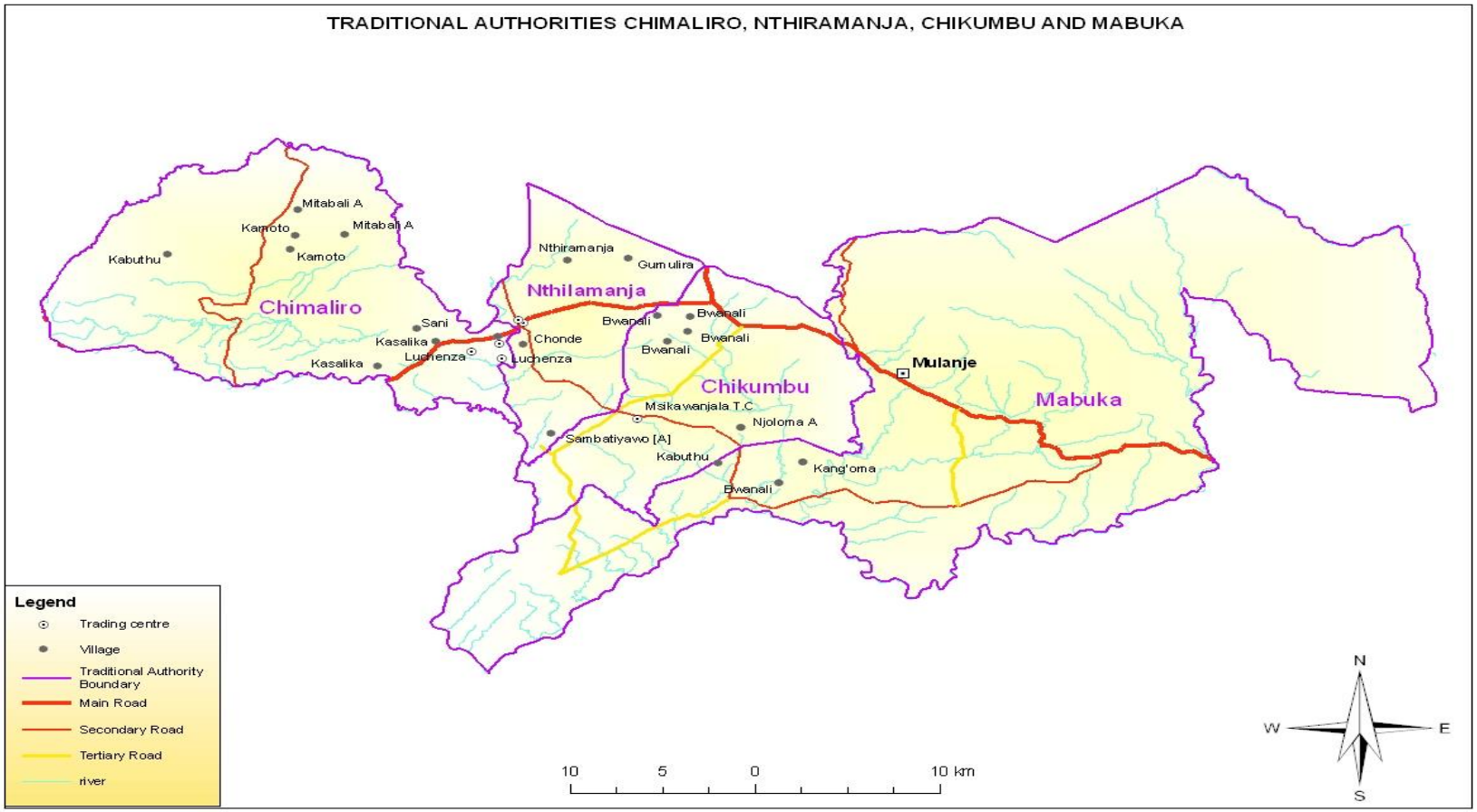

Figure 2: Map Showing Villages for Respondents in the Main Study and Control Sites

(Source: National Spatial Data Centre)

On average, the site receives 700 to 1200mm of rainfall per annum (personal communication with the Assistant Agriculture Extension Development Coordinator, AAEDC). The site has fewer occurrences of floods. However, when they occur, they are light. The site has many rivers flowing through. Many of them are seasonal except Thuchira which is perennial. The site is generally flat with very few hills. Based on projections of 2002, poverty level in TA Nthiramanja was at 72.0% (GOM, 2002). However, the AAEDC indicated that the poverty level in 2007 was at 60.0%. Agriculture is the major occupation in the area, forming 90.0% of livelihoods (personal communication with AAEDC) but other individuals do business while others are employed in the civil service. The main crops grown are maize, cassava, sweet potatoes, groundnuts, pigeon peas and beans. Chickens, goats and pigs are the livestock reared. People in the area mainly rely on maize as staple food and 40.0 % of them are food secure (personal communication with AAEDC). Apart from that, they also take cassava and sweet potatoes.

3.1.2 Control Sites

Control sites were TAs outside TA Nthiramanja. These were selected to provide the researcher with a holistic view of factors affecting adoption of beekeeping without the IFSP. The control sites included TAs Chimaliro in Thyolo District, Chikumbu and Mabuka in Mulanje District. TA Chimaliro lies to the West of TA Nthiramanja and shares boundaries with it while TA Chikumbu lies to the East of TA Nthiramanja where it also shares boundaries with TA Nthiramanja. On the other hand, TA Mabuka lies 20 kilometres east of TA Nthiramanja (Figure 2).

It shares boundaries with TA Chikumbu but not TA Nthiramanja. Among TAs from the control sites, Mabuka was the biggest with a total surface area of 677.9 km ^{2} followed by Chimaliro (285.1 km^2) while Chikumbu (170.9 km^2) was the smallest. In 2008, population in TA Chimaliro was 112, 151 while in Chikumbu was 73, 304 and in Mabuka was 156, 550 (GOM, 2008). A total of 18 villages were selected randomly for the survey from control sites namely; Njoloma, Kampala, Sani, Kamoto, Kasalika, Kogoya, Mitambala, Gomani, Machemba, Mapwesela, Kabuthu, Kandaya, Kangoma, Majawa, Bokosi, Gogodo, Bwanali and Ekhamunu. By virtue of sharing boundaries, diffusion of knowledge and experiences in beekeeping from the main study site to control sites was inevitable. However, the control group did not receive direct influence and benefits from the IFSP.

3.1.3 Vegetation Distribution

The main study and control sites have a diversity of species of vegetation. However, some of the species of vegetation are common while others are scanty. Among the species of vegetation that are commonly found both in the main study and control sites are; *Acacia spp, Annona senegalensis, Azanza garckeana, Bambusa vulgaris, Brachystegia spp, Bridelia micrantha, Breonadia spp, Carica papaya, Citrus sinensis, Dombeya rotundifolia, Eucalyptus spp, Gmelina arborea, Khaya spp, Lantana camara, Mangifera indica, Melia azedarach, Musa spp, Piliostigma thonningii, Psidium guajava, Senna spp, Toona ciliata and Ziziphus mucronata*. Tables G1, G2, G3 and G4 of Appendix G lists some of the species of vegetation that are found in the main study and control sites.

3.2 Research Design

This was a cross sectional study conducted between March and April, 2008.

3.3 Research Methods

Both quantitative and qualitative methods were employed in the research. Quantitative methods involved administration of a semi structured questionnaire (Appendix B1) to adopters, non-adopters and key informants (Appendix B2). Quantitative methods helped to understand the logic in which theories address the hypothesis especially factors affecting adoption of beekeeping. Qualitative methods used were focus group discussions (FGDs) and participant observations. Qualitative methods assisted the researcher to interact with different groups of individuals classified as children, women, men and beekeepers. In so doing, ideas related to adoption of beekeeping were captured from a social and cultural context.

3.4 Sources of data

The study utilised both primary and secondary data sources. Secondary data was obtained from documents such as books, theses, papers, journals, newspaper articles, atlases and pamphlets. Primary data included information collected from respondents, focus groups, key informants and through participant observations.

3.5 Sampling Techniques and Sample Size

The major units of analysis in the study were households in which at least one member was a beekeeper and those where none was a beekeeper.

Coincidentally, all beekeepers were household heads. For purposes of comparability, household heads were also selected from the non-beekeeping category.

3.5.1 Beekeepers

Beekeepers were selected from the main study and control sites through random sampling. Where it was not possible to interview an individual due to logistics, replacement based on accessibility was used. The number of beekeepers selected from the main study site was 60. This was based on Creative Research Systems (2003) formula for calculating sample size (Appendix A). The number of beekeepers from the control group was also 60. These were selected from TAs Chimaliro in Thyolo District, Chikumbu and Mabuka in Mulanje District. The total number of beekeepers from the study and control sites was 120. Table 1 shows the distribution of respondents from the main study and control sites.

3.5.2 Non-beekeepers

These included household heads selected randomly from TA Nthiramanja only. They were selected from all villages where beekeeping is practised. Total number of non-beekeepers that were selected was 60.

3.5.3 Total Number of Respondents

Total number of respondents selected for the survey was 180. Out of this number, 60 respondents were beekeepers from the main study site while 60 respondents were beekeepers from control sites and 60 respondents were non-beekeepers from the main study site.

Table 1: Distribution of Respondents Selected from the Main Study and Control Sites

TA	Number of villages	Identity of respondents		Total number of respondents
		Beekeepers	Non beekeepers	
Nthiramanja	15	60	60	120
Chimaliro	8	29	0	29
Mabuka	8	18	0	18
Chikumbu	2	13	0	13
Total	**33**	**120**	**60**	**180**

3.6 Data Collection Techniques

Various techniques were employed during data collection, namely: administration of questionnaires to adopters, non-adopter household heads, key informant interviews, focus group discussions and participant observations.

3.6.1 Household Heads Interviews

Semi structured questionnaires containing open and closed ended questions were used to collect information from respondents. Such information included age, sex, marital status, education level, access to agricultural information, labour, land tenure, land size, nature of income sources, income level, access to credit, membership in cooperative societies, number of months households consume own grown food, cropping pattern, livestock ownership, cultural values and access to lucrative market.

Beekeepers were further asked about the year they started beekeeping, reasons for starting beekeeping, whether the land used for beekeeping was own property or communal, types of beehives used, number of beehives, harvesting methods used, marketing of honey, factors for success and failure and their perception of the role of beekeeping in forest resource conservation. Non-beekeepers were asked to state the reasons why they did not adopt beekeeping.

3.6.2 Key Informant Interviews

Key informants were interviewed to achieve data triangulation. These included District Commissioners for Mulanje and Thyolo districts, TA Nthiramanja, extension workers, Environmental Officer for Mulanje district and village headmen from both main study and control sites. Adopters, non-adopters and some key informants were interviewed at home while were interviewed in their work places.

3.6.3 Participant Observations

Participant observations involved a study of apiaries for all beekeepers interviewed. These observations helped to build a better understanding of the status of beekeeping especially the types of beehives that were used by beekeepers with respect to their environmental friendliness. Apart from that, the observations helped to check the health of vegetation around hives in case harvesting techniques caused damage. The participant observations also enabled the researcher to appreciate challenges facing adopters such as walking distance, maintenance of beehives and setting of bee hives high up in trees.

These observations also enabled the researcher to conduct a global vegetation survey to understand plant diversity in the main study and control sites.

3.6.4 Focus Group Discussions

Focus group discussions involved beekeepers and non-beekeepers. Focus groups for beekeepers comprised a mixture of male and female participants to enhance wider data capture. Participants in this group were all adults who met frequently during beekeeping association meetings and other activities. Therefore, differences in sex and age would not interfere with their participation in the mixed groups. On the other hand, participants for focus groups involving non-beekeepers were categorised as male adults (aged from and above 18 years), female adults (aged from and above 18 years), boys (aged between 10 and 17 years) and girls (aged between 10 and 17 years). The categorisation of participants for focus groups involving non-beekeepers was deliberately done to enable them participate freely. The focus group discussions assisted the researcher to understand the perception of beekeeping in the main study and control sites from different groups stratified as beekeepers and non-beekeepers (male and female adults, boys and girls).

3.7 Data Analysis

Statistical Package for Social Science (SPSS) and Excel soft wares were applied in data analysis. Methods were grouped as exploratory (descriptive statistics) and modelling.

3.7.1 Exploratory or Descriptive Statistics

This involved calculation of means, frequencies, percentages, cross tabulations and Chi-square tests. Significance testing using Chi-square tests was conducted at 5% level. Graphs were also incorporated to illustrate the magnitude of some parameters. Comparisons of socio-economic characteristics among adopters and non-adopters were done. In addition, these techniques helped to compare economic returns from beekeeping with the rest of the other economic activities. The researcher was not only able to establish whether the methods used when making beehives and harvesting of products from beekeeping were environmentally friendly, but also to determine the major problems facing beekeepers.

3.7.2 Regression Modelling

Binary logistic regression model was applied to examine factors affecting the adoption of beekeeping. Since adoption as a dependent variable is dichotomous, the regression is non-linear in form and ordinary least squares would not provide useful estimators (Maddala, 1983). Instead a dichotomous logistic model technique is ideal for regressing "adoption" on a set of explanatory variables.

3.7.2.1 Model Specification

The dependent variable, adoption of beekeeping technology, is dichotomized by assigning a value of one if a respondent is an adopter and zero if otherwise.

Many researchers [Chinangwa (2006), Lwesaya (2004), Kapanda (2004), Thangata and Alavalapati (2003)] have used the binary logistic regression model to examine similar issues. The logistic regression model is based on the cumulative logistic probability function. According to Gujarati (2003) it is given by:

$$P_i = E(Y = 1 | X_i) = \frac{1}{1 + e^{-(\beta_1 + \beta_2 x_i)}}$$

Where P_i is the probability that an individual will take a certain choice (adopt or not adopt) given the knowledge of X_i , P_i ranges from 0 to 1 and it is non-linear. The dependent variables are all dummy variables of either 1 or 0 where 1 is the yes alternative while 0 is otherwise. The more negative the log-likelihood (0) is, the better is the predictability, $\beta_1 + \beta_2 X_i$ explain how much parameter X_i is affecting the dependent variable. The more negative the sign the less the parameter is affecting the dependent variable. The P-values were used to indicate whether an explanatory variable was significant or not. R-square values were used to explain the variation. Two logistic regression models were built to examine factors for adoption of beekeeping with and without the IFSP. Model (1) computed observations from adopters and non-adopters in the main study group (TA Nthiramanja). Model (2) used observations from adopters in the control group and non-adopters from the main study site.

The equations used to estimate the parameters in each of the two models were:

$$Y_{i} = \alpha + \beta_i AGE + \beta_2 SECECONO + \beta_3 LABOURTHREE + \beta_4 GARDSIZE + \beta_5 EXTCONT + \beta_6 CLUBATT + \beta_7 ORGMEMB + \beta_8 GOATREAR \quad (1)$$

$$Y_{ii} = \alpha + \beta_i AGE + \beta_2 EDU + \beta_3 SECECONO + \beta_4 GARDSIZE + \beta_5 EXTCONT + \beta_6 CLUBATT + \beta_7 ORGMEMB + \beta_8 GOATREAR \quad (2)$$

Where (1) is equation for model (1), (2) is equation for model (2). Y_i and Y_{ii} are the dependent variables representing adoption of beekeeping for the study and control groups respectively, α is a constant and βs are coefficients of each explanatory variable. Variables that were chosen for each model were only those where differences in socio economic characteristic among adopters and non-adopters were significant. Table 2 shows definitions of each explanatory variable.

Table 2: Definition of Explanatory Variables

Variable	Description
AGE (0)	Age of respondent; 1= 20-29 years; 0=otherwise (Reference category)
AGE (1)	Age of respondent; 1=30-39 years; 0= otherwise
AGE (2)	Age of respondent; 1=40-49 years; 0=otherwise
AGE (3)	Age of respondent; 1=50-59 years; 0=otherwise
AGE (4)	Age of respondent; 1=60 years and above; 0=otherwise
EDU	Attainment of any formal education; 1=yes; 0=otherwise
SECECONO	Nature of secondary economic activity; 1=on farm; 0=otherwise
LABOURTHREE	Number of household members supplying labour; 1=>3members; 0=otherwise
GARDSIZE	Size of crop garden; 1=>3acres; 0=otherwise
EXTCONT	Whether respondent has contact with extension workers; 1=yes; 0=otherwise
CLUBATT	Whether respondent attends farmer club meetings; 1=yes; 0=otherwise
ORGMEMB	Whether respondent is a member of any cooperative organisation; 1=yes; 0=otherwise
GOATREAR	Whether respondent rears goats; 1=yes; 0=otherwise

3.7.2.2 Expected Results

Unlike other farming technologies, beekeeping does not require a lot of physical energy hence more suitable for the aged than the youth. It was hypothesised that young age ranges (20-29; 30-39 years) will affect negatively the adoption of beekeeping while older ages (40 years and above) will have a positive effect on the adoption of beekeeping. Beekeeping is not particularly labour intensive and tending can be restricted to periods outside peak work times (Mensing, 1993). However, households with more labour supply will have an added advantage of sharing tasks during harvesting seasons. It was hypothesised that more household labour supply (by three members and above) designated *LABOURTHREE* will have a positive effect on adoption of beekeeping.

Nelson and Phelps (1996) indicated that education enhances one's ability to receive, decode and understand information and educated people make good innovators so that education speeds up the process of technological diffusion. It was hypothesised that education attainment *(EDU)* will promote the adoption of beekeeping.

Major economic activity in the study site was crop farming. Beekeeping blended well with crop farming since it is an on-farm economic activity. It was hypothesised that secondary economic activities *(SECECONO)* that were on-farm in nature would influence positively the adoption of beekeeping unlike those that were off-farm.

Rearing of livestock, especially goats, designated *GOATREAR* will promote adoption of beekeeping because the activity is on-farm in nature.

Chinangwa (2006) noted that some farming technologies require a substantial amount of land, therefore reduction of land size reduces the adoption of such technologies. It was hypothesised that the size of garden designated *GARDSIZE* will promote the adoption of beekeeping.

Extension workers have a concise approach to farmers on what messages to convey, how to convey and when to address the farmers (Vedeld *et al.*, 1998). Therefore, it was hypothesised that contact with extension workers, *EXTCONT* will affect adoption of beekeeping positively.

Membership in cooperative organisations abbreviated *ORGMEMB* promotes farmer's knowledge and understanding of a particular technology (Chinangwa, 2006). It was assumed that respondents belonging to such organisations will likely adopt beekeeping. Farmer clubs are aimed at creating a prosperous life and improved economy for people (Soe, 2007). This is achieved by building a progressive movement of organised and productive farmers. It was hypothesised that attendance in farmer club meetings, *FCLBM* will affect adoption of beekeeping positively.

3.8 Pre-test Survey

Before the actual study, a pre-test survey was conducted in two consecutive days at Kampala village in TA Chikumbu where seven questionnaires were administered to beekeepers and non-beekeeper household heads. Participant observations were made in four apiaries. Two key informant interviews and focus group discussions were carried out in the same village. The pre-test survey assisted in the identification and correction of faults on the instruments before the main survey. The pre-test survey also acted as a training session for research assistants. The main survey was conducted from March to April 2008.

3.9 Limitations of the Study

During the study, it was observed that most of the respondents had no records on expenditures and income generated through different economic activities. Consequently, data collection on such issues was difficult because the respondents used the recall method. To attain higher levels of accuracy, the net values of economic returns were calculated based on average market price of quantities of goods produced and expenditures incurred in the year 2007. Since the survey was conducted at a time when people were harvesting their maize, some eligible respondents were not available in their homes. Consequently, replacement based on accessibility was used. It is likely that some information was not adequately captured. However, it should be stated that the results of the study were in accordance with survey questionnaires that were carefully designed, pre tested, corrected and administered by trained enumerators.

Therefore, the study gives a pointer on factors affecting adoption of beekeeping in TA Nthiramanja with some level of accuracy as per model outputs.

CHAPTER 4

RESULTS AND DISCUSSIONS OF THE FINDINGS

4.1 Social-economic Characteristics of Household Heads

Socio-economic characteristics of household heads were classified as demographic, social, economic and access to agricultural information.

4.1.1 Demographic Characteristics

Demographic characteristics included sex of respondent, age, marital status and household size. To begin with, although not significantly different (Appendix D, Table D6), the study showed small differences in groups by sex of respondents (Table 3). The percentage of male respondents in the whole survey [51.0 % (91)] was slightly higher than that of female respondents [49.0 % (89)]. This picture was replicated among male and female beekeepers in the main study area [52 % (31) versus 48.0 % (29)] although the proportions by sex were the same among beekeepers from the control group and non-beekeepers in the main study site [50.0 % (30)]. It can be argued that, the sex of an individual does not affect their decision to become beekeepers in the survey sites. These results are similar to those of other researchers [Total Transformation Agribusiness (2006), Illgner *et al.* (1998)].

Age of respondents was another important demographic characteristic in the study. The average age of respondents in the whole survey was 46.2 (SD: 18.1) years.

The average age of beekeepers from the main study site was the highest [51.7 (SD: 17.1) years] followed by beekeepers from the control group [49.9 (SD: 18.3) years] while non-beekeepers had the lowest average age [37.0 (SD: 15.4) years]. None of the respondents was aged below 20 years: this was expected considering that they were heads of households. The highest percentage of respondents [22.8% (41)] was in the age range of 30-39 years (Table 3).

Table 3: Number and Distribution (%) of Respondents by Age

Age range (years)	**Beekeepers**				**Non-beekeepers**		**Total**	
	Study area		**Control area**					
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Below 20	0	0.0	0	0.0	0	0.0	0	0.0
20-29	4	6.7	11	18.3	21	35.0	36	20.0
30-39	11	18.3	10	16.7	20	33.3	41	22.8
40-49	16	26.7	8	13.3	6	10.0	30	16.7
50-59	11	18.3	10	16.7	8	13.3	29	16.1
60-69	8	13.3	13	21.7	3	5.0	24	13.3
Above 69	10	16.7	8	13.3	2	3.4	20	11.1
Total	**60**	**100.0**	**60**	**100.0**	**60**	**100.0**	**180**	**100.0**

The highest percentages of beekeepers from the main study and control sites were in the age ranges of 40-49 [26.7% (16)] and 60-69 [21.7% (13)] respectively.

The percentage of respondents aged above 69 years was highest among beekeepers from the main study area [16.7% (10)] followed by beekeepers from the control area [13.3% (8)] while that of non-beekeepers was the lowest [3.4% (2)]. Differences among non-beekeepers and beekeepers from both the main study and control groups were significant with respect to age categories; 20-29, 30-39 and, 60 and above (Appendix D, Table D6). Significant differences were also observed among non-beekeepers and beekeepers from the main study group only with respect to age range, 40-49 years. However, there were no significant differences among non-beekeepers and beekeepers from both the main study and control sites with respect to age range, 50-59 years. Differences were also not significant among non-beekeepers and beekeepers from the control group only with respect to age range, 40-49 years. Generally, beekeepers from both the main study and control sites were older than non-beekeepers.

Another demographic characteristic that was studied was the marital status of respondents. The percentage of married respondents in the whole survey [77.2% (139)] was higher than that of unmarried respondents [22.8% (41)]. The percentage of married respondents was highest among beekeepers from the main study group [83.3% (50)] followed by beekeepers from the control group [75.0 % (45)] while the percentage of married respondents was the lowest among non-beekeepers [73.3% (44)]. Respondents that were single, separated, divorced and widowed were pooled and identified as single to help run the Chi-square test.

Differences among non-beekeepers and beekeepers from the main study and control groups with respect to marital status (married and single) were not significant (Appendix D, Table D6). Therefore, marital status of respondents did not affect their decision to become beekeepers.

Household size was another demographic characteristic. Results show that the average household size in the whole survey was 5.1 (SD: 2.4) members. Beekeepers from the main study group had the highest average household size [5.7 (SD: 2.3) members] followed by beekeepers from the control group [5.3 (SD: 2.8] members while non-beekeepers had the lowest average [4.4 (SD: 1.9) members]. To run Chi-square test, households were pooled into different categories: households with at most two members, three to four members and at least five members. Differences were significant among non-beekeepers and beekeepers from the main study group only with respect to household sizes categorised as less than five members (Appendix D, Table D6). However, there were no significant differences among non-beekeepers and beekeepers from both the main study and control sites with respect to the rest of the other age categories. These results clearly show that beekeepers had generally larger household sizes. This translates into more responsibility among beekeepers in managing their households.

4.1.2 Social Characteristics of Respondents

Social characteristics of respondents included educational level, membership in cooperative organisations, cropping patterns, rearing of livestock, residence status and land tenure.

To start with, results indicated that the majority of respondents [83.9% (151)] attained some formal education while minority [16.1% (29)] did not. Non-beekeepers registered the highest percentage of respondents who attained some formal education [93.3% (56)] followed by beekeepers from the main study area [81.7% (49)] while beekeepers from the control sites had the lowest percentage [76.7% (46)]. The highest percentage of those who attained some formal education [43.9% (79)] dropped at standard 5-8 level. Non-beekeepers registered the highest percentage [20.0% (12)] of respondents who had attained at least form 1-2 level of education while beekeepers from the control area registered the highest percentage of respondents [10.0% (6)] who attained form 3-4 (Table 4).

To compute Chi- square test, respondents were aggregated into those who attained some formal education and those who had never done so. On the one hand, differences among beekeepers from the main study group and non-beekeepers with respect to attainment of some formal education were not significant (Appendix D, Table D6). On the other hand, differences among beekeepers from the control group and non-beekeepers in terms of attainment of some education were significant.

Table 4: Number and Distribution (%) of Respondents by Education Level

Education level	Beekeepers				Non-beekeepers		Total	
	Study area		Control area					
	n	%	n	%	n	%	n	%
None	11	18.3	14	23.3	4	6.7	29	16.1
Std 1-4	10	16.7	10	16.7	13	21.6	33	18.3
Std 5-8	30	50.0	25	41.7	24	40.0	79	43.9
Form1-2	6	10.0	5	8.3	12	20.0	23	12.8
Form 3-4	2	3 .3	6	10.0	7	11.7	15	8.3
Tertiary	1	1.7	0	0.0	0	0.0	1	0.6
Total	**60**	**100.0**	**60**	**100.0**	**60**	**100.0**	**180**	**100.0**

Another social characteristic that was studied among respondents in the survey was membership in cooperative organizations. Table 5 shows that the majority of respondents [67.8 % (122)] belonged to cooperative organisations while minority [32.2 % (58)] did not. Beekeepers from the main study area had the highest percentage [83.3 % (50)] with respect to membership followed by beekeepers from the control sites [76.7% (46)] while non-beekeepers had the lowest percentage [43.3% (26)]. Differences among non-beekeepers and beekeepers from both the main study and control group with respect to membership in cooperative organisations were significant (Appendix D, Table D6). Since the majority of beekeepers belonged to cooperative organisations, diffusion of the innovation, beekeeping, was faster than among non-beekeepers.

Table 5: Number and Distribution (%) of Respondents by Membership in Cooperative Organisations

Membership to organisation	**Beekeepers**				**Non-beekeepers**		**Total**	
	Study area		Control area					
	n	%	n	%	n	%	n	%
Yes	14	23.3	21	35.0	15	25.0	50	27.8
No	46	76.7	39	65.0	45	75.0	130	72.2
Total	**60**	**100**	**60**	**100**	**60**	**100**	**180**	**100**

In addition to that, cropping pattern was another social characteristic. Survey results show that respondents grew different types of crops namely; maize, cassava, potatoes, groundnuts, pigeon peas and beans (Appendix D: Table D4). All respondents [100.0 % (180)] in the whole survey grew maize. This is so because maize is a staple crop for people in the survey sites.

The percentage of respondents that grew maize was followed by that of those that grew cassava [80.6 % (145)]. Beekeepers from the main study site had the highest percentage of respondents that grew cassava [83.3% (50)], followed by non-beekeepers [81.7% (49)] while beekeepers from the control sites had the lowest percentage [76.7% (46)]. Cassava was mainly grown as a cash crop. However, it was also taken as a snack or carbohydrate dish during meals.

Apart from maize and cassava, survey results indicate that the majority of respondents [67.2 % (121)] also grew potatoes. Non-beekeepers registered the highest percentage [75.0 % (45)] with respect to growing of potatoes followed by beekeepers from the main study site [66.7% (40)] while beekeepers from the control sites had the lowest percentage [60.0 % (36)]. Like cassava, potatoes were also grown for sale and food. On a different note, the total percentage of respondents that grew groundnuts [30.6 % (55)] was lower than that of those that did not [69.4 % (125)]. In this group, beekeepers from the control sites registered the highest percentage [40.0 % (24)] followed by beekeepers from the main study site [26.7% (16)] while non-beekeepers had the lowest percentage [25.0% (15)].

Respondents in the survey also grew pigeon peas. Like groundnuts, the percentage of respondents that grew pigeon peas [20.0% (36)] was lower than that of those that did not [80.0% (144)]. Beekeepers from both the main study and control sites had equally higher percentages of respondents that grew pigeon peas [21.7% (13) each] than non-beekeepers [16.7% (10)]. Some respondents grew beans. Like groundnuts and pigeon peas, the percentage of respondents that grew beans was lower [13.3% (24)] than that that of those that did not [86.7% (156)]. The percentage of respondents that grew beans was highest among non-beekeepers [15.0% (9)] followed by beekeepers from the control site [13.3% (8)] while that of beekeepers from the main study site was the lowest [11.7% (7)]. Based on these results, growing of legumes was not popular among all categories of respondents. One major reason could be lack of adequate land.

This could be compounded by the fact that legumes were not major sources of income and food for the majority of people in the survey sites. However, differences among non-beekeepers and beekeepers from both the main study and control groups with respect to growing of maize, cassava, potatoes, groundnuts, pigeon peas and beans were not significant (Appendix D, Table D6). Other crops were grown by small percentages of respondents (Appendix D, Table D4).

Another social characteristic among respondents was rearing of livestock Appendix D: Table D5). Results of the study reveal that majority of respondents [85.0% (153)] reared livestock. Among those that reared livestock, the percentage of respondents that reared chickens was the highest [62.8% (113)] followed by that of those that reared goats [41.7% (75)], pigs [14.4% (26)], cattle [7.2% (13)], doves [6.1% (11)], ducks [3.3% (6)], guinea fowls [2.2% (4)] and pea cocks [0.6% (1)]. The percentage of respondents that reared chickens was highest among non-beekeepers [68.3% (41)] followed by beekeepers from the control sites [61.7% (37)] and lowest among beekeepers from the main study site [58.3% (35)]. Table 6 shows that beekeepers from the main study and control groups had same higher percentages of respondents that reared goats [51.7% (31)] than non-beekeepers [21.7% (13)].

Table 6: Number and Distribution (%) of Respondents by Rearing of Goats

Rearing of goats	**Beekeepers**				**Non-beekeepers**		**Total**	
	Study area		Control area					
	n	%	n	%	n	%	n	%
Yes	31	51.7	31	51.7	13	21.7	75	41.7
No	29	48.3	29	48.3	47	78.3	105	58.3
Total	**60**	**100**	**60**	**100**	**60**	**100**	**180**	**100**

With respect to rearing of pigs, beekeepers from the control sites registered the highest percentage [20.0% (12)] followed by beekeepers from the main study site [15.0% (9)] while non-beekeepers had the lowest percentage [8.3% (5)]. Chickens were the most popular form of livestock. This could be attributed to several reasons. Firstly, rearing of chickens especially local type is cheaper than other animals. Apart from that, chickens supply people with meat which is liked by almost everyone in the survey sites. Furthermore, markets for chickens are readily available. No wonder, there were no significant differences among beekeepers and non-beekeepers with respect to rearing of chickens. However, differences were significant among beekeepers and non-beekeepers with respect to rearing of goats only (Appendix D, Table D6). By rearing goats, beekeepers had a wider potential to earn more income than non-beekeepers in the survey sites where employment was hard to find.

Residential status was another social characteristic that was studied among respondents. Results of the survey revealed that respondents differed with respect to their residential status. The majority of respondents [78.9 % (142)] lived in their own home village while the rest [11.1 % (18)] lived in their spouse's home villages hence [2]*mkamwini* and [3]*mtengwa* respectively (Appendix D, Table D1). Beekeepers from the main study group registered the highest percentage [85.0 %(51)] of respondents that lived in their own home villages followed by beekeepers from the control sites [76.6 % (46)] while non-beekeepers had the lowest percentage [75.0 % (45)]. However, differences among beekeepers and non-beekeepers from both the main study and control sites with respect to their residential status were not significant (Appendix D, Table D6). In this case, living in either one's own home village or spouse's did not affect respondent's decision to become a beekeeper. However, beekeepers from both the main study and control sites had an upper hand in deciding on how to use their land since they had higher percentages of respondents that lived in their own home villages than non-beekeepers.

Apart from that, land tenure for crops was another social characteristic that was studied in the survey. The majority of respondents [91.6% (176)] cultivated crops on own land while [1.7% (3)] rented land and 0.6% (1) cultivated their crops on borrowed land. Rented and borrowed lands were aggregated as 'not own'.

[2] mkamwini a married man staying with his family at his wife's homestead

[3] mtengwa a married woman staying with her family at her husband's homestead

Beekeepers from the main study group had the highest percentage with respect to growing crops on own land [100.0% (60)] followed by beekeepers from the control sites [98.3% (59)] while non-beekeepers had the lowest percentage [95.0% (57)]. Chi-square tests were not conducted since some cells had less than five counts. However, beekeepers had an upper hand to use part of their land for other activities such as beekeeping since they owned land.

4.1.3 Economic Characteristics of Respondents

Economic characteristics included land size, economic activities, income level, access to credit, number of members of the household that supplied labour and availability of own grown food. Table 7 shows that the highest percentage of all respondents [32.7% (59)] had 0.4 hectare of land, while [30.0% (54)] had 0.8 hectares and 17.8% (32) had less than 0.4 hectares of land. Some [4.4% (8)] had more than 2.0 hectares of land. The percentages of respondents that had 1.6 and 2.0 hectares were equal [1.7% (3)]. The average land hectareage in the whole survey was 1.5 (SD: 1.4) hectares. Beekeepers from the control sites had the highest average of land hectareage [1.6 (SD: 1.9)] hectares, seconded by beekeepers from the main study site [1.5 (SD: 1.3)] hectares while non-beekeepers had the lowest average land hectareage [1.3 (SD: 1.0)] hectares. Chi-square tests were computed with respect to different land sizes; at most 0.4 hectares, 0.8 hectares and less than 1.2 hectares. Significant differences were observed among non-beekeepers and beekeepers from both the main study site and control sites with respect to land size aggregated as less than 1.2 hectares (Appendix D, Table D6).

Generally, beekeepers had more land hectareage than non-beekeepers. This gave them an added advantage to use part of their land for beekeeping in addition to crop farming.

Table 7: Number and Distribution (%) of Respondents by Garden size

Garden size	**Beekeepers**				**Non-beekeepers**		**Total**	
	Study site		Control sites					
	n	%	n	%	n	%	n	%
No garden	0	0.0	0	0.0	0	0.0	0	0.0
< 0.4 hectare	9	15.0	12	20.0	11	18.3	32	17.8
0.4 hectare	18	30.0	16	26.7	25	41.7	59	32.7
0.8 hectare	20	33.3	14	23.3	20	33.3	54	30.0
1.2 hectare	9	15.0	9	15.0	3	5.0	21	11.7
1.6 hectare	1	1.7	2	3.3	0	0.0	3	1.7
2 hectares	2	3.3	1	1.7	0	0.0	3	1.7
>2 hectares	1	1.7	6	10.0	1	1.7	8	4.4
Total	**60**	**100**	**60**	**100**	**60**	**100**	**180**	**100**

Apart from that, economic activities among respondents were also studied. The economic activities were classified as main and secondary economic activities. Results indicated that the majority of respondents [88.3% (159)] depended on crop farming as their main economic activity while the rest [11.7% (21)] indicated other economic means (Appendix D, Table D2).

These included livestock production [2.2% (4)], beekeeping [2.2% (4)], employment [2.2 % (4)], fish farming [1.6% (3)], poultry [1.1 % (2)], poles [0.6% (1)], casual labour [0.6% (1)], seedlings [0.6% (1)] and firewood [0.6% (1)]. All the main economic activities were pooled into two categories; crop farming and otherwise. The percentage of respondents who indicated crop farming as their main economic activity was highest among non-beekeepers [91.8% (55)] followed by beekeepers from the main study group [88.3% (53)] while that of beekeepers from the control sites was the lowest [85.0 % (51)]. Differences among non-beekeepers and beekeepers from both the main study and control group with respect to their main economic activities categorised as crop farming and otherwise were not significant (Appendix D, Table D6).

The highest percentage of respondents [40.0% (72)] indicated that beekeeping was their secondary economic activity (Appendix D, Table D3). This was followed by employment [12.1% (22)] while crop farming came third [11.6% (21)]. Small percentages of respondents indicated other economic activities (Appendix D, Table D3). All the secondary economic activities were pooled into two categories; those that were on-farm and off-farm (Table 8). Beekeepers from the control sites registered the highest percentage of respondents whose secondary economic activities were on-farm [88.3% (53)] followed by beekeepers from the main study site [71.7% (43)], while non-beekeepers had the lowest percentage [25.5% (14)]. There were significant differences among non-beekeepers and beekeepers from the main study and control groups with respect to secondary economic activities being on-farm and off-farm (Appendix D, Table D6).

Table 8: Number and Distribution (%) of Respondents by Nature of Secondary Economic Activities

Secondary Economic Activities	**Beekeepers**				**Non-beekeepers**		**Total**	
	Study area		Control area					
	n	%	n	%	n	%	n	%
On-farm	43	71.7	53	88.3	14	25.5	110	61.1
Off-farm	17	28.3	7	11.7	46	74.5	70	38.9
Total	**60**	**100**	**60**	**100**	**60**	**100**	**180**	**100**

Since the majority of beekeepers relied on secondary economic activities that were on-farm in nature, they could attend to crop farming and their secondary economic activities without much disturbance. Beekeeping in particular, harmonises with crop farming since it does not require much labour and farmers can arrange to work in their crop gardens in the morning hours and attend to their hives in the evening.

Another economic characteristic among the respondents was income level. Results of the study indicate that the total sum of economic returns in the whole survey was MK1 4,936,661.15 (Appendix E, Tables E4 and E5). The total average of all economic returns among all respondents was MK82, 981.45 (SD: 94712.03 / household/annum). Beekeepers from the control sites had the highest average of economic returns [MK91, 297.37 (SD: 79,409.61) household/annum] followed by non-beekeepers from the main study site [MK79, 829.00 (SD: 103190.10 /household/annum).

Beekeepers from the main study site had the lowest average of economic returns [MK77, 817.98 (SD: 100043.50) /household/annum]. Higher percentage [70.6% (127)] of respondents had income that was below average [MK82, 981.45 (SD: 94712.0)/household/annum] while lower percentage [29.4% (53)] had income level that was above average. Beekeepers from the control sites had the highest percentage [35.0 % (21)] of respondents whose income level was above total average followed by non-beekeepers [28.3% (17)] while beekeepers from the main study site had the lowest [25.0% (15)]. There were no significant differences among non-beekeepers and beekeepers from both the main study and control groups in terms of income levels categorised as above and below average (Appendix D, Table D6). From the results, it is clear that beekeepers from the main study site had the lowest income. This contradicts with the observation by non-beekeepers who indicated through focus group discussions that beekeepers were better off financially as compared to non-beekeepers.

Access to loans was another economic characteristic among respondents. Results revealed that the percentage of respondents that had accessed loans at least once [33.9% (61)] was lower than that of those that had never done so [66.1% (119)]. Beekeepers from the main study site had the highest percentage [38.3% (23)] of respondents who accessed loans while beekeepers from the control group and non-beekeepers had equally lower percentages [31.7% (19) each]. Differences among non-beekeepers and beekeepers from the main study and control sites with respect to access to loans were not significant (Appendix D, Table D6). Many respondents wished they got loans but access was limited due to several reasons.

Firstly, some respondents did not know where they could get the loans. Others tried but failed due to restrictions imposed by lending institutions such as opening up an account with the banks.

Another economic characteristic that was studied was the number of members that supplied the household with labour. Table 9 shows that, the highest percentage of respondents [35.0 % (63)] got labour from two members followed by those who got labour from three members [21.1% (38)]. The percentage of respondents who got labour from four members came third [17.7% (20)] while for those who got labour from one and five members came fourth [9.4% (17)]. Only 1.7% (3) got labour from seven members, while 0.6% (1) got labour from eight, eleven and twelve members each. None of the respondents got labour from nine and ten members (0%). On average, household labour in the whole survey was provided by 3.1 (SD: 1.7) members. Beekeepers from the main study site had the highest average of labour supply [3.4 (SD: 1.49)] members followed by beekeepers from the control sites [3.3 (SD: 2.1)] members while non-beekeepers had the lowest average [2.7 (SD: 1.4) members]. Respondents were pooled into different categories: those who got labour from one member, two members and at least three members. Differences were significant among non-beekeepers and beekeepers from the main study group only with respect to labour supply by at least three members (Appendix D, Table D6). The general picture is that beekeepers had more labour supply than non-beekeepers. This gave them an added advantage to work in their crop gardens and attend to beekeeping especially during the peak season.

Table 9: Number and Distribution (%) of Respondents by Supply of Labour

Number of Members Supplying Labour	**Beekeepers**				**Non-beekeepers**		**Total**	
	Study area		Control area					
	n	%	n	%	n	%	n	%
1 person	4	6.7	4	6.7	9	15.0	17	9.4
2 people	16	26.6	21	35.0	26	43.3	63	35.0
3 people	15	25.0	17	28.2	6	10.0	38	21.1
4 people	11	18.3	9	15.0	12	20.0	32	17.7
5 people	10	16.7	2	3.3	5	8.4	17	9.4
6 people	1	1.7	4	6.7	2	3.3	7	3.9
7 people	3	5.0	0	0.0	0	0.0	3	1.7
8 people	0	0.0	1	1.7	0	0.0	1	0.6
9 people	0	0.0	0	0.0	0	0.0	0	0.0
10 people	0	0.0	0	0.0	0	0.0	0	0.0
11people	0	0.0	1	1.7	0	0.0	1	0.6
12 people	0	0.0	1	1.7	0	0.0	1	0.6
Total	**60**	**100**	**60**	**100**	**60**	**100**	**180**	**100**

Apart from that, availability of own grown food in the household was another economic characteristic that was studied. Although the majority of respondents in the survey sites practised crop and animal husbandry, the results show that the majority of them [50.6% (91)] did not produce enough food to last them the whole year while minority [49.4% (89)] did. Beekeepers from the control group had the highest percentage of respondents who had enough own grown food throughout the year [58.3% (35)] followed by beekeepers from the main study area [48.3% (29)] while non-beekeepers had the lowest percentage [41.7% (25)]. However, there were no significant differences among non-beekeepers and beekeepers from both the main study and control sites in terms of availability of own grown food throughout the year (Appendix D, Table D6). Thus, availability of own grown food did not influence respondent's decision to become beekeepers. However, beekeepers were more food secure than non-beekeepers. The possible reason could be that they got more food since their major and secondary economic activities were on-farm in nature.

4.1.4 Sources of Agricultural Information

Respondents got agricultural information through different means namely: extension officers, farmer clubs, radio, fellow farmers, village headmen, television and newspaper.

Table 10 shows that, beekeepers from the main study site registered the highest percentage [70.0% (42)] with respect to contact with extension workers followed by beekeepers from the control group [66.7% (40)] while non-beekeepers had the lowest percentage [48.3% (29)].

Differences among non-beekeepers and beekeepers from the main study and control groups with respect to contact with extension workers were significant (Appendix D, Table D6). Since majority of beekeepers had contact with extension workers, they had a higher chance of learning new innovations than non-beekeepers.

Table 10: Number and Distribution (%) of Respondents by Sources of Information through Extension Contact

Extension Contacts	**Beekeepers**				**Non beekeepers**		**Total**	
	Study area		Control area					
	n	%	n	%	n	%	n	%
Yes	42	70.0	40	66.7	29	48.3	111	61.7
No	18	30.0	20	33.3	31	51.7	69	38.3
Total	**60**	**100**	**60**	**100**	**60**	**100**	**180**	**100**

Apart from extension workers, respondents from the survey sites got agricultural information through farmer clubs (Table 11). The total percentage of respondents who got agricultural information through farmer clubs [49.4% (89)] was slightly lower than that of those who did not [50.6% (91)]. Beekeepers from the main study group registered the highest percentage of those that got agricultural information through farmer clubs [60.0% (36)] followed by beekeepers from the control sites [55.0% (33)] while non-beekeepers had the lowest percentage [33.3% (20)]. There were significant differences among non-beekeepers and beekeepers from the main study and control groups with respect to getting agricultural information through farmer clubs (Appendix D, Table D6).

These results really show that beekeepers were very progressive with respect to participation in different associations including farmer clubs.

Table 11: Number and Distribution (%) of Respondents by Sources of Information through Farmer Clubs

Farmer club	**Beekeepers**				**Non- beekeepers**		**Total**	
	Study area		Control area					
	n	%	n	%	n	%	n	%
Yes	36	60.0	33	55.0	20	33.4	89	49.4
No	24	40.0	27	45.0	40	66.6	91	50.6
Total	**60**	**100**	**60**	**100**	**60**	**100**	**180**	**100**

In addition to receiving agricultural information through participation in farmer clubs, the majority of respondents [73.3% (132)] also relied on the radio while minority did not [26.7 % (48)]. The percentage of respondents who relied on the radio was highest among non- beekeepers [78.3% (47)] followed by beekeepers from the main study site [75.0% (45)] while beekeepers from the control site had the lowest percentage [66.7% (40)]. Differences among non-beekeepers and beekeepers from the main study and control sites with respect to receiving agricultural information through the radio were not significant (Appendix D, Table D6). The fact that more non-beekeepers than beekeepers relied upon the radio for agricultural information means that the radio was either ineffective or underutilised in transmitting information related to beekeeping.

Some respondents [37.2 % (67)] got agricultural information from fellow farmers. Beekeepers from the control sites registered the highest percentage of those that relied on fellow farmers for agricultural information [40.0% (24)] followed by non-beekeepers [36.7% (22)] while beekeepers from the main study site had the lowest percentage [35.0% (21)]. Differences among non-beekeepers and beekeepers from both the main study and control groups in terms of dependence on fellow farmers for agricultural information were not significant (Appendix D, Table D6).

In addition to that, small percentages of respondents relied on village heads, television and newspaper for agricultural information. The total percentage of respondents that received agricultural information from their village heads was 9.4% (17). In this category, beekeepers from the control sites registered the highest percentage 11.7% (7) followed by non-beekeepers 10.0% (6) while beekeepers from the main study group had the lowest percentage 6.7% (4). Beekeepers from the main study group interacted most with extension workers. Other respondents 4.4% (8) got agricultural information through television. In this category, beekeepers from the control group and non-beekeepers had equally higher percentages 5.0 % (3) than beekeepers from the main study site 3.3 % (2). Access to television in the survey sites was limited due to lack of economic means to procure the facility. However, as a source of agricultural information, this could be more effective than the radio since both senses of sight and hearing could be utilised. Some respondents 2.2 % (4) received agricultural information through newspaper. This category comprised of same percentages of beekeepers from the main study and control sites 3.3 % (2) and none of the non-beekeepers 0.0 % (0).

Like television, access to newspaper was limited due to lack of income. Chi-square tests were not calculated with respect to acquisition of agricultural information through village heads, television and newspaper because frequencies of observations in some cells were less than five.

4.2 Status of Beekeeping

This section describes the following: period when beekeeping started, reasons for starting beekeeping, how beekeepers got the knowledge and skills in beekeeping, where hives for beekeepers were set, types of hives used with respect to environmental friendliness, harvesting techniques used, whether beekeepers used protective clothing during harvesting, number of cases stung by bees during harvesting, whether beekeepers were satisfied with the price of honey, problems faced by beekeepers, reasons expressed by non-beekeepers for not starting beekeeping and perception by respondents on the link between beekeeping and conservation of forests.

4.2.1 Period Beekeeping Begun

Before the implementation of the IFSP in the year 2003, some respondents [21.0% (25)] were already beekeepers (Figure 3). Among this group, beekeepers from the main study site registered a higher percentage [28.3% (17)] than those from the control sites [13.6% (8)]. The highest percentage of beekeepers [42.0% (50)] started the practice during the time it was being introduced by the IFSP (2003-2004). During this period, beekeepers from the main study group registered a higher percentage [51.7% (31)] than those from the control group [32.2% (19)].

After the project phase, 37.0% (44) of beekeepers adopted the practice with higher percentage [54.2% (32)] from the control sites than the main study site [20.0% (12)]. The increase in the number of beekeepers from the control group happened after 2004 due to diffusion of the technology from the main study site.

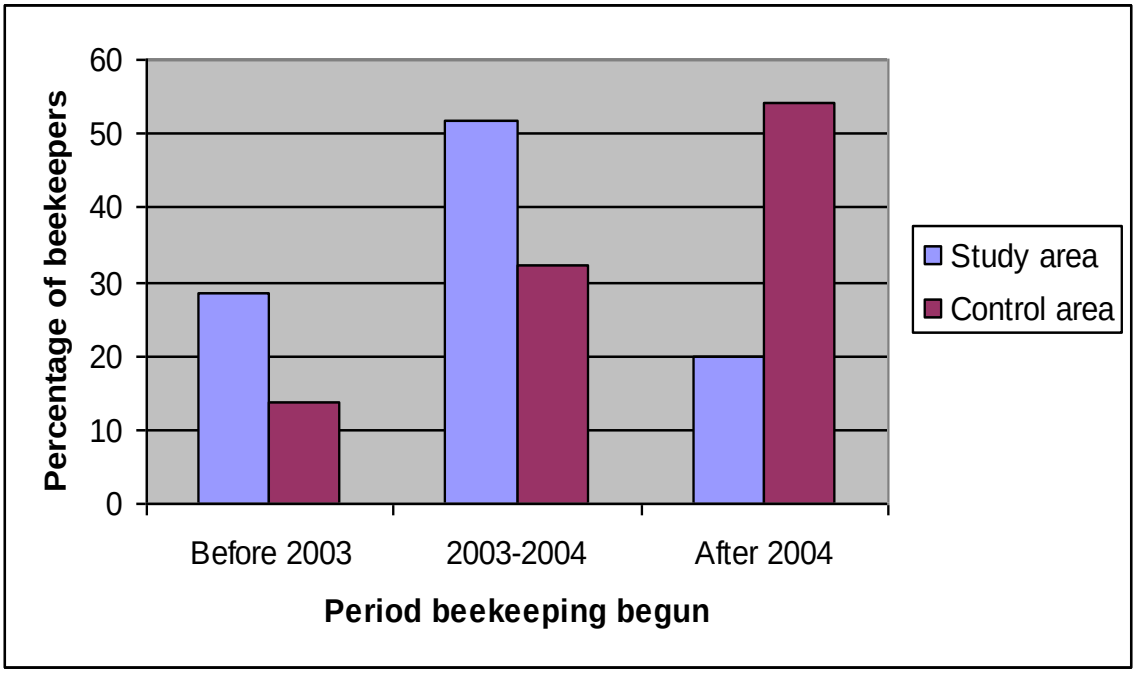

Figure 3: Period Beekeeping Begun in the Main Study and Control Sites

4.2.2 Reasons for Starting Beekeeping

Figure 4 shows that income generation was the major reason for starting beekeeping. This was cited by 96.7% (58) and 90.0% (54) of beekeepers from the main study and control sites, respectively.

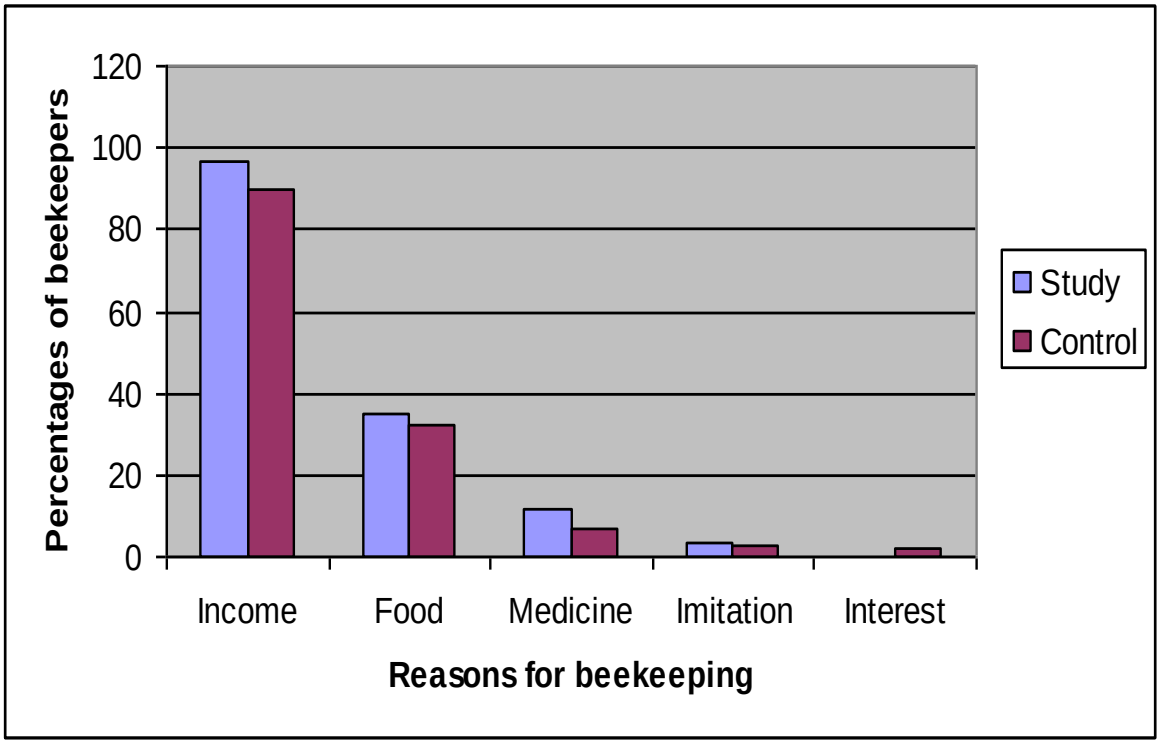

Figure 4: Reasons for Beekeeping

This was followed by the need for food which was expressed by 35.0% (21) and 32.0% (19) of beekeepers from the main study and control sites, respectively. Other reasons such as the need for medicine, imitation, hobby and mere interest, were minor. The National Coordinator for Programme for Biomass Energy Conservation (PROBEC) indicated that honey consumption had medicinal values and promoted good health especially for those suffering from Acquired Immune Deficiency Syndrome (AIDS). Being aware of such impact, some beekeepers were encouraged to start the practice.

4.2.3 How Beekeepers Knew about Beekeeping

The highest percentage [33.3% (40)] of beekeepers learnt the knowledge and skills from extension workers. As shown in Figure 5, beekeepers from the main study site registered a higher percentage [43.3% (26)] than those from the control sites [23.3% (14)].

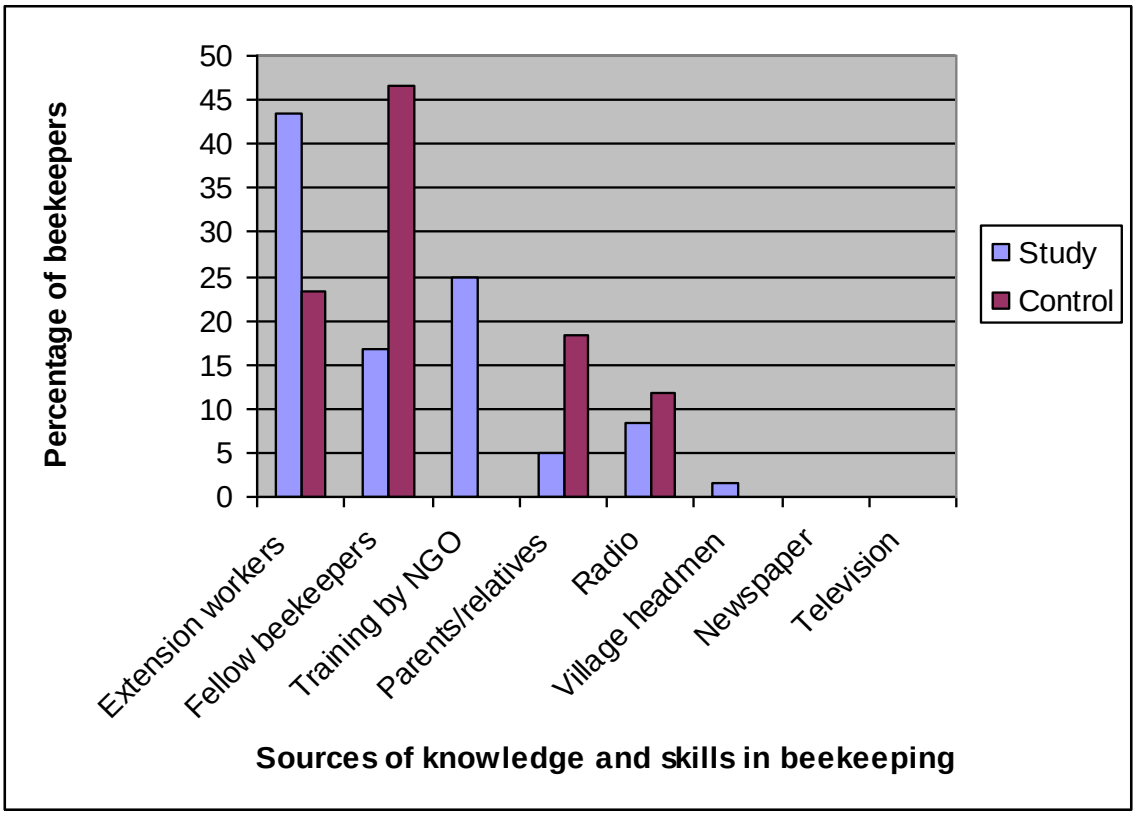

Figure 5: Sources of Knowledge and Skills in Beekeeping

Other beekeepers [31.7% (38)] got the knowledge and skills through fellow beekeepers. This was the major means utilised by beekeepers from the control sites whose percentage [46.7% (28)] was higher than that from the main study site [16.7% (10)].

The third means was through the NGO that implemented the IFSP. This mainly included 25.0% (15) of beekeepers from the main study site but none 0.0% (0) from the control sites. Other beekeepers [11.7% (14)] got the knowledge and skills through parents. This included 18.3% (11) of beekeepers from the control sites and 5.0% (3) of beekeepers from the main study site. Few beekeepers got the knowledge and skills through village headmen and radio. However, none of them got the knowledge and skills through television and newspaper.

4.2.4 Where Hives Were Set

The highest percentages of beekeepers [48.3 % (58) each] set hives on village forest land and on own land (Figure 6). The highest percentage of beekeepers from the main study site [81.7% (49)] set their hives on village forest areas while 16.7% (10) set their hives on own land. Only 1.7% (1) of beekeepers set their hives on borrowed land. In the control sites the highest percentage [80.0 % (48)] set hives on own land while 15.0 % (9) on village forest land and 5.0 % (3) on borrowed land. None of the beekeepers (0%) set hives on rented land. In the main study site, village forests are located along river banks especially Thuchira, Mlemba and Mapanga where some beekeepers set their hives. This scenario is different from that in the control sites where village forest areas are located away from river banks.

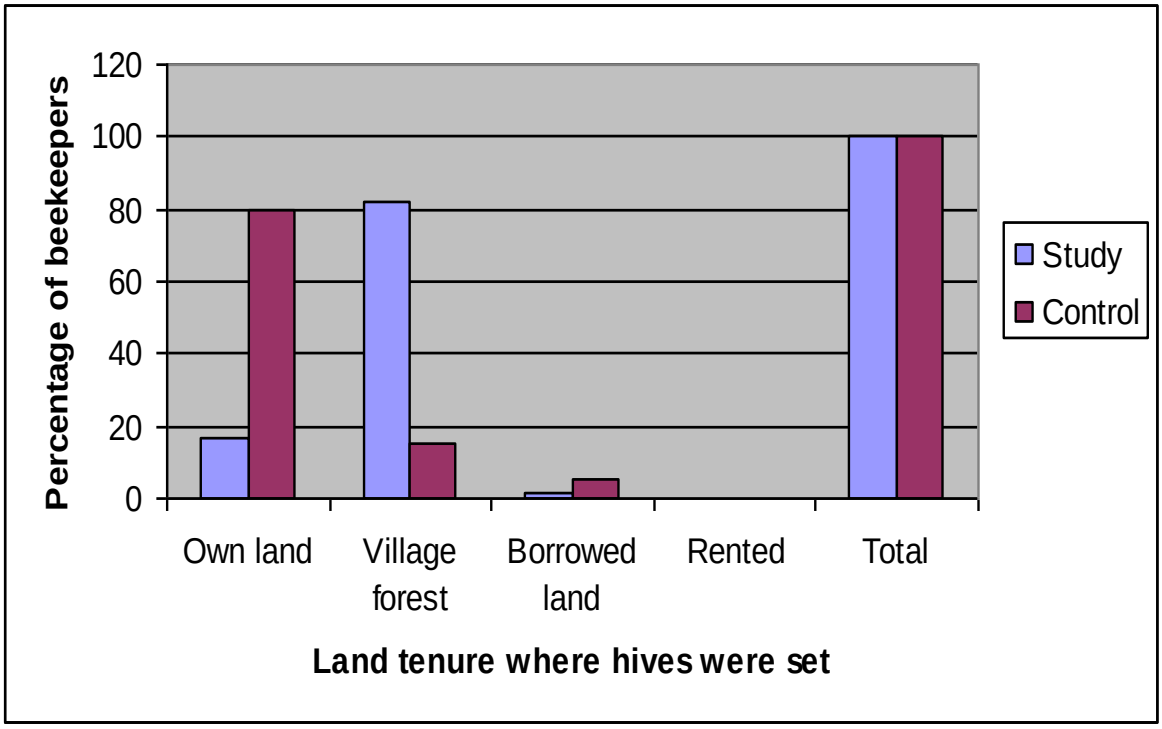

Figure 6: Land Tenure Where Hives Were Set

4.2.5 Number of Beekeepers by Production Methods

Beekeepers from both the main study and control sites used different production methods. The methods were categorised as modern and local. Modern hives used were Malawi standard beehives (Appendix H, Plate 1) while local hives included clay, logs, barks and cave or stone hives (Appendix H, Plates 2 to 5). Figure 7 shows that, the highest percentage of beekeepers [95.0 % (114)] used modern hives. Beekeepers from the main study site registered a higher percentage [100.0 % (60)] than beekeepers from the control sites [90.0 % (54)] with respect to use of modern hives.

It is clear that modern hives were used by the majority of beekeepers although others used clay, bark, logs, tins and caves. All beekeepers in the main study site had at least a modern beehive because this type was promoted by the IFSP.

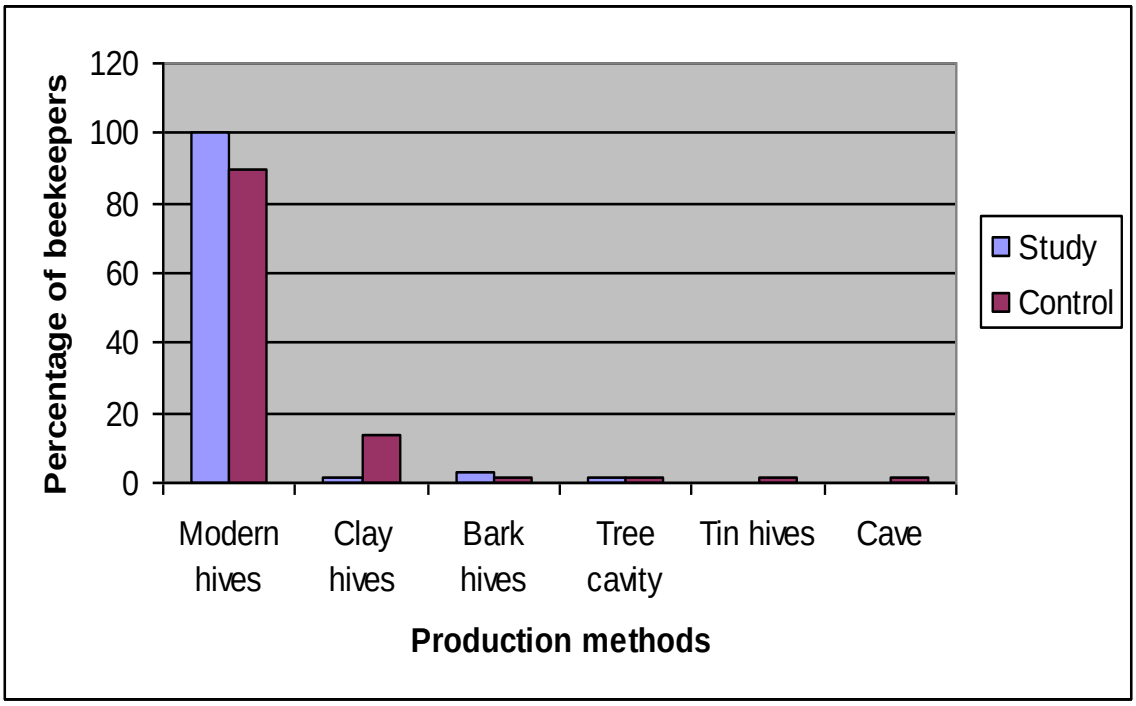

Figure 7: Percentage of Beekeepers by Production Methods of Beehives

4.2.6 Percentage of each Type of Hive

The total number of hives from the main study and control sites was 529. This comprised 239 hives from the main study site and 290 from the control sites. As illustrated in Figure 8, the percentage of modern hives was higher from the main study site [96.7% (231)] than control sites [87.9% (255)]. On the other hand, the percentage of clay hives was higher in the control sites [8.3% (24)] than the main study site [0.8% (2)].

The percentage of tree cavity hives was slightly higher in the control sites [1.0 % (3)] than main study site [0.8% (2)]. Only 0.7 % (2) of hives were tin and cave by type. However, both types were found in the control sites only.

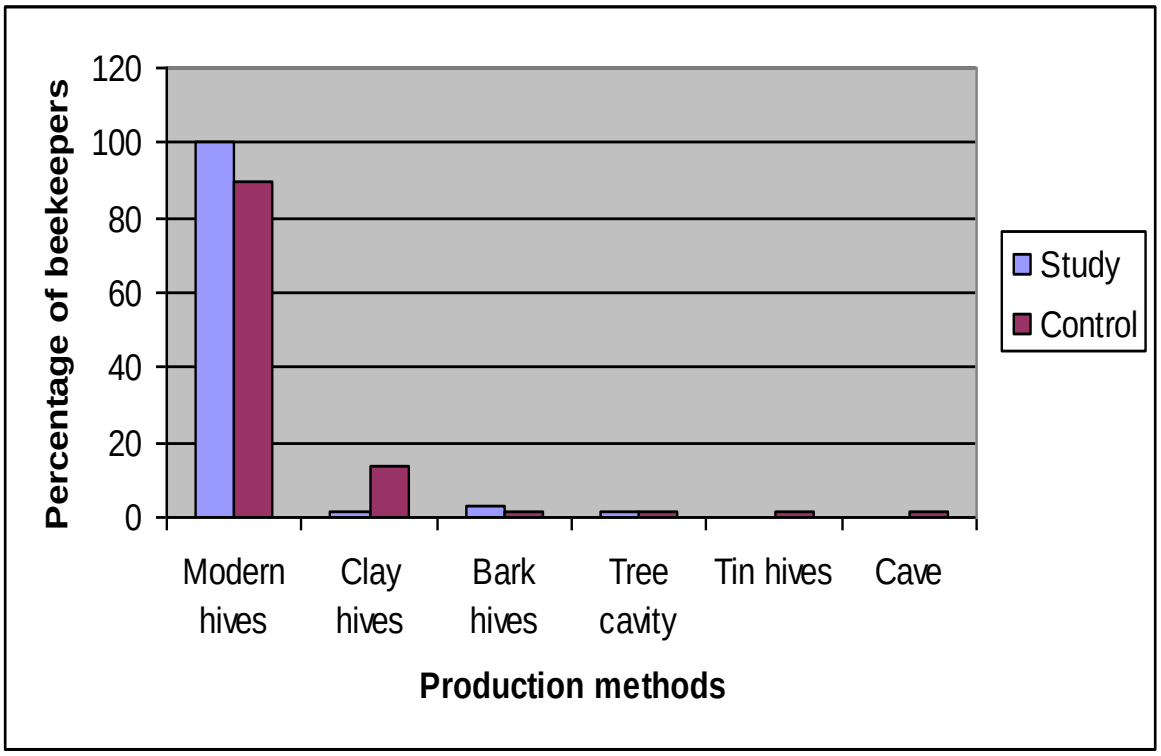

Figure 8: Percentages of Hives Used

4.2.7 Percentages of Hives by Environmental Friendliness

Environmentally friendly hives included modern hives, clay hives, stone hives and tin hives. These do not encourage deforestation. Environmentally unfriendly hives comprised bark and log hives. These destroy vegetation especially trees that have been ring barked or drilled to make hives.

As shown in Figure 9, the total percentage of environmentally friendly hives among beekeepers from both the main study and control sites 97.6 % (516) was higher than that of environmentally unfriendly hives [2.4% (13)]. Beekeepers from the control sites had a slightly higher percentage of environmentally friendly hives [97.6% (283)] than those from the main study site [97.5% (233)].

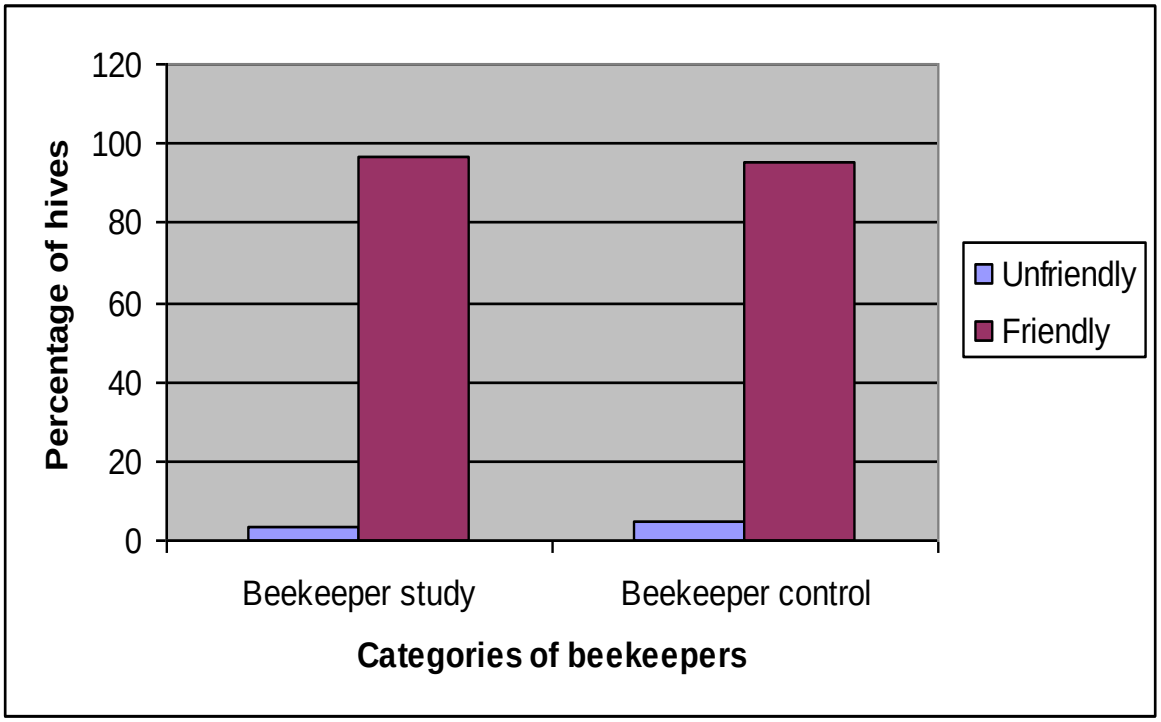

Figure 9: Percentages of Hives by Environmental Friendliness

4.2.8 Types of Trees Used for Hives

Different species of trees were used for construction of beehives (Figure 10). Beehives from Gmelina trees were used by 88.3% (106) of beekeepers followed by Pine [6.7% (8)] and Figs [1.7% (2)]. Smaller percentages of beekeepers used hives made from Blue gum, Mahogany, Mulanje cedar and Palm.

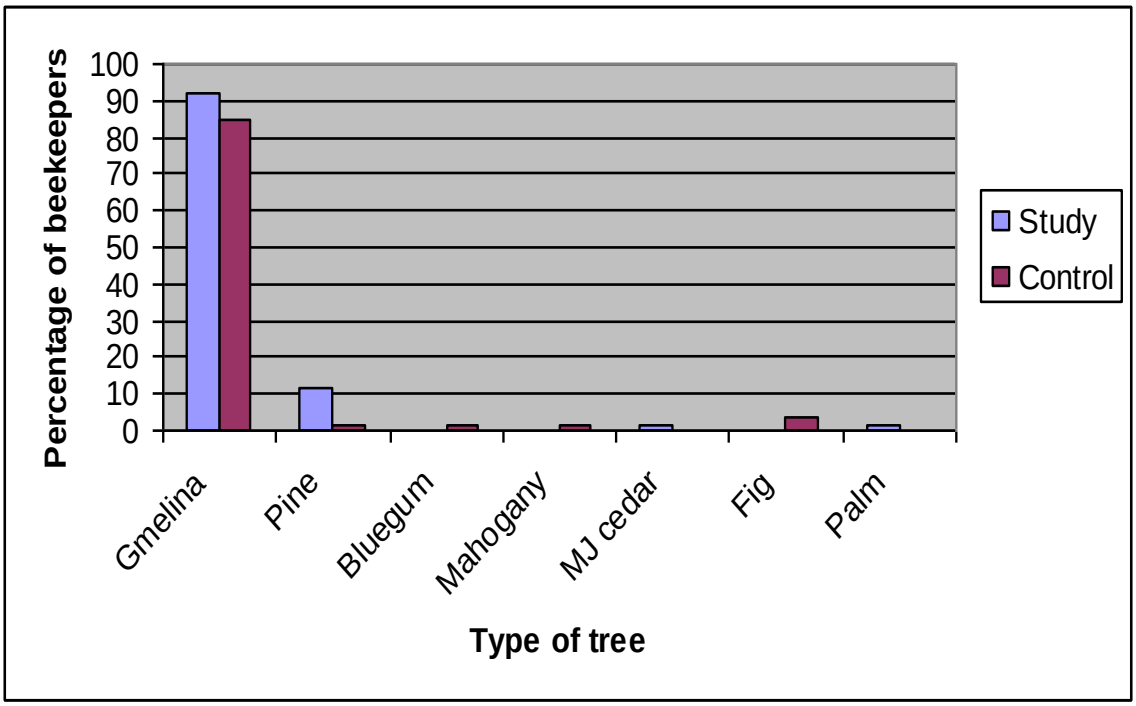

Figure 10: Percentages of Beekeepers by Type of Tree Used for Hives

The percentage of beekeepers that used hives made from Gmelina was higher among beekeepers found in the main study site [91.7% (55)] than the control sites [85.0 % (51)]. Similarly, the percentage of beekeepers that used hives made from Pine was also higher among the main study group [11.7% (7)] than control group [1.7% (1)]. Hives from Figs were used by 3.3% (2) of beekeepers from the control sites only.

Similarly, hives from Mahogany were used by 1.7% (1) of beekeepers from the control group only. On the other hand, hives from Palm and Mulanje cedar were each used by 1.7 % (1) of beekeepers from the main study site. Therefore, the majority of beekeepers used hives that were constructed from Gmelina. This was the case primarily due to the abundance of Gmelina trees in the main study and control sites. Gmelina produces good quality hives that retain the quality of honey unlike other trees. Environmentally, the use of Gmelina for hives is advantageous for two reasons. Firstly, Gmelina is renewable and fast regenerating. Consequently, its use promotes sustainable use of forest resources. Apart from that, use of Gmelina for hives protects other indigenous trees that are difficult to regenerate. The only disadvantage with Gmelina is that it contributes towards water abstraction which may result into loss of other species of trees and vegetation especially in upland areas.

4.2.9 Harvesting Techniques Used by Environmental Friendliness

Figure 11 shows that, the highest percentage of beekeepers [90.0 % (108)] used smokers during harvesting. These are environmentally friendly. On the other hand, 10.0 % (12) used fire torches which destroy honey and sometimes create bush fires thereby bringing in environmentally unfriendly effects. All beekeepers from the main study site [100.0 % (60)] used smokers and none of them (0.0 %) used fire torches. On the other hand, 80.0 % (48) of beekeepers from the control sites used smokers while 20.0 % (12) used fire torches. Beekeepers that used fire torches indicated that they did so due to lack of information and cash to procure smokers.

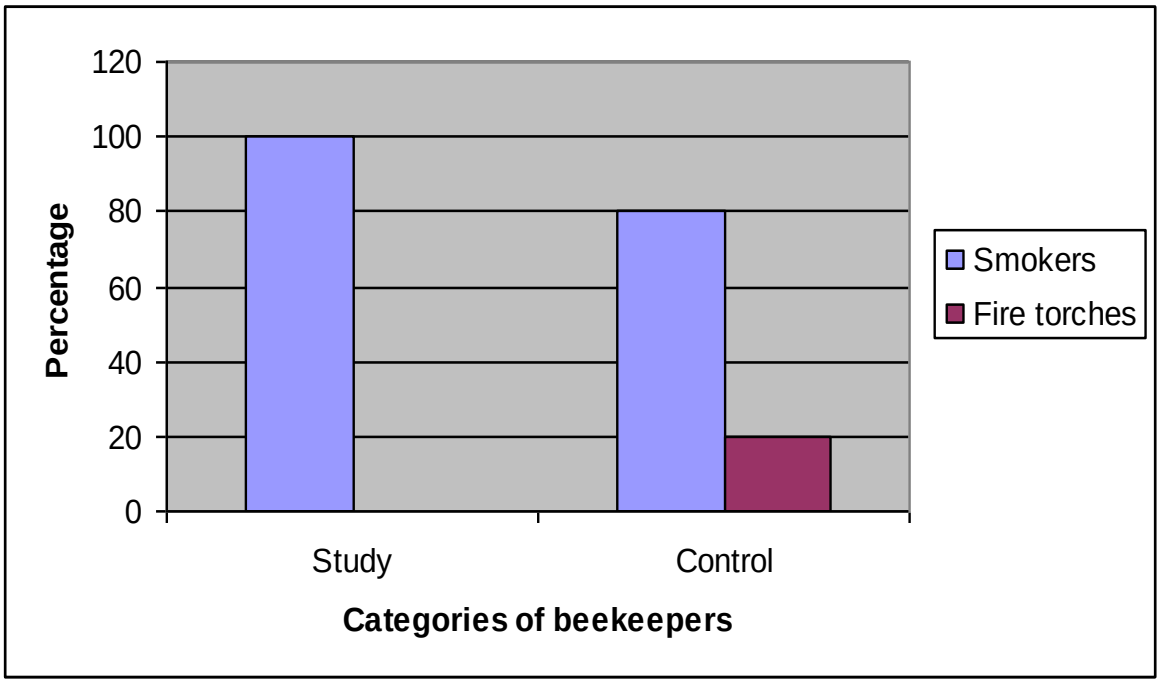

Figure 11: Harvesting Techniques

4.2.10 Reported Cases of Destruction of Bees during Harvesting

As illustrated in Figure 12, higher percentage of beekeepers [85.0 % (102)] reported that they had never heard about other beekeepers destroying bees during harvesting while 15.0 % (18) did. The percentage of beekeepers that had never heard about destruction of bees during harvesting was higher among the main study group [95.0 % (57)] than control group [75.0 % (45)]. These results could be attributed to the effectiveness of smokers which weaken honey bees for the safety of the beekeepers without necessarily killing the bees during harvesting of honey.

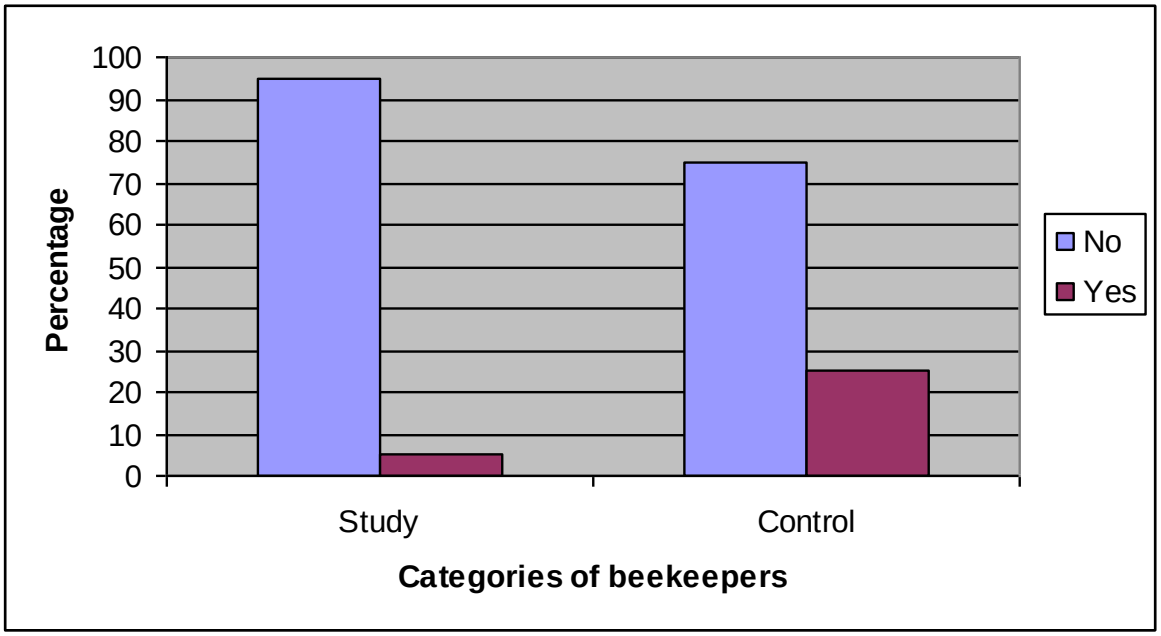

Figure 12: Destruction of Bees during Harvesting

4.2.11 Destruction of Forests during Honey Harvesting

The highest percentage of beekeepers [85.8% (103)] indicated that they had never heard about other beekeepers burning forests during harvesting while 14.2% (17) did (Figure 13). The percentage of beekeepers that had never heard about others destroying forests during harvesting was higher among those from the main study sites [91.7% (55)] than from the control site [80.0 % (48)]. This could be the case because more beekeepers in the main study than control group used smokers. Smokers reduce the risk of fire outbreaks unlike the use of fire torches. These results are different from those obtained during participant observations in which all apiaries visited 100.0 % (120) showed no cases of burnt trees due to harvesting of honey.

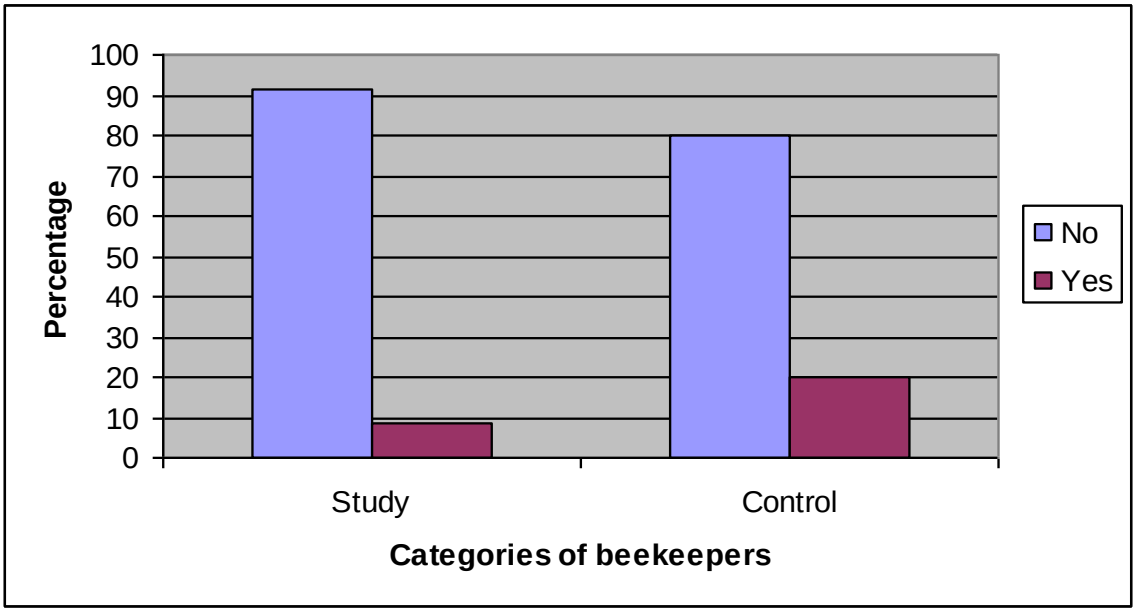

Figure 13: Destruction of Forests during Harvesting

4.2.12 Attacks from Bees during Harvesting

The total percentage of beekeepers that were attacked by bees at least once during harvesting was [60.0 % (72]. As depicted in Figure 14, beekeepers from the control sites had a higher percentage [65.0 % (39)] of those that were attacked by bees during harvesting than those from the main study site [55.0 % (33)]. The fact that majority of beekeepers experienced beestings means that technologies used during honey harvesting were not effective enough to offer them full protection against the beestings. On the other hand, bee stings are thought to help ease the symptoms of a wide range of diseases, including arthritis, multiple sclerosis, tendonitis and fibromyalgia (Woolston, 2009). Woolston also documented that beestings are also thought to promote desensitization to bee stings.

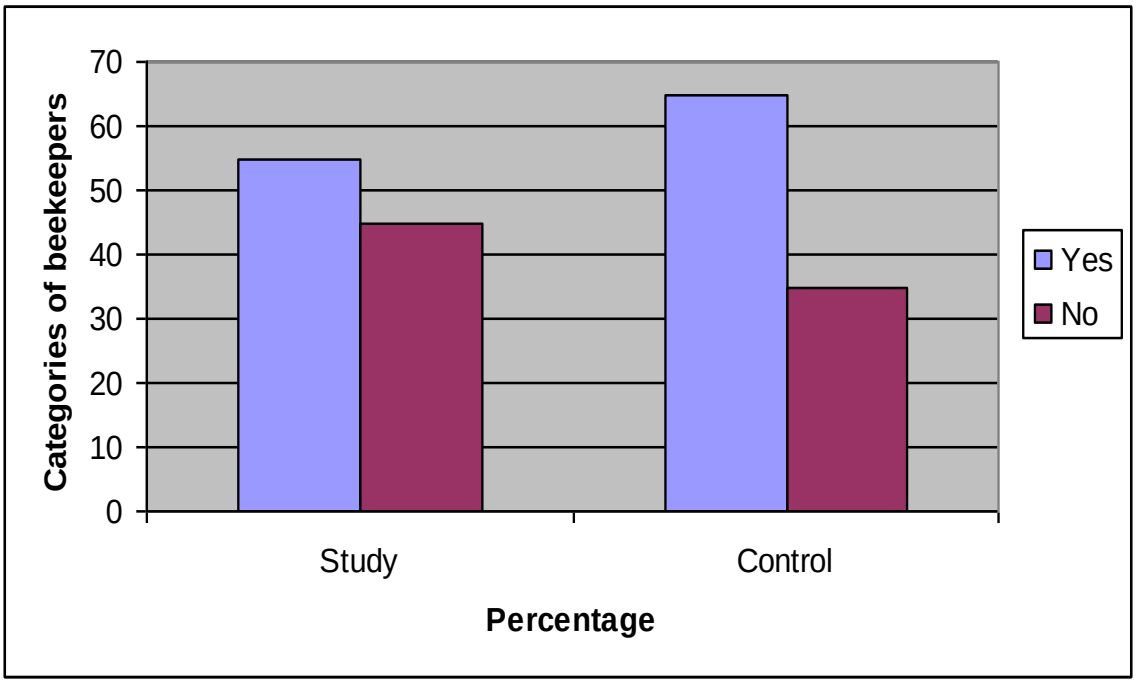

Figure 14: Attacks from Bees during Harvesting

4.2.13 Use of Protective Clothing during Honey Harvesting

The majority of beekeepers [88.3% (106)] used protective clothing during harvesting of honey. As illustrated in Figure 15, the percentage of beekeepers that used protective clothing was higher among those from the main study group [98.3% (59)] than the control group [78.3% (47)]. No wonder, cases of attacks from bees during harvesting were lower for the main study than control group. The major reasons why some beekeepers did not use protective clothing were lack of money and information regarding access.

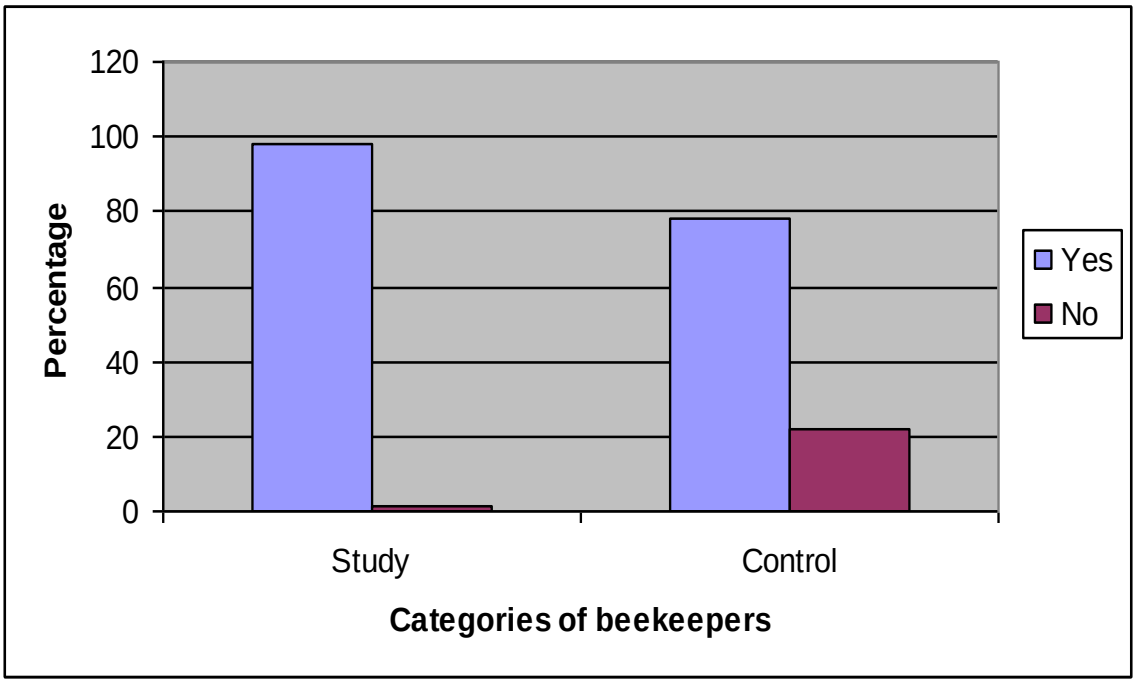

Figure 15: Percentage of Beekeepers by Use of Protective Clothing

4.2.14 Re-investment of Economic Returns in Beekeeping

Only 22.6% (27) of beekeepers re-invested part of the economic returns back into beekeeping. As illustrated in Figure 16, the percentage was higher among beekeepers from the main study site [33.3% (20)] than those from the control sites [11.7% (7)]. The major reason why the majority could not re-invest economic returns back into beekeeping was inadequate income from sales of honey. This was compounded by financial problems that beekeepers faced. No wonder some beehives observed during participant observations were in poor state since the beekeepers failed to maintain them.

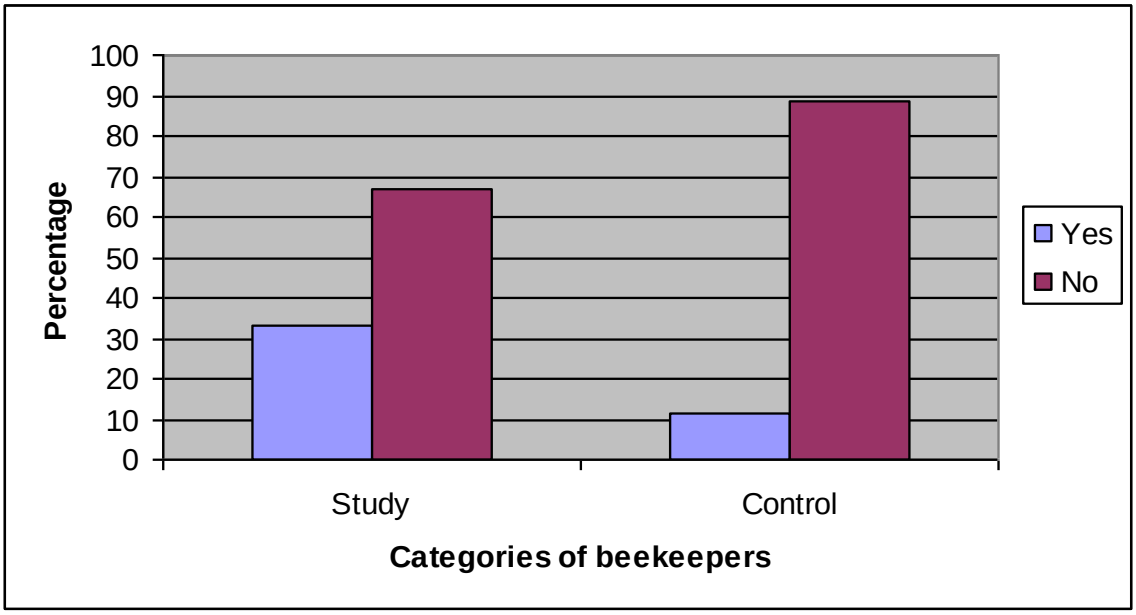

Figure 16: Percentage of Beekeepers by Re-investments in Beekeeping

4.2.15 Problems Facing Beekeeping

The first major problem cited by beekeepers was poor market (Figure 17). This was expressed by 80.0 % (96) of beekeepers of which 75.0 % (45) were from the main study group and 85.0 % (51] from the control group. This problem was seconded by lack of knowledge expressed by 42.5% (51) of beekeepers of which 36.7% (22) were from the main study group while 48.3% (29) were from the control group. Invasion of hives by ants was the third major problem cited by a total of 37.5% (45) of beekeepers of which 38.3% (23) were beekeepers from the main study site while 36.7% (22) were from the control group. The fourth problem was low yields. This was expressed by 26.7% (32) of respondents where by 28.3% (17) were beekeepers from the main study group while 25.0 % (15) were beekeepers from the control group.

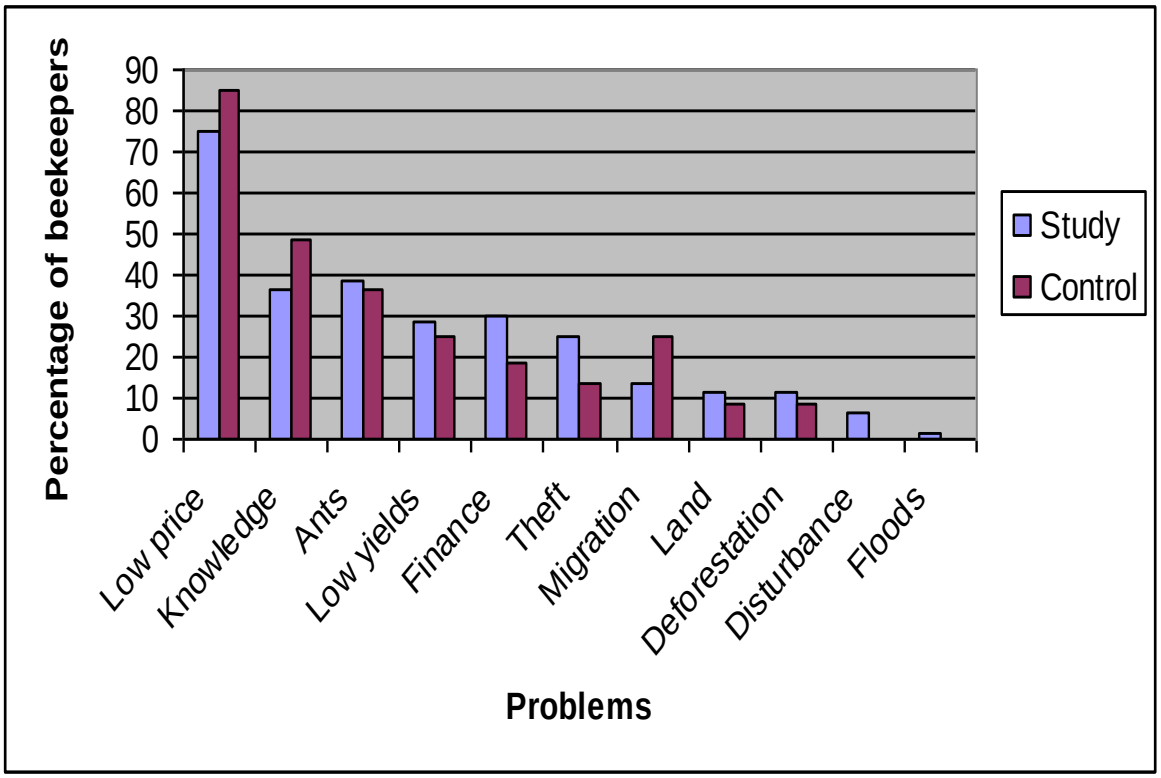

Figure 17: Problems Facing Beekeeping

Lack of finance to boost up the number of hives was the fifth major problem raised by 24.7% (29) of beekeepers 30.0 % (18) of which were beekeepers from the main study group and 18.3% (11) from the control group. Other problems such as theft, migration of bees, lack of land, lack of vegetation, disturbance from wild animals and floods were cited as minor problems. During key informant interviews, TA Nthiramanja indicated that sometimes disputes arose among beekeepers during setting of hives on village forest areas along river banks. However, such disputes could be settled amicably as soon as they occurred rendering themselves minor problems.

These results are consistent with observations by Magombo (personal communication) who indicated that access to better markets was a common problem facing beekeeping in Malawi. The results are also similar to studies conducted by Total Transformation Agribusiness Ltd (2006) that show that in Manica province of Mozambique, there is no one institution that buys honey in large quantities such that beekeepers sell honey individually along the roads and in the cities. Similar studies conducted in South Africa indicate that there is no national marketing strategy in place to stimulate the demand for honey. This problem also prevails in Botswana.

4.2.16 Reasons Expressed by Non-beekeepers for Not Practising Beekeeping

Figure 18 shows that, the three major reasons expressed by non-beekeepers for not practising beekeeping were lack of capital, poor market and lack of information. Lack of capital was cited by 66.7% (40) of non-beekeepers, while poor market was expressed by 15.0 % (9), and lack of information was cited by 13.3% (8) of the non-beekeepers. Other reasons such as fear of bee stings, migration of bees, lack of land, lack of interest, lack of forests and fear of theft were cited as minor reasons and summed up to 16.7% (10). However, none of the non-beekeepers indicated cultural constraints as a reason for not starting beekeeping. During focus group discussions, non-beekeepers expressed that they were interested in the practise. However, such interest could not translate into reality due to lack of capital. On the other hand, none of the non-beekeepers registered fear of beestings as a cause although the National Coordinator for PROBEC included that as one reason for not starting beekeeping.

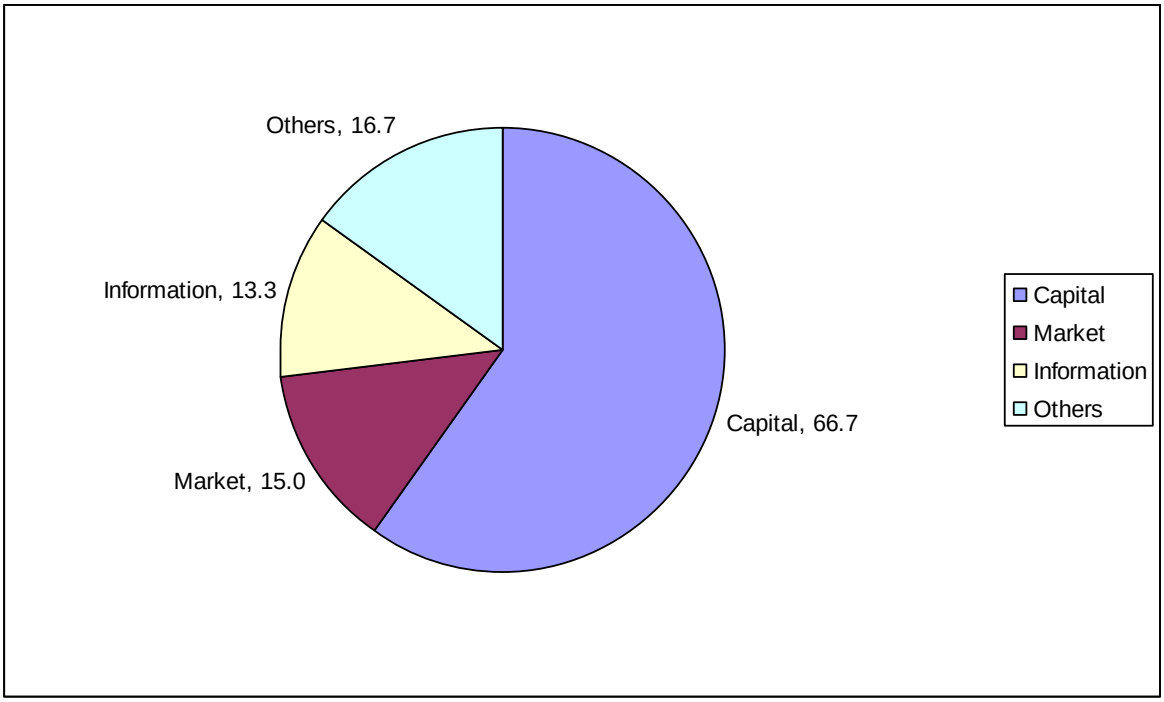

Figure 18: Reasons by Percentage for Not Starting Beekeeping

4.2.17 Beekeeping and Forest Conservation

Figure 19 shows that the majority of respondents [98.9% (178)] indicated that beekeeping was helping to conserve forests. Among them included 100.0 % (60) of beekeepers from the main study and control sites respectively. The percentage of non- beekeepers that had same observation was slightly lower [96.7% (58)]. Only 1.1% (2) of the total number of respondents was not sure about whether beekeeping was helping to conserve vegetation. This group comprised 3.3% (2) of non-beekeepers only. During focus group discussions, beekeepers and non-beekeepers stated that people avoid cutting down trees on which hives were set for fear of bee stings and disturbing production. With this connection, the people suggested that the Forestry Department should promote beekeeping in order to conserve trees.

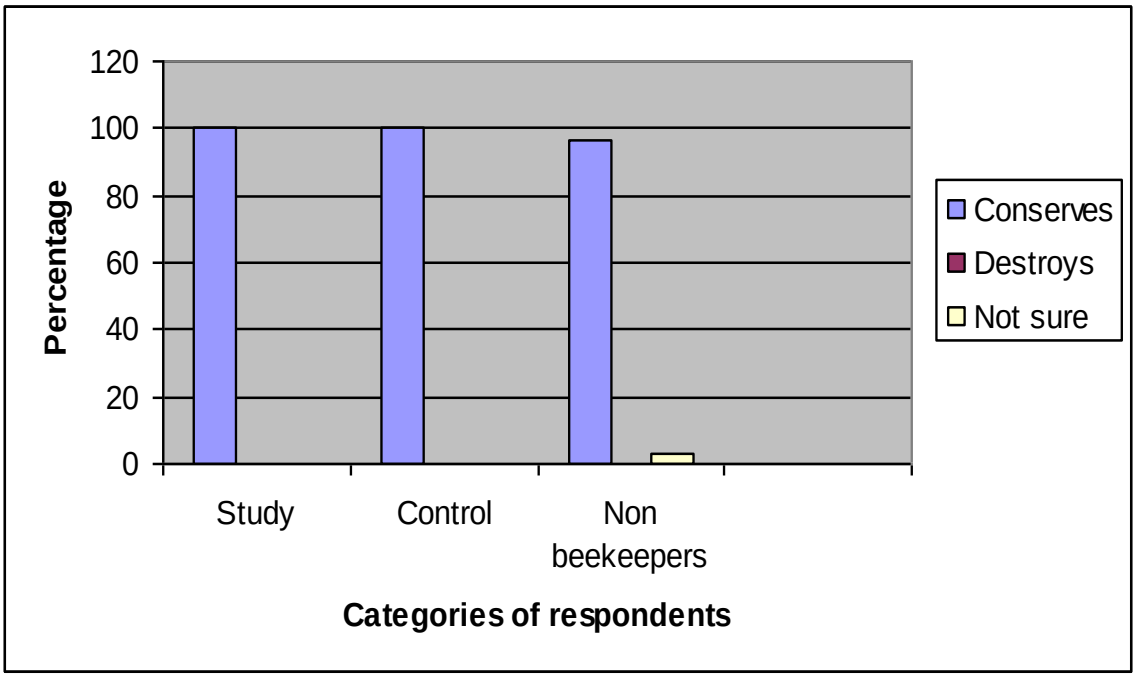

Figure 19: Beekeeping and Forest Conservation

4.3 Economic Returns from Different Sources during the Year 2007

Respondents from the main study and control sites generated income from different economic sources. Among these included production of maize, cassava, potatoes, groundnuts, beans, peas, vegetables, sugarcanes, fruits, milk, goats, poultry, pigs, beekeeping, employment, selling poles, charcoal, firewood, carpentry, seedlings, banana fritters, casual labour, selling clothes, timber and housing construction. Total amounts of economic returns from different sources among the respondents and their groups varied. There were also variations in average income from different sources among the different groups of respondents.

4.3.1 Economic Returns for Beekeepers from the Main Study Group

As shown in Appendix E, Table E1, the total economic returns from maize were the highest (MK2, 064, 370.00), representing 44.2% of the total economic returns of the beekeepers in the main study group. Beekeeping came second with a sum total of MK479, 650.00, representing 10.3% of the total economic returns while employment came third by contributing MK317, 500.00, equivalent to 6.8 % of the total economic returns. The economic returns from assorted businesses came fourth by generating a sum total of MK228, 000.00, representing 4.9% of the total income for the group. The economic returns from cattle came fifth and contributed MK181, 750.00, equivalent to 3.9% of the total income followed by goats whose economic returns amounted to MK165, 299.00, equivalent to 3.5% of the total economic returns. Cassava emerged seventh as it contributed MK153, 980.00 or 3.3 % of the total economic returns while groundnuts emerged eighth by contributing MK151, 900.00, equivalent to 3.3% of the total economic returns. Pigs contributed MK139, 260.00, equivalent to 2.9% of the total economic returns and emerged ninth. The total economic returns from casual labour amounted to MK131, 700.00, equivalent to 2.8% and came tenth. The rest of the economic activities (Appendix E, Table E1) contributed an aggregate of MK655, 670.00, representing 14.0% of the total economic returns for the group. With respect to total economic returns, beekeeping was number two among beekeepers from the main study site. The rest of the economic activities except maize production had lower total economic returns than beekeeping.

On the other hand, the average economic returns from different sources were not proportional to magnitude of total sum of economic returns from the different sources. Although the highest sum of economic returns for beekeepers in the main study category were sourced from maize, the highest average economic returns were realised from milk and loans (MK50, 000.00/respondent/annum each) as depicted in Figure 20.

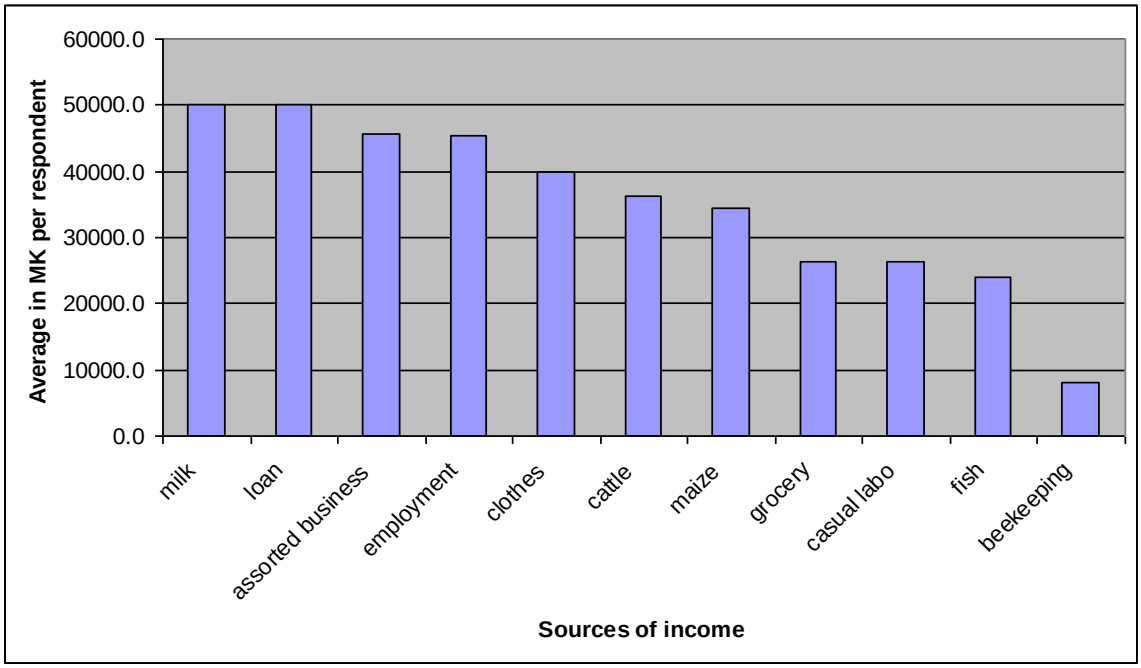

Figure 20: Average Economic Returns from Different Sources for Beekeepers from the Main Study Site

This was followed by assorted business such as selling of sweet beer, banana fritters, freezes and other small scale businesses (MK45, 357.14.00/respondent/annum). The average income from employment emerged third (MK45, 600.00/respondent/annum) while that from selling clothes emerged fourth (MK40, 000.00/respondent/annum).

This was followed by cattle rearing which emerged fifth (MK36, 350.00/respondents/annum) while maize cultivation emerged sixth (M34, 406.17/respondent/annum). The average economic returns from grocery emerged seventh (MK26, 400.00/respondent/annum) while that from casual labour emerged eighth (MK26, 340.00/respondent/annum). The average economic returns from selling fish ranked ninth (MK24, 000.00/respondent/annum). However, the average income from the rest of the sources was relatively small (Appendix E, Table E1). This included average income from beekeeping (MK7, 994.17/respondent/annum). No wonder, beekeepers complained of poor honey prices despite their interest and efforts in the practice.

4.3.2 Economic Returns for Beekeepers from the Control Sites

The total economic returns for beekeepers from the control sites amounted to MK5, 477, 842.33 in the year 2007 (Appendix E, Table E2). Maize production contributed the highest sum of economic returns (MK2, 227, 260.00), representing 40.7% followed by employment which contributed a sum total of MK849, 000.00, equivalent to 15.5% of the total economic returns. Rearing of goats emerged third by contributing a sum total of MK249, 440.00, representing 4.6 % of the total economic returns. Cattle production emerged fourth by contributing a sum total of MK219, 800.00, equivalent to 4.0% followed by production of pigs which contributed MK217, 800.00 or 3.9% of the total economic returns. Cassava production ranked sixth by contributing MK195, 750.00, equivalent to 3.6% of the total economic returns while groundnuts contributed a sum total of MK185, 400.00 or 3.4% and came seventh.

Timber contributed MK159, 000.00 or 2.9% and emerged eighth while beekeeping contributed MK152, 307.33, equivalent to 2.8% and emerged ninth. Economic returns from chickens ranked tenth by contributing a sum total of MK137, 910.00, representing 2.5%. The rest of the economic activities (Appendix E, Table E2) contributed an aggregate sum of MK884, 175.00 representing 16.1% of the total economic returns. Therefore, in the control sites, economic returns from beekeeping were lower than eight others namely: maize, employment, goats, cattle, pigs, cassava, groundnuts and timber but higher than those from chickens and the rest of the economic activities. No wonder, only 35.0% (21) indicated it as number one economic activity.

Similar to the picture observed among beekeepers from the main study group, the average economic returns from different sources among beekeepers from the control group were not proportional to the total sum of income generated. Figure 21 shows that, the highest average of economic returns among beekeepers from the control group was realised from timber (MK159, 000.00/respondent/annum). This was followed by tobacco (MK65, 770. 00) while that from employment emerged third (MK60, 642.86). The average economic returns from casual labour emerged fourth (MK38, 333.33/respondent/annum) while that from maize ranked fifth (MK37, 121.00/respondent/annum).

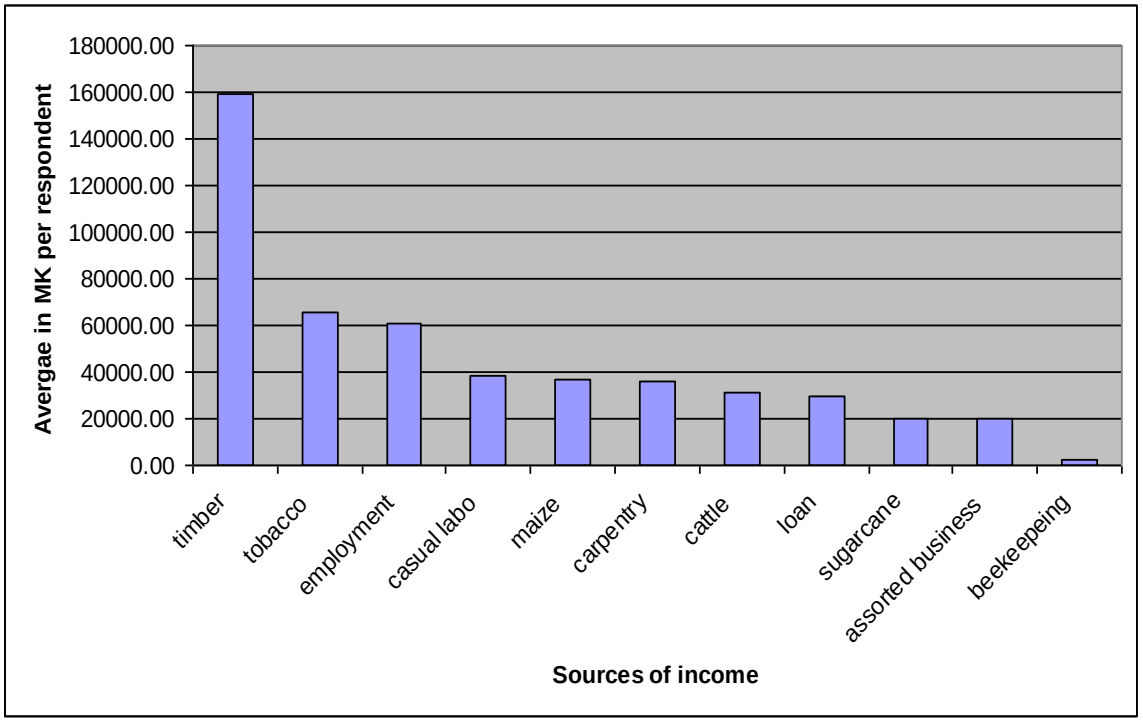

Figure 21: Average Economic Returns for Beekeepers from the Control Group

This was followed by carpentry (MK36, 000.00/respondent/annum) while that from cattle emerged seventh (MK31, 400.00). The average economic returns from loans ranked eighth (MK30, 000.00/respondent/ annum) while that from sugarcanes was ninth (MK20, 400.00/respondent/ annum. The tenth average economic returns came from assorted business especially selling of sweet beer and banana fritters. The average economic returns from beekeeping were among the lowest (MK2, 538.46.00/respondent/annum). No wonder, this group complained more than the main study group on poor honey selling prices.

4.3.3. Economic Returns for Non-beekeepers in the Main Study Site

The total economic returns from different economic sources for non-beekeepers amounted to MK4, 789, 739.82 (Appendix E, Table E 3). Maize production contributed the highest sum (MK1, 512, 940.00), equivalent to 31.6 % of the total economic returns. This was followed by employment whose economic returns amounted to MK865, 750.00, or 18.1 % of the total economic returns. Groceries emerged third by contributing a sum total of MK385, 475.00, equivalent to 8.1% while carpentry contributed MK291, 000.00 or 6.1 % and emerged fourth. Cassava contributed a sum total of MK182, 190.00 or 3.8% and came fifth while chickens emerged sixth by contributing a sum total of MK178, 059.00, representing 3.7% of the total economic returns. Pigs contributed a sum total of MK166, 500.00 representing 3.5% and came seventh followed by milk which contributed MK149, 640.82 or 3.1% of the total income. Buildings emerged ninth as they contributed a sum total of MK120, 000.00, equivalent to 2.5 % while potatoes ranked tenth by contributing a sum total of MK98, 150.00, representing 2.1% of the total economic returns. The rest of the sources (Appendix E, Table E3) contributed a sum total of MK840, 035.00, representing an aggregate of 17.5%.

As depicted in Figure 22, the highest average of economic returns for non-beekeepers were also realised from sales of cow milk (MK149, 640.82/respondent/annum). This was followed by housing construction works (MK120, 000.00/respondent/annum). The third highest average economic returns were realised from groceries (MK96, 368.75/respondent/annum) while those from carpentry emerged fourth (MK72, 750.00/respondent/annum).

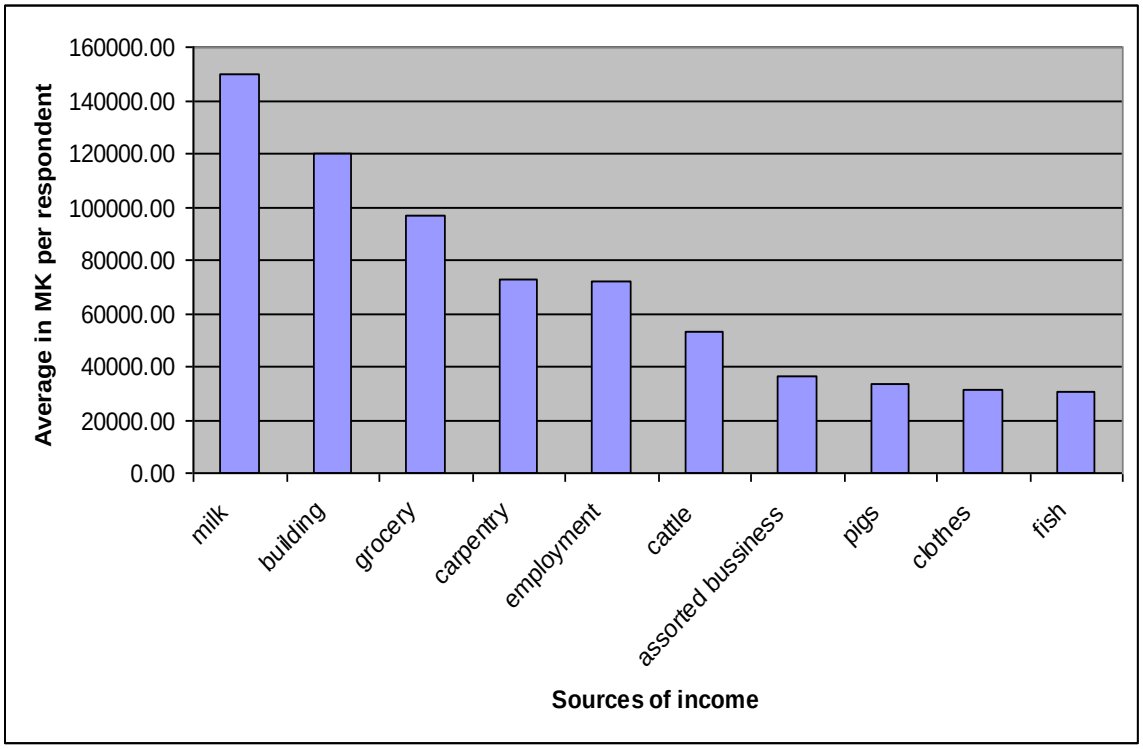

Figure 22: Average Economic Returns for Non-beekeepers

The average economic returns from employment ranked fifth (MK72, 145.83/respondent/annum) while those from sales of cattle emerged sixth (MK53, 400.00). Next to that were average economic returns from assorted businesses, mainly, sweet beer, banana fritters and local cakes (MK36, 500.00/respondent/annum) while sales from pigs emerged eighth (MK33, 300.00/respondent/annum). Sales from clothes ranked ninth (MK31, 000.00) while those from fish were tenth (MK30, 750.00 /respondent/annum). Unlike the other two groups of respondents, the average economic returns from maize were not within the top ten among the non- beekeepers.

4.3.4 Honey Price

Figure 23 shows that, the average selling price of honey was higher for beekeepers in the main study site (MK210.00 SD: 44.16/Kg) than in the control sites (MK203.15 SD: 107.27/Kg). The minimum selling price of honey for beekeepers in the main study site (MK130.00/Kg) was higher than in the control sites (MK16.13 /Kg). However, the maximum selling price of honey in the main study site (MK275.00/Kg) was lower than in the control sites (MK600.00/Kg). The average between maximum and minimum selling prices of honey in the control sites (K308.07 SD412.86/Kg) was higher than that in the main study site (K202.50 SD: 102.53/Kg). On the other hand, the retail price of honey from shops (MK800.00/Kg) was higher than what beekeepers were getting in the main study and control sites. Most of the honey produced by beekeepers from the main study site was sold to Wild life and Environmental Society. In the control sites, most of the honey was sold to ordinary people sometimes unprocessed. That is why the average selling price of honey was lower in the control sites than main study site. However, some beekeepers from both the main study and control sites sold their honey to commercial honey buyers. Such beekeepers got better honey prices than the rest.

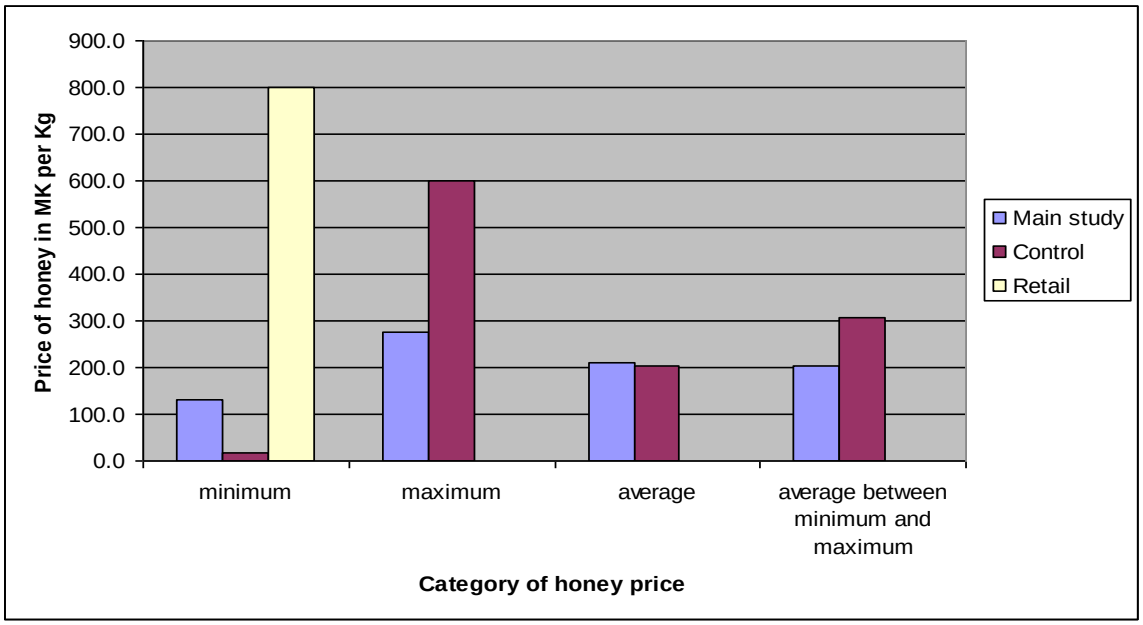

Figure 23: Selling Price of Honey

4.3.5 Satisfaction with Honey Selling Price by Beekeepers

The highest percentage of beekeepers [75.0% (90)] was not satisfied with the selling price of honey (Figure 24). Within their groups, beekeepers from the control sites registered a higher percentage [78.3% (47)] than the main study group [71.7% (43)] with respect to dissatisfaction. Only 17.5% (21) were partly satisfied and this group comprised 21.7% (13) of beekeepers from the main study area and 13.3% (8) from the control sites. Only 7.5% (9) of beekeepers were satisfied with honey price. Among this group were 6.7% (4) of beekeepers from the main study site and 8.3% (5) of beekeepers from the control sites. Although the majority was not satisfied with economic returns from beekeeping, the general sentiments from respondents were that beekeeping contributed positively towards their livelihoods. On the other hand, non-beekeepers expressed through focus group discussion that honey prices were very high.

This could be attributed to the fact that they could not appreciate the efforts by beekeepers in the practice. During key informant interviews, TA Nthiramanja registered concern that beekeepers were earning little money from honey sales. However, the Environmental Officer in Mulanje District indicated that the solution to poor honey pricing is formation of beekeeping associations that will facilitate selling of honey in bulk to big markets in town or commercial business persons.

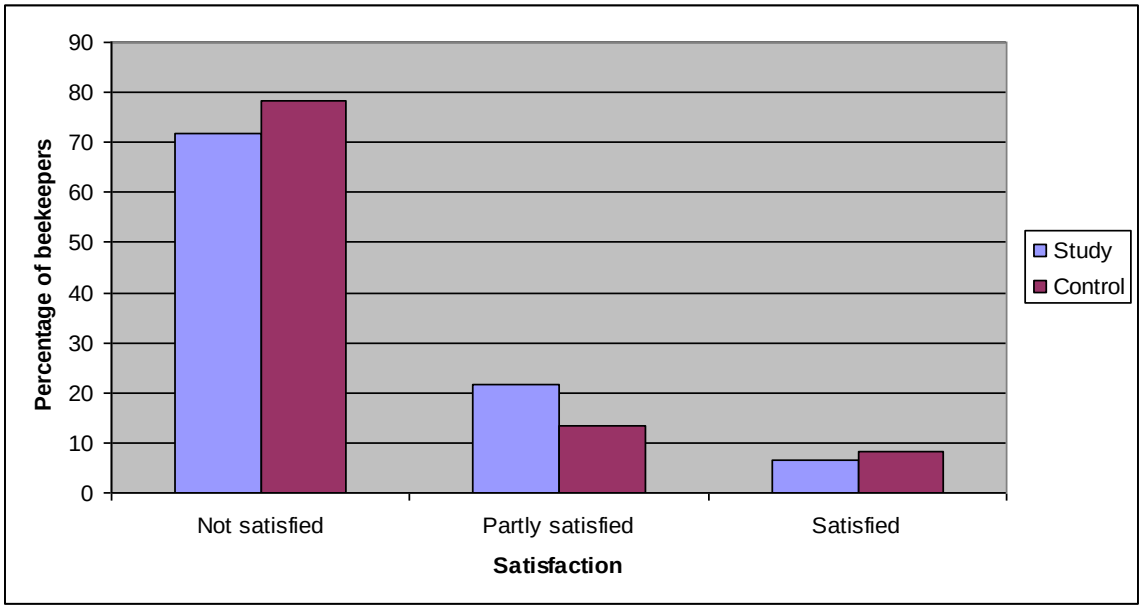

Figure 24: Satisfaction with the Selling Price of Honey

4.3.6 Rank of Beekeeping as an Economic Activity

As shown in Figure 25, the majority of beekeepers [90.8% (109)] considered beekeeping as number one and number two economic activities. The percentage of beekeepers who considered beekeeping as number one economic activity was 45.0 % (54). This category had a higher percentage [55.0 % (33)] of beekeepers from the main study site than from the control sites [35.0 % (21)].

The percentage of beekeepers who indicated that beekeeping as an economic activity was number two was 45.8 % (55). Within the groups, the percentage of beekeepers from the control group [53.3% (32)] was higher than from the main study group [38.3% (23)]. The percentage of beekeepers who regarded beekeeping as number three economic activity was 8.3% (10) of which 6.7% (4) were from the main study group and 10.0% (6) from the control group. Only 0.8% (1) considered beekeeping as fourth economic activity. This was indicated by 1.7% (1) of beekeepers from the control group but none (0.0%) from the main study group.

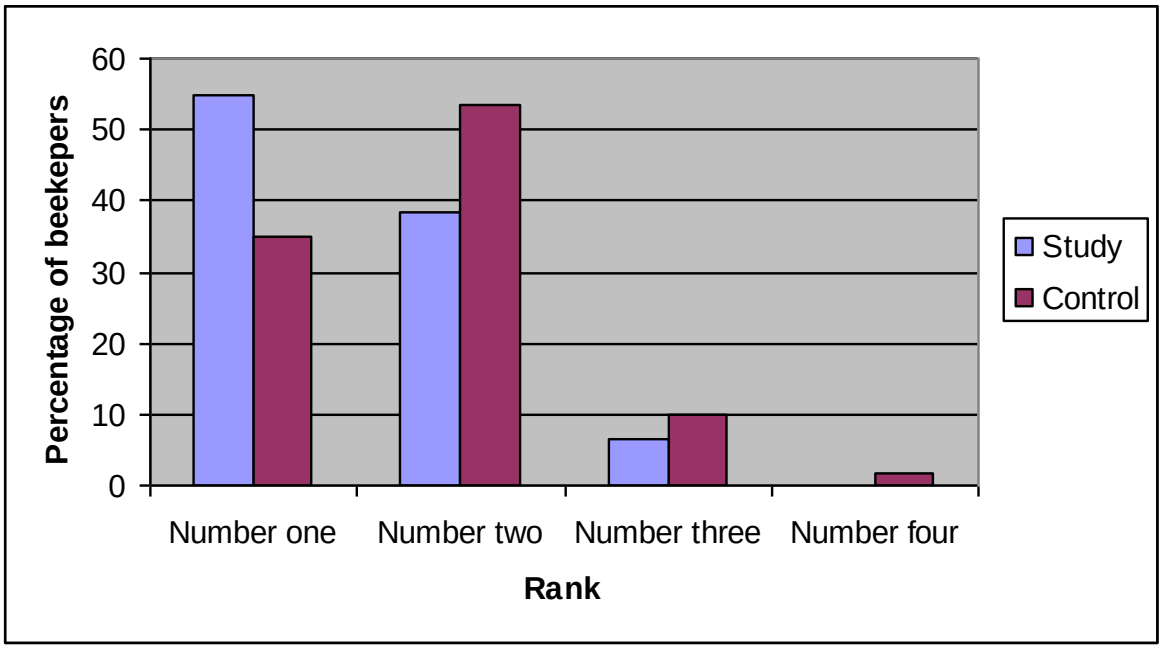

Figure 25: Rank of Beekeeping

4.4 Factors Affecting the Adoption of Beekeeping in TA Nthiramanja

Results from the two logistic regression models (beekeepers from the main study group versus non-beekeepers and beekeepers from the control group versus non-beekeepers) revealed the factors affecting adoption of beekeeping in TA Nthiramanja.

4.4.1 Results of the Logistic Regression Models for Adoption of Beekeeping

Tables 12 and 13 present results of the logistic regression models for the adoption of beekeeping based on the main study and control groups respectively.

Computed at 5% significance level, the variables age (p=0.014), nature of secondary economic activities (p=0.000) and membership in cooperative organisations (p=0.001) are the main determinants for adoption of beekeeping in TA Nthiramanja where IFSP was implemented. The nature of secondary economic activities (p=0.000) and membership in cooperative organisations (p=0.029) are the main determinants for adoption of beekeeping in the control sites where beekeeping begun without the direct influence of the IFSP.

Based on model one, respondents aged 30 to 39 years are 0.081 (95% CI: 0.011, 0.597) times less likely to adopt than those aged 20-29 years after adjusting for other variables in the model. Although not statistically significant, on the other hand, those aged 50-59 years are 1.399 (95% CI: 0.210, 9.319) times more likely to adopt than those aged 20-29 years. The respondents aged 60 years and above are 1.113 (95% CI: 0.165, 7.515) times more likely to adopt than those aged 20-29 years.

Table 12: Logistic Regression Model (1): Beekeepers from Main Study Group versus Non-beekeepers

Variable	Sig.	Exp (B)	95% C.I. for EXP (B)	
			Lower	Upper
AGE (30-39)	**0.014**	0.081	0.011	0.597
AGE (40-49)	0.178	0.335	0.068	1.646
AGE (50-59)	0.728	1.399	0.210	9.319
AGE (60+)	0.912	1.113	0.165	7.515
SECECONO	**0.000**	18.614	4.754	72.879
LABTHREE	0.903	0.921	0.243	3.487
GARDSIZE	0.555	0.640	0.145	2.819
EXTCONT	0.259	2.392	0.527	10.859
CLUBATT	0.493	0.613	0.152	2.479
ORGMEMB	**0.001**	13.349	2.744	64.993
GOATREAR	0.185	2.171	0.690	6.831
CONSTANT	0.092	0.096		

Significance level set at 5%
Reference group for age: 20-29 years

SECECONO: Nature of secondary economic activity
LABOURTHREE: Number of household members supplying labour =>3members
GARDSIZE: Size of crop garden =>1.2 hectares
EXTCONT: Contact with extension workers
CLUBATT: Attendance in farmer club meetings
ORGMEMB: Membership in cooperative organisation
GOATREAR: Whether goats were reared

Table 13: Logistic Regression Model (2): Beekeepers from Control Group versus Non-beekeepers

Variable	Sig.	Exp (B)	95% C.I. for EXP (B)	
			Lower	Upper
AGE (30-39)	0.168	0.159	0.022	1.137
AGE (50-59)	0.349	0.364	0.044	3.025
AGE (60+)	0.800	0.768	0.099	5.963
EDUC	0.581	1.620	0.292	8.985
SECECONO	**0.000**	37.733	8.956	158.985
GARDSIZE	0.621	1.512	0.293	7.811
EXTCONT	0.823	0.832	0.166	4.165
CLUBATT	0.377	0.455	0.080	2.605
ORGMEMB	**0.029**	5.275	1.181	23.551
GOATREAR	0.122	2.627	0.773	8.929
CONSTANT	0.065	0.092		

Significance level set at 5%
Reference category for age: 20-29 years

SECECONO: Nature of secondary economic activity
EDU: Attainment of any formal education
GARDSIZE: Size of crop garden =>1.2 hectares
EXTCONT: Contact with extension workers
CLUBATT: Attendance in farmer club meetings
ORGMEMB: Membership in cooperative organisation
GOATREAR: Whether goats were reared

Although age is not significant in the model for beekeepers in the control group, the results are similar to some extent with those in model one. As age increases from 50 years and above, the likelihood of somebody becoming a beekeeper also increases.

Although our results need to be confirmed with a larger sample size, this scenario is consistent with results from similar studies by Farinde *et al.* (2005) and Saner *et al.* (2004) where the majority of adopters was aged 51 to 60 years while minority was aged 31 to 40 years. This is so because unlike other farming technologies, beekeeping does not require lots of physical energy. Therefore, being less energetic than younger ones, older household heads prefer beekeeping to other economic activities that demand a lot of energy. On the other hand, younger household heads are more energetic than older ones. Therefore, they choose economic activities that demand lots of energy such as casual labour and carpentry, on top of crop farming which is labour demanding too. In addition to that beekeeping is associated with older people because it has to do with going into the bush where young people seem not to be interested. Finally, the skill of making hives especially traditional ones is more with older people than younger ones.

In model one respondents whose secondary economic activities are on-farm in nature are 18.614 (95% CI: 4.754, 72.879) times more likely to adopt than those whose secondary economic activities are off-farm in nature. Similar observations were made in model two for the control group.

Beekeepers in the control group that indicated that their secondary economic activities were on-farm in nature are 37.733 (95% CI: 8.956, 158.98) times more likely to adopt than those whose secondary economic activities were off-farm in nature after adjusting for other variables in the model.

Being on-farm, beekeeping blends well with other on-farm economic activities such as production of maize, cassava, groundnuts, pigeon peas, potatoes, sugarcanes, sorghum, peas, vegetables, fruits, seedlings, rearing of goats and poultry in the main study site. Off-farm activities, often conducted by non-beekeepers include employment, grocery, carpentry, selling charcoal, selling fish, banana fritters, mending bicycles, selling cooked rice among others.

In model one, respondents that belong to cooperative organisations are 13.349 (95% CI: 2.744, 64.993) times more likely to adopt beekeeping than the rest. For beekeepers in the control group, individuals that belong to different cooperative organisations are 5.275 (95% CI: 1.181, 23.551) times more likely to adopt beekeeping than the rest.

These results are similar to findings by Farinde *et al.* (2005) in Oyo State, Nigeria, who observed that 76.0% of beekeepers belonged to cooperative organisations. In the main study site, the majority of beekeepers [83.5%(50)] subscribe to different associations such as Beekeeping Association, Malawi Rural Development Fund (MARDEF), Adventist Development and Relief Agency (ADRA), Programme for Biomass Energy Conservation (PROBEC), Forest club, Social welfare club and Youth clubs.

Other associations include: Malawi care, National Association of People Living with HIV/AIDS in Malawi (NAPHAM), Pottery club, Women's club, Orphan care and Family Planning club. Through such associations, diffusion of innovations including beekeeping is facilitated. Beekeeping Associations offer beekeepers an opportunity to interact and discuss issues related to the practice. Interestingly, some non-beekeepers joined beekeeping associations in order to acquire the knowledge and skills in beekeeping.

On the other hand, attendance at farmer club meetings has the unexpected negative effect on adoption of beekeeping in both models. In model one, respondents that attend farmer club meetings are 0.613 (95% CI: 0.152, 2.479) times less likely to adopt beekeeping than the rest. In model two, respondents that attend farmer club meetings are 0.455 (95% CI: 0.080, 2.605) times less likely to adopt than the rest after adjusting for other variables in the model.

The negative effect of attendance at farmer clubs on adoption of beekeeping in both models arises because farmer clubs focus on different farming technologies such as Sasakawa, use of different crop varieties, pest and disease control, but not beekeeping. No wonder, none of the beekeepers indicated having received their knowledge and skills through farmer clubs.

Extension contact is not significant in model one but has a positive effect on adoption of beekeeping as expected. Respondents that have contact with extension workers are 2.392 (95% CI: 0.527, 10.859) times more likely to adopt than the rest.

On the other hand, extension contact has a negative unexpected effect on adoption of beekeeping in model two. Consequently, respondents that have contacts with extension workers are 0.832 (95% CI: 0.166, 4.165) times less likely to adopt than those that have no contacts with the extension workers.

Results on the positive effect of contact with extension on adoption for the main study group are similar to findings by other researchers including Vedeld *et al.* (1998), Thangata and Alavalapati (2003) and Lwesya (2004). In the main study site, some extension workers got trained in beekeeping during the IFSP. Since then they have been disseminating the knowledge and skills in beekeeping. Through contacts with such extension workers, 43.3% (26) of beekeepers in TA Nthiramanja got their knowledge and skills in beekeeping. Extension contact has a negative effect on adoption of beekeeping in the control sites. This is so because none of them got trained in beekeeping. Therefore, they focus on crop farming and other farming activities except beekeeping. However, some beekeepers from the control category [23.3 % (14)] got the skills from the extension worker who is based in the main study site.

Education was applied in model two only since the differences among the non-beekeepers and beekeepers were significant for the control group only. Although education is not significant in the model, it carries the expected positive effect. Respondents that have some education are 1.620 (95% CI: 0.292, 8.985) times more likely to adopt beekeeping than the rest after adjusting for other variables in the model.

Results of the positive effect of education on adoption of beekeeping as depicted in model one are consistent with findings by other researchers such as Saner *et al.* (2004) who noted that, on average, beekeepers in their study population had six years of formal education. Farinde *et al.* (2005) also noted that most of the beekeepers in Oyo State of Nigeria attained tertiary education. Educated individuals are more flexible in accepting a new innovation than the rest. Beekeeping demands the acquisition of appropriate knowledge and skills such as proper construction of hives, identifying appropriate sites for hives, setting hives, introducing bees into hives, testing readiness of honey, harvesting honey, processing honey, proper management of the site where hives are set and proper management of records. Acquisition and utilisation of such skills and knowledge demand some education.

In model one, land size has the unexpected negative effect on adoption of beekeeping. Respondents that have at least 1.214 hectares of land are 0.640 (95% CI: 0.145, 2.819) times less likely to adopt beekeeping than the rest. The scenario is different in model two where land hectareage has the expected positive effect on adoption of beekeeping.
Based on model two, household heads that have at least 1.214 hectares of land are 1.512 (95% CI: 0.293, 7.811) times more likely to adopt than those whose land hectareage is less than 1.214 hectares.

The negative unexpected effect of land size on adoption of beekeeping in the main study group shows that beekeeping is practised by respondents that possess relatively small land hectareage (less than 1.214 hectares).

However, beekeepers in the main study site manage beekeeping because they practise it at small scale level. Furthermore, the majority of beekeepers from the main study group [81.7% (49)] set their hives on village forest areas that are located along river banks (Thuchira, Mlemba and Mapanga). Therefore, even if individuals have little land hectareage in the main study site, they can still set their hives on village forest areas. The opposite is the case in the control sites where beekeeping is practised by those that posses relatively large land hectares (atleast 1.214 hectares). The reason for this observation is that unlike the main study sites, control sites had very few village forest areas where anyone could set up their hives. Consequently, the majority of beekeepers [80.0 % (48)] in the control sites set their hives on personal land. Therefore, those that possess more land hectareage have an added advantage to start beekeeping than the rest.

Household labour supply was used in model one only because significant differences were observed among non-beekeepers and beekeepers from the main study group only. Though not significant in the model, it has an unexpected negative effect. Based on the model, respondents whose labour is supplied by at least three household members are 0.921 (95% CI: 0.243, 3.487) more likely to adopt than the rest. This could be so because households that have more labour supply invest their labour in other activities that demand a lot of labour especially crop farming which is considered as the major economic activity for majority of respondents in the main study and control sites [88.3% (159)]. However, those with less labour supply manage beekeeping because it is not labour intensive (Mensing, 1993; Kumwenda, 2007). On the other hand, those with more labour supply have an added advantage of sharing tasks during honey harvesting seasons.

4.4.2 Evaluation of the Two Models

The two models were appropriate for several reasons. Firstly, their Goodness of Fit (Omnibus test of Model Coefficients) Chi-square test results [$\chi^2(11) = 73.228$, P= 0.000 for model one and $\chi^2(11) = 78.270$, P= 0.000 for model two] were significant (Appendix F, Tables F1 and F2). Significance of this test in the models shows that models with their predictors are significantly different from models with only the intercept (Garson, 1998). This implies that at least one of the predictors is significantly related to the response variable hence adequate fit of the data. Secondly, Hosmer and Lemeshow Chi-square test results [$\chi^2(8)=5.398$, P=0.714 for model one and $\chi^2(7) = 12.736$, P=0.079 for model two] were not significant. The non-significance of this test in the models means that there is no difference between the observed and predicted values, implying that each model's estimates fit the data at high level (Garson, 1998). Thirdly, model one correctly explains 83.5% of the variation of adoption of beekeeping for the main study group, while model two correctly explains 88.7% of the variation of adoption of beekeeping for the control group.

CHAPTER 5

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

5.1 Conclusions

The purpose of the study was to examine the extent to which socio-economic factors affect adoption of beekeeping while promoting environmental conservation in TA Nthiramnja, Mulanje District, Malawi. Study results have shown that similarities exist among non-beekeepers and beekeepers with respect to socio-economic characteristics. The study has shown that most of the respondents were married. The majority of respondents had low income. Most of the respondents in all the three groups relied upon crop farming as their main economic activity. The majority of respondents relied on radio and friends as sources of information about farming. Almost half of each of the three groups run out of own grown food at some point. Most of the respondents grew cassava, potatoes, groundnuts, pigeon peas and beans. The majority raised chickens and some reared pigs. Majority of the respondents had no access to loans. Beekeepers from the control site had same labour supply as non-beekeepers. Most of the beekeepers and non-beekeepers from the main study group attained some formal education.

Differences were also observed among non-beekeepers and beekeepers from both the main study and control sites. Generally, beekeepers from both the main study and control groups were order than non-beekeepers.

Secondary economic activities for most of the beekeepers were on-farm while for non-beekeepers were off-farm. Most of the beekeepers had larger households than non-beekeepers. Beekeepers had larger land hectareage than non-beekeepers. Most of the beekeepers had contacts with extension workers unlike non-beekeepers. Attendance at farmer club meetings was higher among beekeepers than the non-beekeepers. Generally, most of the beekeepers belonged to cooperative organisations especially beekeeping associations and ADRA. Rearing of goats was high among beekeepers, unlike non-beekeepers. Beekeepers from the main study site had more supply of labour compared to non-beekeepers.

The study has shown that before the implementation of IFSP, some individuals were already practising beekeeping in the main study and control sites. However, in the main study site the rate of adoption was higher during the IFSP. In the control sites, the rate of adoption was higher after the project phase. The major reason for starting beekeeping expressed by the majority of beekeepers from both the main study and control sites was to generate income. Most of the beekeepers from the main study site got the knowledge and skills through extension workers while those from the control site got them from fellow beekeepers.

Hives for the majority of beekeepers from the main study group were set on village forest areas, especially along river banks, while in the control sites, most of the hives were set on personal forest areas.

The majority of beekeepers from the main study and control groups used modern hives made from Gmelina although the percentages were higher among those from the main study site. Small percentages of beekeepers used hives made from tree cavities and barks. Some beekeepers from the control sites used hives made from tin and stones (caves). Most of the beekeepers from the main study site used smokers during honey harvesting than those from the control sites. Generally, production and harvesting techniques used by the majority of beekeepers were environmentally friendly. Most of the beekeepers from the main study group wore protective clothing during harvesting of honey, unlike those from the control group. Consequently, beekeepers from the control group reported more cases of bee stings during harvesting than those from the main study group. Most of the beekeepers were not satisfied with the selling price of honey. The major problem facing beekeeping was poor market, seconded by lack of information. Most of the non-beekeepers indicated that they could not start beekeeping due to lack of capital and poor markets for honey. However, all respondents, except one, indicated that beekeeping as an economic activity was helping in the conservation of vegetation.

The study has shown that the total economic returns from beekeeping ranked number two in the main study site after crop farming in the main study site. In the control sites, however, the economic returns from beekeeping ranked number nine. On the other hand, the average economic returns from beekeeping ranked number nineteen for beekeepers in the main study group and number twenty-eight for the control group. Generally, beekeepers were getting very little economic returns from the practice. However, this practice contributed positively towards people's livelihoods.

The logistic regression model for the main study group revealed that factors affecting adoption of beekeeping in TA Nthiramanja were age, nature of secondary economic activities and membership in cooperative organisations. Those aged 20-29, 30-39 and 40-49 years are less likely to adopt beekeeping compared to those aged 50 years and above. Secondary economic activities that were based on the farm had a positive influence on adoption of beekeeping, unlike those that were off-farm. Membership in cooperative organisations had a positive influence on the adoption of beekeeping. Similar observations were made in model two for the control group, except that age had a significant influence at 10%.

5.2 Recommendations

The potential that beekeeping has in uplifting the economic status of beekeepers as well as conservation of vegetation calls for the need for its promotion both in the main study and control sites. There is need to encourage the following groups of people to start beekeeping: younger household heads especially those aged below 50 years, household heads whose secondary economic activities are off-farm and those that do not subscribe to any cooperative organisations. Loans could have a positive impact and should be provided by money lending institutions, NGOs and well wishers. There is need for honey pricing committee to fix better prices for honey. This will also encourage other individuals to start beekeeping. There is need to promote the use of radio in disseminating information about beekeeping because the majority of respondents including non-beekeepers depend on it for agricultural information.

Beekeepers should be encouraged to work in groups so that they can support one another and purchase equipment, especially; harvesting suits, smokers and packing bottles. This will enable them to be more efficient and they will earn more money. Beekeepers should be encouraged to re-invest part of the proceeds back into beekeeping to enable the industry to grow. There is need for training of more extension workers on beekeeping technologies. The Ministry of Natural Resources and Environmental Affairs should facilitate the training in conjunction with colleges such as Bunda College and Natural Resources College. The modern production techniques should be promoted because they are environmentally friendly. The harvesting technologies should be improved to reduce cases of beestings during honey harvesting.

5.3 Implications for Future Research

This study has revealed the factors affecting adoption of beekeeping in TA Nthiramanja. There is a need for further research that would focus on related issues of the study findings. The researcher proposes that future studies should concentrate on the following areas:

(a) Comparative analysis of the quality of honey that is produced and harvested through environmentally friendly and unfriendly technologies,

(b) Examination of factors affecting the market value chain of honey from beekeepers to retail shops,

(c) The impact of beekeeping on forest cover,

(d) A similar study can be conducted elsewhere in the country.

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APPENDICES

Appendix A: Sampling Formula for Beekeepers

$$ss = \frac{Z^{2} * (p) * (1-p)}{c^{2}}$$ (Creative Research Systems, 2003)

where:

ss = sample size

Z = Z value (1.96 for 95% confidence level)

C = confidence interval, expressed as decimal (0.064)

$$ss = \frac{(1.96)^{2} * (0.5) * (1-0.5)}{(0.064)}$$

= 234.4726563

Correction for finite population

$$\text{Actual ss} = \frac{ss}{1 + \frac{ss-1}{Pop}}$$

Where:

pop = population of beekeepers in Traditional Authority Nthiramanja

= 81 beekeepers (documented by extension worker)

$$\text{Actual ss} = \frac{234.47265663}{1 + \frac{234.47265663 - 1}{81}}$$

= 60

Appendix B: Questionnaires

Appendix B1: Questionnaire for Bee and Non-beekeeper Respondents

Instruction to Interviewer:

Use capital letters when filling in open ended responses and ticks for closed ended questions

To Interviewee (respondent):

We would like to collect information from you which will be used for academic purpose at Chancellor College. The information will be treated confidential therefore we expect you to be precise and open. Thank you

A Official Details

A1 Questionnaire number: ☐☐

A2 Name of the Interviewer: ☐☐☐☐☐☐☐☐☐☐☐☐

A3 Interview conducted on: Day ☐☐ Month ☐☐ Year ☐☐

A4 Remarks by Interviewer:_____

B General Information

B1 Name of respondent: ☐☐☐☐☐☐☐☐☐☐☐☐

B2 Name of the village: ☐☐☐☐☐☐☐☐☐☐☐☐☐

B3 Traditional Authority: ☐☐☐☐☐☐☐☐☐☐☐☐

B4 District: ☐☐☐☐☐☐☐

C Socio-economic Information

	Actual question	**Responses**	**Code**
C1	Age of household head		
C2	Sex of household head	1[ ]male 2[ ]female	
C3	Marital status of household head	1[ ]Married 2[ ]Single 3[ ]Separated 4[ ] Divorced 5[ ]Widowed 6[ ]Other (Specify)	
C4	Status of household head in the village	1[ ]Village headman 2[ ]Settler 3[ ] Citizen 4[ ]Mkamwini	

		5[ ]Mtengwa 6[ ]Others (Specify):	
C5	Highest level of education	1[ ]None 2[ ]Std 1-4 3[ ]Std 5-8 4[ ]Form 1-2 5[ ]Form 3-4 6[ ]Tertiary 7[ ]Other (Specify):	
C6	Main economic activity **(one)**	1[ ]Crop farming 2[ ]Livestock farming 3[ ] Employment 4[ ]Grocery 5[ ]Selling firewood 6[ ]Selling charcoal 7[ ]Selling poles 8[ ]Selling fruits 9[ ]Poultry 10[ ]Carpentry 11[ ]Selling vegetables 12[ ]Beekeeping 13[ ]Others (Specify)	
C7	Secondary economic activity **(one)**	1[ ]Crop farming 2[ ]Livestock farming 3[ ]Employment 4[ ]Grocery 5[ ]Selling firewood 6[ ]Selling charcoal 7[ ]Selling poles 8[ ]Selling fruits 9[ ]Poultry 10[ ]Carpentry 11[ ]Selling vegetables 12[ ]Beekeeping 13[ ] Others (Specify)	
C8	How many members are there in your household?	1[ ]member 2[ ]members 3[ ]members 4[ ]members 5[ ]members 6[ ]members 7[ ]members 8[ ]members 9[ ]members 10[ ]members 11[ ]members 12[ ]Others specify	
C9	How many members help you with labour in your household?	1[ ]member 2[ ]members 3[ ]members 4[ ]members 5[ ]members 6[ ]members 7[ ]members 8[ ]members 9[ ]members 10[ ]members 11[ ]members 12[ ]Others specify	
C10	Land tenure	1[ ]own land 2[ ]rented 3 [ ]bought 4[ ] borrowed	
C11	Size of crop garden	1[ ]No garden 2[ ]Less than 1 acre 3[ ]1 acre 4[ ]2 acres 5[ ]3 acres 6[ ]4 acres	

		7[ ]5acres 8[ ]> 5 acres	
C12	How often do you meet extension workers?	1[ ]Never 2[ ]Once a week 3[ ]Once every two weeks 4[ ]Once every month 4[ ]Once every 2 months 5[ ]Once every 3 months 6[ ]Others (Specify	
C13	How often do you attend farmer club meetings?	1[ ]Never 2[ ]Once a week 3[ ]Once every two week 4[ ]Once a month 5[ ]Once every two months 6[ ]Others (specify)	
C14	Any other sources of information related to farming	1[ ]Radio 2[ ]Fellow farmers 3[ ]Television 4[ ]Newspaper 5[ ]Village head 6[ ]Others (Specify)	
C15	(a) Have you ever taken a loan?	1[ ]Yes 2[ ]No If yes go to C15 (b), If no go to C15(c)	
	(b) From where?		
	(c) Why not?		
C16	(a) Do you belong to any cooperative organisation such as beekeeping association, ADRA, farmer club?	1[ ]Yes 2[ ]No If Yes go to C16(b) If No continue to C17	
	(b) Name of organisation		
C17	(a) How long did your own grown staple food last?	1[ ]One month 2[ ]Two months 3[ ]Three months 4[ ]Four months 5[ ]Five months 6[ ]Six months 7[ ]Seven months 8[ ]Eight months 9[ ]Nine Months 10[ ]Months 11[ ]Eleven months 12[ ] Twelve months If your response is 1-11 go to C17 (b), If your	

		response is 12 continue to C18	
	(b) How did you acquire the extra food when your own grown staple food lasted?	1[ ]Casual labour 2[ ]Firewood selling 3[ ] Charcoal selling 4[ ]Honey selling 5[ ]Loans 6[ ]Selling chickens 7[ ]Vegetable selling 8[ ] Fruit selling 9[ ]Food for work 10[ ]Selling goats 11[ ] Assistance from Community 12[ ]Others (Specify)	
C18	Major crops grown	1[ ]Maize 2[ ]Tea 3[ ]Cotton 4[ ]Tobacco 5[ ]Groundnuts 6[ ]Cassava 7[ ]Potatoes 8[ ]Beans 9[ ]Fruits 10[ ]Pepper 11[ ] Vegetables 12[ ]Others (Specify)	
C19	Animals reared	1[ ]Cattle 2[ ]Goats 3[ ]Pigs 4[ ]Rabbits 5[ ]Chickens 6[ ]Doves 7[ ]Others (specify)	

D Economic Returns from Different Economic Activities

D1	What were the variable costs for growing each of the crops last year?	**Crop**	**Seed**	**Fert**	**Lab**	**Che**	**Tra**	**Other**	**Total**
		Maize							
		Tea							
		Tobac							
		G/nuts							
		Cassav							
		Potato							
		Beans							
		Fruits							
		Pepper							
		Vegeta							
		Others							
D2	How much	**Crop**		**Measurements**					

	harvest did you did you get from each of the crops grown last year?		Units	kg	Bags	Carts
		Maize				
		Tea				
		Cotton				
		Tobacco				
		G/nuts				
		Cassava				
		Potatoes				
		Beans				
		Fruits				
		Pepper				
		Vegetables				
		Others				

D3	How much did you consume or sell for each of the crops grown last year?	**Crop**	**Measurements**		
			Units	**Kg**	**Bags** **Oxcarts**
		Maize			
		Tea			
		Cotton			
		Tobacco			
		G/nuts			
		Cassava			
		Potatoes			
		Potatoes			
		Beans			
		Fruits			
		Pepper			
		Vegetab			
		Others			

D4	What was the selling price for each of the crops you grew last year?	**Crop**	**Selling price**
		Maize	
		Tea	
		Cotton	
		Tobacco	
		G/nuts	
		Cassava	
		Potatoes	
		Beans	
		Fruits	
		Pepper	
		Vegetables	
		Others	
D5	What were the total economic returns from each of the crops grown?	**Crop**	**Economic returns** (Income-expenditures)
		Maize	
		Tea	
		Cotton	
		G/nuts	
		Cassava	
		Potatoes	
		Beans	
		Fruits	
		Pepper	
		Vegetables	
		Others	

D6	What were the economic returns generated through selling of each of the following livestock?	**Livestock**	**Economic returns**
		Cattle	
		Goats	
		Pigs	
		Rabbits	
		Chickens	
		Doves	
		Others	
D7	What was the total income generated from the following economic activities last season?	**Economic activity**	**Income**
		Employment	
		Grocery	
		Selling firewood	
		Selling charcoal	
		Selling poles	
		Carpentry	
		Others	
D8	What was the total income from the above economic activities?	D5 +D6 +D7	
Section (E) To (L) for Beekeeper Household Heads Only **E Status of Beekeeping**			
E1	When did you start beekeeping?		

E2	Why did you start beekeeping?	1[ ]To generate income 2[ ]Food 3[ ]Medicine 4[ ]Hobby 5[ ]Imitating others 6[ ]Other reasons	
E3	How did you know about beekeeping? Or who influenced you to start beekeeping?	1[ ]Parents/relatives 2[ ]Fellow beekeepers 3[ ]Training by NGO 4[ ]Extension workers 5[ ]Radio 6[ ]Newspaper 7[ ]Television 8[ ]Others (specify)	
E4	Land tenure where beehives are set	1[ ]Own land 2[ ]Borrowed 3[ ]Bought 4[ ]Rented 5[ ]Village forest area 6[ ]Others (Specify)	
F Production Methods Used by Beekeepers			
F1	What kind of beehives do you use?	1[ ] Caves 2[ ]Tree cavities 3[ ] Clay pots 4[ ] Grass 5[ ]Traditional (barks, logs) 6[ ]Modern (Kenya top bar, box, Malawi standard hive Langstroth) 7[ ] Others (specify)	
F2	Why do you use the type of beehive above?	1[ ]Cheap 2[ ]Durable 3[ ]Common 4[ ]Others	
F3	From what species of tree are the hives made?	1[ ]Gmelina 2[ ]Pine 3[ ]Blue gum 4[ ]Mbawa 5[ ]Acacia 6[ ]Others	
F4	How many beehives do you have for each type of beehive?	1[ ] Caves 2[ ]Tree cavities 3[ ] Clay pots 4[ ] Grass 5[ ]Traditional (barks, logs) 6[ ]Modern (Kenya top bar, box, Malawi standard hive Langstroth) 7[ ] Others (specify) Grand total number of hives=	
G Harvesting Methods Used by Beekeepers and their Effects			

G1	What technique do you use in order to drive away bees during harvesting?	1[ ]Fire torches 2[ ]Smoker 3[ ]Others (specify)	
G2	(a) Have you ever seen/ (heard about) people destroying bees colonies during honey harvesting?	1[ ]Yes 2[ ]No If Yes go to G2(b) If No continue to G3	
	(b) How many times?	1[ ]Once 2[ ]Twice 3[ ]Thrice 4[ ]Many times	
G3	(a) Have you ever seen/(heard about) people burning forests during honey harvesting ?	1[ ]Yes 2[ ]No If Yes go to G3(b) If No continue to G4	
	(b) How many times?	1[ ]Once 2[ ]Twice 3[ ]Thrice 4[ ]Many times	
G4	(a) Do you wear protective clothing during harvesting	1[ ]Yes 2[ ]No If No go to G4(b) If Yes continue to G5	
	(b) Why not?		
G5	(a) Have you ever been attacked by bees during harvesting?	1[ ]Yes 2[ ]No If yes go to G5 (b) If No continue to H1	
	(b) If yes how many times?	1[ ]Once 2[ ]Twice 3[ ]Many times 4[ ]Every time I harvest honey	
H	**Utilisation of Products from Beekeeping**		

H1	What products from beekeeping do you use?	1[ ]Propolis 2[ ]Wax 3[ ]Venom 4[ ]Royal jelly 5[ ]Honey 6[ ]Brood 7[ ]Others (specify)	
H2	How do you use products from beekeeping?	1[ ]Food 2[ ]Food ingredient 3[ ]Selling 4[ ] Medicine 5[ ]Candle making 6[ ]Mending beehives 7[ ]Gifts 8[ ]Others (specify)	

J Economic Returns from Beekeeping

J1	What was the total sum of expenditures in beekeeping last season?	**Item**	**Cost**
		Maintenance	
		Packing bottles	
		Labour	
		Transport	
		Others	
		Total	
J2	How much honey did you harvest last season?	**Measurement**	**Amount**
		Pails	
		Kg	
J3	What was the selling price of honey last season?		
J4	How much honey did you sell last season?		
J5	How much money did you collect from honey last season?		

J6	What were the total economic returns from beekeeping last season?	(J5-J1)	
J7	(a) Did you reinvest some of the money back into beekeeping?	1[ ]Yes 2[ ]No If Yes go to J6(b) If No go to J6(c)	
	(b) What proportion	1[ ]1/4 2[ ]1/3 3[ ]1/2 4[ ]3/4 5[ ]Other specify	
	(c) Why not?		
J7	What was your total net income from different economic activities last year? (D8 + J6)		
K Marketing System of Honey			
K1	Who buys honey from you?	1[ ]Wildlife 2[ ]Local consumers 3[ ]Companies 4[ ]Others specify	
K2	Do you sell it processed or unprocessed?	1[ ]Processed 2[ ]Unprocessed 3[ ]Partially processed	
K3	(a) Are you satisfied with the honey marketing system?	1[ ]No 2[ ]Partly 3[ ]Yes For response 1 and 2 go to K3(b) For response 3 continue to K4	
	(b) What should be done to improve the honey marketing system?		

K4	How do you rank beekeeping in relation to other economic activities?	1[ ]Number one 2[ ]Number two 3[ ]Number three 4[ ]Number four 5[ ]Others specify	
L Factors for Success and Failures of Beekeeping			
L1	**Success factors for beekeeping** Are the following factors available in this area	1[ ]Market is available 2[ ]Research 3[ ]Fair prices 4[ ]Credit scheme 5[ ]Village demonstration 6[ ]Debt cancellation during drought **(checklist)**	
L2	**Failures of beekeeping** Do you experience the following problems?	1[ ]Disturbance from animals 2[ ]Deforestation and scarcity of flowers 3[ ]Lack of knowledge 4[ ]Poor market 5[ ]Theft 6[ ]Invasion by ants 7[ ]Bees migrate frequently 8[ ]Low yield below expectation 9[ ]Finance 10[ ]Limited land **(checklist)**	
L3	(a) Does beekeeping help to conserve or destroy forests in this area?		
	(b) Explain		
Sections (M) to (O) For Non-beekeeper Household Heads Only **M Constraints for Adoption of Beekeeping**			
M1	(a) Have you ever heard about beekeeping?	1[ ]Yes 2[ ]No If yes go to M1(b) and M1(c), If no go to N	
	(b) From what	1[ ]Beekeepers 2[ ]Friends/relatives	

	sources?	3[ ]Radio 4[ ]Newspaper 5[ ]NGO 6[ ]Television 7[ ]Others (specify)	
	(c) Why did you not adopt beekeeping	1[ ]Fear of bee stings 2[ ]Cultural constraints 3[ ] Lack of market 4[ ]Not profitable 5[ ]Busy with other economic activities 6[ ]Lack of capital 7[ ]Lack of land 8[ ]Lack of information 9[ ]Fear of going out in the night 10[ ]Fear of climbing up trees 11[ ]Lack of forest 12[ ]Fear of theft 13[ ]Bees migrated away 14[ ]Others (specify)	
N Utilisation of Products from Beekeeping by Non-beekeepers			
N1	(a) What products from beekeeping do you use?	1[ ]Propolis 2[ ]Wax 3[ ]Venom 4[ ]Royal jelly 5[ ]Honey 6[ ]Brood 7[ ]Others (specify) 8[ ]None For response 8 go to N1(b) For response 1 to 7 go to N2	
	(b) Why not?		
N2	How do you use products from beekeeping?	1[ ]Food 2[ ]Food ingredient 3[ ]Selling 4[ ] Medicine 5[ ]Candles 6[ ]Gifts 7[ ]Others (specify)	
Beekeeping and Forest Resource Conservation			
1	(a) What is the effect of beekeeping on forests?	1[ ]conserves 2[ ]destroys	
	(b) Explain		

End of Questions

Appendix B2: Key Informant Interview Guide Questions

Instruction to Interviewer:

Use capital letters when filling in open ended responses and ticks for closed ended questions

To Interviewee (respondent):

We would like to collect information from you which will be used for academic purpose at Chancellor College. The information will be treated confidential therefore we expect you to be precise and open. Thank you

A Official Details

A1 Questionnaire number: | | |

A2 Name of the Interviewer: | | | | | | | | | | | | | |

A3 Interview conducted on: Day | | | Month | | | Year | | | |

A4 Remarks by Interviewer:_____

B General Information

B1 Name of respondent: | | | | | | | | | | | | | |

B2 Name of the village: | | | | | | | | | | | | | |

B3 Traditional Authority: | | | | | | | | | | | | | |

B4 District: | | | | | | | |

B5 Identity of key informant: 1[ ] Village head 2[ ] Group village head 3[ ] Extension worker 4[ ] Wildlife official 5[ ] Environmental officer 6[ ] District commissioner 7[ ] Forestry department officer 8[ ] Beekeeping association officer

C Status of Beekeeping

C1 Have you ever heard about beekeeping in this area?

C2 When did beekeeping start in the area/village/TA?

C3 How did beekeeping begin?

C4 How many beekeepers are there in this village?

C5 What is your role in beekeeping?

C6 Why did some people adopt beekeeping in this area?

C7 Why did some people not adopt beekeeping in this area?

C8 Are there any effects of production and harvesting methods used by beekeepers on the environment (trees, bees, people, animals)?

C9 How is beekeeping contributing towards livelihoods?

C10 Do beekeepers have markets for their products?

C12 What problems are beekeepers facing in this area?

End of Guide Questions

Appendix B3: Guide Questions for Focus Group Discussion

A Official details

Guide Questionnaire number ☐

Name of the facilitator:_____

Date of the discussion:_____

Time: _____

Remarks by facilitator:_____

B Location

1 Group type: 1[ ] children 2[ ] male adults (above 18) 3[ ] female adults (above 18) 4[ ] beekeepers

2 Number of participants in the focus group discussion:_____

3 Name of the village:_____

4 Traditional authority: _____

5 District:_____

1 Have you ever heard about beekeeping?

2 Why do some people practice beekeeping?

3 Why do some people not practise beekeeping?

4 What products do you utilise from beekeeping?

5 How do you utilise products from beekeeping?

6 Are products from beekeeping being sold at high or low prices?

7 Are beekeepers richer or poorer than non beekeepers?

8 Is beekeeping contributing towards conservation or destruction of forests in this area?

9 Does beekeeping have a future in this area

10 What problems are beekeepers facing in this area?

End of Guide Questions

Appendix B4: Sample Form for Global Vegetation Survey

Traditional Authority:……

Serial	Species of vegetation	Villages	Frequency
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			

Appendix B5: Participant Observation Sheet

1 Where are hives set?

1[ ] Arable land 2[ ] Mountain /hill 3[ ] In trees along river bank

4[ ] Personal forest 5[ ] Borrowed forest 6[ ] Village forest

7[ ] Others (specify)

2 Number of hives observed:

3 Types of beehives observed:

1[ ] Cavities of trees 2[ ] Traditional (bark hive, logs) 3[ ] Modern

4[ ] Clay 5[ ] Grass 6[ ] Others (specify)

4 Harvesting technique used

1[ ] Smoker 2[ ] Fire torches

5 Harvesting method affects

1[ ] vegetation 2[ ] beekeepers 3[ ] bees 4[ ] people

5[ ] animals 6[ ] any other living things

6 Species of trees observed in the forest

End of Participant Observation Guide Sheet

Appendix C: Distribution of Respondents

Appendix C 1: Distribution of Respondents from the Main Study and Control Sites

	Village	Traditional Authority	District	Number of Beekeepers	Number of Non-beekeepers	Total
1	Nthiramanja	Nthiramanja	Mulanje	6	6	12
2	Mtambo	Nthiramanja	Mulanje	1	1	2
3	Nakoma	Nthiramanja	Mulanje	2	3	5
4	Sambatiyao	Nthiramanja	Mulanje	8	8	16
5	Chonde	Nthiramanja	Mulanje	12	12	24
6	Mzinganyama	Nthiramanja	Mulanje	5	4	9
7	Majiya	Nthiramanja	Mulanje	3	5	8
8	Gumulira	Nthiramanja	Mulanje	8	5	13
9	Komwa	Nthiramanja	Mulanje	3	4	7
10	Chiuta	Nthiramanja	Mulanje	4	4	8
11	Mwamadi	Nthiramanja	Mulanje	3	3	6
12	Abunu	Nthiramanja	Mulanje	2	2	4
13	Kayano	Nthiramanja	Mulanje	1	1	2
14	Kamtunda	Nthiramanja	Mulanje	1	1	2
15	Kululira	Nthiramanja	Mulanje	1	1	2
Total				**60**	**60**	**120**

Appendix C2: Number and Distribution of Beekeepers from the Control Sites

Village		Traditional Authority	District	Number of Beekeepers
1	Njoloma	Chikumbu	Mulanje	10
2	Kampala	Chikumbu	Mulanje	3
3	Sani	Chimaliro	Thyolo	14
4	Kamoto	Chimaliro	Thyolo	3
5	Kasalika	Chimaliro	Thyolo	3
6	Kogoya	Chimaliro	Thyolo	2
7	Mitambala	Chimaliro	Thyolo	2
8	Gomani	Chimaliro	Thyolo	1
9	Machemba	Chimaliro	Thyolo	1
10	Mapwesela	Chimaliro	Thyolo	3
11	Kabuthu	Mabuka	Mulanje	6
12	Kandaya	Mabuka	Mulanje	2
13	Kangoma	Mabuka	Mulanje	3
14	Majawa	Mabuka	Mulanje	2
15	Bokosi	Mabuka	Mulanje	1
16	Gogodo	Mabuka	Mulanje	1
17	Bwanali	Mabuka	Mulanje	2
18	Ekhamunu	Mabuka	Mulanje	1
Total				**60**

Appendix D: Characteristics of Respondents

Appendix D1: Number and Distribution (%) of Respondents by Residence Status

Residence status	Beekeepers				Non-beekeepers		Total	
	Study area		Control area					
	n	%	n	%	n	%	n	%
Living home	51	85.0	46	76.6	45	75.0	142	78.9
Spouse's homest	9	15.0	14	23.4	15	25.0	18	21.1
Total	**60**	**100.0**	**60**	**100.0**	**60**	**100.0**	**180**	**100.0**

Appendix D2: Number and Distribution (%) of Respondents by Main Economic Activity

Serial	Main Economic Activity	Beekeepers				Non-beekeepers		Total	
		Study area		Control area					
		n	%	n	%	n	%	n	%
1	Crop farming	53	88.1	51	85.0	55	91.7	159	88.3
2	Livestock	1	1.7	3	5.0	0	0.0	4	2.2
3	Employment	1	1.7	1	1.7	2	3.3	4	2.2
4	Firewood	1	1.7	0	0.0	0	0.0	1	0.6
5	Poles	1	1.7	0	0.0	0	0.0	1	0.6
6	Poultry	0	0.0	0	0.0	2	3.3	2	1.1
7	Beekeeping	1	1.7	3	5.0	0	0.0	4	2.2
8	Casual labour	1	1.7	0	0.0	0	0.0	1	0.6
9	Seedlings	1	1.7	0	0.0	0	0.0	1	0.6
10	Fish farming	0	0.0	2	3.3	1	1.7	3	1.6
Total		**60**	**100.0**	**60**	**100.0**	**60**	**100.0**	**180**	**100**

Appendix D3: Number and Distribution (%) of Respondents by Secondary Economic Activity

Serial	Secondary Economic Activity	Beekeepers				Non-beekeepers		Total	
		Study area		Control					
		n	%	n	%	n	%	n	%
1	Crop farming	4	6.6	10	16.7	7	12.7	21	12.0
2	Livestock	2	3.3	5	8.3	1	1.8	8	4.6
3	Employment	4	6.6	4	6.7	14	25.5	22	12.6
4	Grocery	1	1.7	0	0.0	4	7.3	5	2.9
5	Firewood	1	1.7	0	0.0	1	1.8	2	1.1
6	Charcoal	0	0.0	0	0.0	3	5.5	3	1.7
7	Poles	1	1.7	0	0.0	4	7.3	5	2.9
8	Fruits	2	3.3	0	0.0	1	1.8	3	1.7
9	Poultry	1	1.7	1	1.7	2	3.6	4	2.3
10	Carpentry	2	3.3	0	0.0	3	5.5	5	2.9
11	Vegetables	0	0.0	1	1.7	4	7.3	5	2.9
12	Beekeeping	35	58.3	37	61.6	0	0.0	72	41.1
13	Casual labour	1	1.7	0	0.0	0	0.0	1	0.6
14	Sweet beer	2	3.3	0	0.0	2	3.6	4	2.3
15	Selling flour	1	1.7	0	0.0	0	0.0	1	0.6
16	Selling clothes	1	1.7	0	0.0	2	3.6	3	1.7
17	Bicycles	1	1.7	0	0.0	0	0.0	1	0.6
18	Sugarcanes	1	1.7	0	0.0	1	1.8	2	1.1
19	Sawing timber	0	0.0	2	3.3	0	0.0	2	1.1
20	Fish	0	0.0	0	0.0	1	1.8	1	0.6
21	Rice	0	0.0	0	0.0	2	3.6	2	1.1
22	Banana fritters	0	0.0	0	0.0	2	3.6	2	1.1
23	Builder	0	0.0	0	0.0	1	1.8	1	0.6
Total		**60**	**100.0**	**60**	**100.0**	**55**	**100**	**175**	**100.0**

Appendix D4: Number and Distribution (%) of Respondents by Crops Grown

	Crop	Beekeepers				Non-beekeepers		Total	
		Study area		Control					
		n	%	n	%	n	%	n	%
1	Maize	60	100.0	60	100.0	60	100.0	180	100.0
2	Tea	0	0.0	0	0.0	0	0.0	0	0.0
3	Tobacco	1	1.7	2	3.3	0	0.0	3	1.7
4	Groundnuts	15	26.7	24	40.0	15	25.0	55	30.6
5	Cassava	50	83.3	46	76.7	49	81.7	145	80.6
6	Potatoes	40	66.7	36	60.0	45	75.0	121	67.2
7	Beans	7	11.7	8	13.3	9	15.0	24	13.3
8	Fruits	3	5.0	2	3.3	3	5.0	8	4.4
9	Pepper	0	0.0	1	1.7	1	1.7	2	1.1
10	Vegetables	2	3.3	8	13.3	5	8.3	15	8.3
11	Pigeon peas	13	21.7	13	21.7	10	16.7	36	20.0
12	Sorghum	2	5.0	7	15.0	4	6.7	16	8.9
12	Wheat	0	0.0	1	1.7	0	0.0	1	0.6
13	Sugarcanes	3	5.0	5	8.3	3	5.0	11	6.1
14	Soya	0	0.0	2	3.3	0	0.0	2	1.1
15	Peas	4	6.7	0	0.0	5	8.3	9	5.0
16	Rice	0	0.0	1	1.67	5	8.3	6	3.3

Total percentages of respondents by types of crops grown add up to more than 100% due to multiple responses

Appendix D5: Number and Distribution (%) of Respondents by Livestock Reared

Livestock	Beekeepers				Non-beekeepers		Total	
	Study area		Control area					
	n	%	n	%	n	%	n	%
Cattle	5	8.3	7	11.7	1	1.7	13	7.2
Goats	31	51.7	31	51.7	13	21.7	75	41.7
Pigs	9	15.0	12	20.0	5	8.3	26	14.4
Rabbits	1	1.7	3	5.0	0	0.0	4	2.2
Chickens	35	58.3	37	61.7	41	68.3	113	62.8
Doves	4	6.7	6	10.0	1	1.7	11	6.1
Guinea fowls	1	1.7	3	5.0	0	0.0	4	2.2
Ducks	2	3.3	3	5.0	1	1.7	6	3.3
Peacock	0	0.0	1	1.7	0	0.0	1	0.6
None	9	15.0	8	13.3	10	16.7	27	15.0

Total percentages of respondents by types of livestock reared add up to more than 100% due to multiple responses

Appendix D6: Chi-Square Test Results for Differences among beekeepers and Non-beekeepers

Characteristics	Beekeepers from the Main Study Group Versus Non-beekeepers	Beekeepers From the Control Group Versus Non-beekeepers
Sex		
Male	$\chi^2(1)=0.033$, P=0.855	$\chi^2(1)=0.000$, P=1.000
Age		
20-29years	$\chi^2(1)=15.908$, P=0.000	$\chi^2(1)=5.057$, P=0.025
30-39years	$\chi^2(1)=2.844$, P=0.092	$\chi^2(1)=3.683$, P=0.055
40-49 years	$\chi^2(1)=5.566$, P=0.018	$\chi^2(1)=0.323$, P=0.570
50-59 years	$\chi^2(1)=0.563$, P=0.453	$\chi^2(1)=0.261$, P=0.609
60 above	$\chi^2(1)=7.500$, P=0.006	$\chi^2(1)=10.753$, P=0.001
Marital status		
Married	$\chi^2(1)= 1.768$, P=0.184	$\chi^2(1)=0.043$, P=0.835
Education status		
Some education	$\chi^2(1)=3.733$, P=0.053	$\chi^2(1)=6.536$, P=0.011
Residential status		
Own home	$\chi^2(1)=1.875$, P=0.171	$\chi^2(1)=0.045$, P=0.827
Main economic activity		
Crop farming	$\chi^2(1)=0.370$, P=0.543	$\chi^2(1)=1.294$, P= 0.255
Secondary economic activity		
On-farm	$\chi^2(1)=24.514$, P=0.000	$\chi^2(1)=46.656$, P= 0.000

N/A Not applicable since some cells had less than five counts

Appendix D6: Chi-Square Test Results For Differences among Beekeepers and Non-Adopters

Characteristics	Beekeepers from Main Study Group Versus Non-beekeepers	Beekeepers from Control Group Versus Non-beekeepers
Household size		
<=2 members	N/A	N/A
3-4 members	$\chi^2(1)=3.001$, P=0.083	$\chi^2(1)=0.564$, P=0.453
=>5 members	$\chi^2(1)=9.701$, P=0.002	$\chi^2(1)=3.337$, P=0.068
Household labour		
=1 member	N/A	N/A
=2 members	$\chi^2(1)=3.663$, P=0.056	$\chi^2(1)=1.269$, P=0.260
=>3 members	$\chi^2(1)=7.552$, P=0.006	$\chi^2(1)=3.333$, P=0.068
Land size		
<=0.4 hectares	$\chi^2(1)=2.136$, P=0.144	$\chi^2(1)=1.637$, P=0.201
<=0.8 hectares	$\chi^2(1)=0.000$, P=1.000	$\chi^2(1)=1.477$, P=0.224
=>1.2hectares	$\chi^2(1)=5.551$, P=0.018	$\chi^2(1)=9.755$, P=0.002
Sources of agricultural information		
Extension	$\chi^2(1)=5.829$, P=0.016	$\chi^2(1)=4.126$, P=0.042
Radio	$\chi^2(1)=0.186$, P=0.666	$\chi^2(1)=2.048$, P=0.152
Fellow farmers	$\chi^2(1)=0.036$, P=0.849	$\chi^2(1)=0.141$, P=0.707
Farmer club	$\chi^2(1)=8.571$, P=0.003	$\chi^2(1)=5.711$, P= 0.017

Appendix D6: Chi-Square Test Results for Differences among beekeepers and Non-beekeepers

Characteristics	**Beekeepers from Main Study Group Versus Non-beekeepers**	**Beekeepers From Control Group Versus Non-beekeepers**
Access to loans		
Yes	$\chi^2(1)=0.586$, P=0.444	$\chi^2(1)=0.000$, P=1.000
Income level		
Low	$\chi^2(1)=0.170$, P=0.680	$\chi^2(1) =0.016$, P=0. 432
Membership		
Yes	$\chi^2(1)=20.670$, P=0.000	$\chi^2(1)=13.889$, P=0.000
Availability of food		
Throughout the year	$\chi^2(1)=0.539$, P=0.463	$\chi^2(1)=3.333$, P= 0.068
Crops grown		
Maize	N/A	N/A
Cassava	$\chi^2(1)=0.058$, P=0.810	$\chi^2(1)=0.455$, P=0.500
Potatoes	$\chi^2(1)=1.008$, P=0.315	$\chi^2 (1)=3.077$, P=0.079
Groundnuts	$\chi^2(1)=0.043$, P=0.835	$\chi^2(1)=3.077$, P=0.079
Pigeon peas	$\chi^2(1)=0.484$, P=0.487	$\chi^2(1) =0.484$, P=0. 487
Beans	$\chi^2(1)=0.288$, P=0.591	$\chi^2(1)=0.069$, P=0.793
Animals reared		
Chickens	$\chi^2(1)=1.292$, P=0.256	$\chi^2(1)=0.586$, P= 0.444
Goats	$\chi^2(1)=11.627$, P=0.001	$\chi^2(1)=11.627$, P=0.001
Pigs	$\chi^2(1)=1.294$, P=0.255	$\chi^2 (1)=3.358$, P=0.067

Appendix E: Economic Returns from Different Activities

Appendix E1: Economic Returns from Different Economic Activities for Beekeepers in the Main Study Area

Serial	Income source	n	Mean income in MK	Total income in MK	Percentage (%)
1	Maize	60	34406.17	2064370.00	44.2
2	Beekeeping	60	7994.17	479650.00	10.3
3	Employment	7	45357.14	317500.00	6.8
4	Business	5	45600.00	228000.00	4.9
5	Cattle	5	36350.00	181750.00	3.9
6	Goats	31	5332.23	165299.00	3.5
7	Cassava	50	3079.60	153980.00	3.3
8	Groundnuts	16	9493.75	151900.00	3.3
9	Pigs	9	15473.33	139260.00	3.0
10	Casual labour	5	26340.00	131700.00	2.8
11	Chickens	35	2924.86	102370.00	2.2
12	Potatoes	40	1557.25	62290.00	1.3
13	Sugarcane	4	14500.00	58000.00	1.2
14	Sweet beer	4	14450.00	57800.00	1.2
15	Milk	1	50000.00	50000.00	1.1
16	Loan	1	50000.00	50000.00	1.1
17	Fruits	3	16000.00	48000.00	1.0
18	Clothes	1	40000.00	40000.00	0.9
19	Pigeon peas	13	2548.08	33125.00	0.7
20	Grocery	1	26400.00	26400.00	0.6
21	Fish	1	24000.00	24000.00	0.5
22	Beans	7	3214.29	22500.00	0.5
23	Firewood	2	8500.00	17000.00	0.4
24	Carpentry	1	15000.00	15000.00	0.3

Appendix E1: Economic Returns from Different Economic Activities for Beekeepers In the Main Study Area

Serial	Income source	n	Mean income in MK	Total income in MK	Percentage (%)
25	Maintenance	1	15000.00	15000.00	0.3
26	Peas	4	2925.00	11700.00	0.3
27	Doves	4	1516.25	6065.00	0.1
28	Tobacco	1	5650.00	5650.00	0.1
30	Poles	2	2700.00	5400.00	0.1
29	Sorghum	2	1450.00	2900.00	0.1
31	Rabbits	1	1200.00	1200.00	0.0
32	Ducks	2	350.00	700.00	0.0
33	Vegetables	2	285.00	570.00	0.0
Total				**4, 669,079.00**	**100.00**

Appendix E2: Economic Returns for Beekeepers in the Control Areas

Serial	Income source	n	Mean income MK	Total income MK	Percent (%)
1	Maize	60	37121.00	2227260.00	40.6
2	Employment	14	60642.86	849000.00	15.4
3	Goats	31	8046.45	249440.00	4.5
4	Cattle	7	31400.00	219800.00	4.0
5	Pigs	12	18150.00	217800.00	4.0
6	Cassava	46	4255.43	195750.00	3.6
7	Groundnuts	24	7725.00	185400.00	3.4
8	Timber sawing	1	159000.00	159000.00	2.9
9	Beekeeping	60	2538.46	152307.33	2.8
10	Chickens	37	3727.30	137910.00	2.5
11	Tobacco	2	65770.00	131540.00	2.4
12	Casual labour	3	38333.33	115000.00	2.1
13	Sugarcane	5	20400.00	102000.00	1.9
14	Pigeon peas	13	6907.69	89800.00	1.6
15	Potatoes	36	2245.83	80850.00	1.5
16	Beans	8	8597.50	68780.00	1.3
17	Loan	2	30000.00	60000.00	1.1
18	Vegetables	8	5379.38	43035.00	0.8
19	Carpentry	1	36000.00	36000.00	0.7
20	Business	2	16500.00	33000.00	0.6
21	Fish	3	7166.67	21500.00	0.4
22	Sweet beer	1	20000.00	20000.00	0.4
23	Guinea fowl	3	6666.67	20000.00	0.4
24	Soya	2	6000.00	12000.00	0.2
25	Assistance	1	10000.00	10000.00	0.2
26	Pepper	1	7000.00	7000.00	0.1

Appendix E2: Economic Returns for Beekeepers in the Control Sites

Serial	Income source	n	Mean income MK	Total income MK	Percent (%)
27	Sorghum	7	945.71	6620.00	0.1
28	Doves	6	983.33	5900.00	0.1
29	Fruits	2	2500.00	5000.00	0.1
30	Rice	1	4500.00	4500.00	0.1
31	Charcoal	1	4000.00	4000.00	0.1
32	Wheat	1	3000.00	3000.00	0.1
33	Ducks	3	883.33	2650.00	0.0
34	Peacocks	1	2000.00	2000.00	0.0
Total				**5, 477, 842.33**	**100**

Appendix E3: Economic Returns for Non-beekeepers in the Main Study Site

Serial	Income source	n	Mean income MK	Total income MK	Percentage (%)
1	Maize	60	25215.67	1512940.00	31.6
2	Employment	12	72145.83	865750.00	18.1
3	Grocery	4	96368.75	385475.00	8.1
4	Carpentry	4	72750.00	291000.00	6.1
5	Cassava	49	3718.16	182190.00	3.8
6	Chickens	41	4342.90	178059.00	3.7
7	Pigs	5	33300.00	166500.00	3.5
8	Milk	1	149640.82	149640.82	3.1
9	Building	1	120000.00	120000.00	2.5
10	Potatoes	45	2181.11	98150.00	2.0
11	Groundnuts	15	6351.33	95270.00	2.0
12	Beans	9	9057.78	81520.00	1.7
13	Rice	5	15838.00	79190.00	1.7
14	Goats	13	5822.31	75690.00	1.6
15	Assorted business	2	36500.00	73000.00	1.5
16	Fish	2	30750.00	61500.00	1.3
17	Firewood	2	27000.00	54000.00	1.1
18	Cattle	1	53400.00	53400.00	1.1
19	Fruits	3	16266.67	48800.00	1.0
20	Charcoal	2	23100.00	46200.00	1.0
21	Business	1	31000.00	31000.00	0.6
22	Pepper	1	29900.00	29900.00	0.6
23	Radio	1	25000.00	25000.00	0.5
24	Banana fritters	2	11125.00	22250.00	0.5

Appendix E3: Economic Returns for Non-beekeepers in the Main Study Site

Serial	Income	n	Mean income MK	Total income MK	Percentage (%)
25	Pigeon peas	10	1870.00	18700.00	0.4
26	Vegetables	5	2115.00	10575.00	0.2
27	Loan	2	5000.00	10000.00	0.2
28	Sugarcane	2	3100.00	6200.00	0.1
29	Sorghum	4	1250.00	5000.00	0.1
30	Casual labour	2	2250.00	4500.00	0.1
31	Peas	5	664.00	3320.00	0.1
32	Ducks	1	1750.00	1750.00	0.1
33	Clothes	1	1600.00	1600.00	0.0
34	Rabbits	3	423.33	1270.00	0.0
35	Doves	1	400.00	400.00	0.0
Total				**4,789,739.82**	**100.00**

Appendix E4: Total Economic Returns for all Respondents

Serial	Income	n	Mean income MK	Total income MK	Percentage (%)
1	Maize	180	32247.61	5804570.00	38.86
2	Employment	33	61583.33	2032250.00	13.61
3	Beekeeping	120	5266.31	631957.33	4.23
4	Cassava	145	3668.41	531920.00	3.56
5	Pigs	26	20136.92	523560.00	3.51
6	Goats	75	6539.05	490429.00	3.28
7	Cattle	13	34996.15	454950.00	3.05
8	Groundnuts	55	7864.91	432570.00	2.90
9	Chickens	113	3702.12	418339.00	2.80
10	Grocery	5	82375.00	411875.00	2.76
11	Carpentry	6	57000.00	342000.00	2.29
12	Business	8	36500.00	292000.00	1.95
13	Casual labour	10	25120.00	251200.00	1.68
14	Potatoes	121	1994.13	241290.00	1.62
15	Milk	2	99820.41	199640.82	1.34
16	Beans	24	7200.00	172800.00	1.16
17	Sugarcane	11	15109.09	166200.00	1.11
18	Timber sawing	1	159000.00	159000.00	1.06
19	Sweet beer	7	21542.86	150800.00	1.01
20	Pigeon peas	36	3934.03	141625.00	0.95
21	Tobacco	3	45730.00	137190.00	0.92
22	Loan	5	24000.00	120000.00	0.80
23	Building	1	120000.00	120000.00	0.80
24	Fish	6	17833.33	107000.00	0.72
25	Fruits	8	12725.00	101800.00	0.68

Appendix E4: Total Economic Returns for all Respondents

Serial	Income Source	n	Mean Income in MK	Total Income	Percentage
26	Rice	1	83695.00	83695.00	0.56
27	Firewood	4	17750.00	71000.00	0.48
28	Vegetables	15	3612.00	54180.00	0.36
29	Charcoal	1	50202.00	50202.00	0.34
30	Clothes	2	20800.00	41600.00	0.28
31	Pepper	2	18450.00	36900.00	0.25
32	Radio	1	25000.00	25000.00	0.17
33	Banana fritters	2	11125.00	22250.00	0.15
34	Guinea fowl	3	6666.67	20000.00	0.13
35	Peas	9	1668.89	15020.00	0.10
36	Bicycles	1	15000.00	15000.00	0.10
37	Sorghum	13	1116.92	14520.00	0.10
38	Doves	11	1123.45	12358.00	0.08
39	Soya	2	6000.00	12000.00	0.08
40	Assistance	1	10000.00	10000.00	0.07
41	Poles	2	2700.00	5400.00	0.04
42	Ducks	6	850.00	5100.00	0.03
43	Wheat	1	3000.00	3000.00	0.02
44	Rabbits	4	617.50	2470.00	0.02
45	Peacocks	1	2000.00	2000.00	0.01
Total				**14,936,661.15**	**100.00**

Appendix E5: Average Income for Different Groups of Respondents in 2007

Serial	Category	n	Total income in MK	%	Mean income in MK/household/annum	Standard deviation
1	Beekeepers: main study group	60	4669079.00	31.3	77817.98	1000043.5
2	Beekeepers: control group	60	5477842.33	36.7	91297.37	79409.6
3	Non beekeepers	60	4789739.00	32.0	79829.00	103190.1
Total		**180**	**14,936, 661.15**	**100**	**82, 981.45**	**94,712.0**

Appendix F: Logistic Regression Models

Appendix F1: Logistic Regression Output for Beekeepers from the Main Study Group versus Non-beekeepers

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	AGERANGE			9.091	4	.059			
	AGERANGE(1)	-2.509	1.017	6.086	1	.014	.081	.011	.597
	AGERANGE(2)	-1.092	.812	1.812	1	.178	.335	.068	1.646
	AGERANGE(3)	.336	.967	.121	1	.728	1.399	.210	9.319
	AGERANGE(4)	.107	.974	.012	1	.912	1.113	.165	7.515
	SECECONO(1)	2.924	.696	17.629	1	.000	18.614	4.754	72.879
	LABTHREE(1)	-.083	.680	.015	1	.903	.921	.243	3.487
	AGRGARDE(1)	-.446	.756	.348	1	.555	.640	.145	2.819
	EXTCONTA(1)	.872	.772	1.276	1	.259	2.392	.527	10.859
	CLUBATT(1)	-.489	.712	.470	1	.493	.613	.152	2.479
	MEMBORGA(1)	2.591	.807	10.309	1	.001	13.349	2.744	64.933
	GOATS(1)	.775	.585	1.758	1	.185	2.171	.690	6.831
	Constant	-2.343	1.391	2.837	1	.092	.096		

a. Variable(s) entered on step 1: AGERANGE, SECECONO, LABTHREE, AGRGARDE, EXTCONTA, CLUBATT, MEME GOATS.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	73.228	11	.000
	Block	73.228	11	.000
	Model	73.228	11	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	85.979	.471	.628

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	5.398	8	.714

Classification Table[a]

Observed			Predicted		
			identity of respondent		
			nonbeekeeperstudy	beekeeper study area	Percentage Correct
Step 1	identity of respondent	nonbeekeeperstudy	45	10	81.8
		beekeeper study area	9	51	85.0
	Overall Percentage				83.5

a. The cut value is .500

Appendix F2: Logistic Regression Output for Beekeepers from the Control Group versus Non-beekeepers from the Main Study

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	AGERANGE			4.295	4	.368			
	AGERANGE(1)	-1.383	1.003	1.901	1	.168	.251	.035	1.791
	AGERANGE(2)	-1.838	1.003	3.356	1	.067	.159	.022	1.137
	AGERANGE(3)	-1.012	1.081	.876	1	.349	.364	.044	3.025
	AGERANGE(4)	-.264	1.046	.064	1	.800	.768	.099	5.963
	SOMEEDU(1)	.483	.874	.305	1	.581	1.620	.292	8.985
	SECECONO(1)	3.631	.734	24.477	1	.000	37.733	8.956	158.985
	AGRGARDE(1)	.414	.838	.244	1	.621	1.512	.293	7.811
	EXTCONTA(1)	-.184	.822	.050	1	.823	.832	.166	4.165
	CLUBATT(1)	-.786	.890	.781	1	.377	.455	.080	2.605
	MEMBORGA(1)	1.663	.763	4.745	1	.029	5.275	1.181	23.551
	GOATS(1)	.966	.624	2.393	1	.122	2.627	.773	8.929
	Constant	-2.382	1.291	3.404	1	.065	.092		

a. Variable(s) entered on step 1: AGERANGE, SOMEEDU, SECECONO, AGRGARDE, EXTCONTA, CLUBATT, MEMB GOATS.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	78.270	11	.000
	Block	78.270	11	.000
	Model	78.270	11	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	80.937	.494	.659

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	12.736	7	.079

Classification Table[a]

Observed			Predicted		
			identity of respondent		
			nonbeekeepers study	beekeeper control	Percentage Correct
Step 1	identity of respondent	nonbeekeepers study	47	8	85.5
		beekeeper control	5	55	91.7
	Overall Percentage				88.7

a. The cut value is .500

Appendix G: Global Vegetation Survey

Appendix G1: Some Species of Vegetation Found in Traditional Authority Nthiramanja

Serial	Species of vegetation	Frequency
1	*Acacia polyacantha*	Common
2	*Acacia sieberana*	Common
3	*Acanthospermum hispidus*	Very common
4	*Adansonia digitata*	Common
5	*Afzelia quanzesis*	Common
6	*Agave sisalana*	Very common
7	*Albizia glaberrima*	Common
8	*Albizia lebbeck*	Common
9	*Annona senegalensis*	Common
10	*Antidesma venosum*	Common
11	*Aspilia mossambicensis*	Common
12	*Azanza garckeana*	Common
13	*Bambusa vulgaris*	Common
14	*Bauhinia monandra*	Common
15	*Bauhinia petersiana*	Common
16	*Bidens pilosa*	Very common
17	*Brachystegia boehmii*	Not common
18	*Breonadia salicina*	Common
19	*Bridelia micrantha*	Common
20	*Burttdavya nyasica*	Common
21	*Capparis erythrocarpos*	Common
22	*Carica papaya*	Very common
23	*Casimiroa edulis*	Very common
24	*Catunaregam spinosa*	Common
25	*Cissus integrifolia*	Common

Appendix G1: Some Species of Vegetation Found in Traditional Authority Nthiramanja

Serial	Species of vegetation	Frequency
26	*Citrus sinensis*	Very common
27	*Combretum adenogonium*	Common
28	*Combretum microphyllum*	Common
29	*Cordyla africana*	Common
30	*Cynodon dactylon*	Very common
31	*Dalbergia fischeri*	Common
32	*Dalbergiella nyasae*	Common
33	*Delonix regia*	Common
34	*Dichrostachys cinerea*	Common
35	*Diospyros mespiliformis*	Common
36	*Diospyros squarrosa*	Common
37	*Dombeya rotundifolia*	Common
38	*Ehretia goetzei*	Common
39	*Elephantorrhiza goetzei*	Common
40	*Eleusine indica*	Very common
41	*Erythrina abyssinica*	Common
42	*Erythroxylum emarginatum*	Common
43	*Eucalyptus spp.*	Very common
44	*Faidherbia albida*	Common
45	*Ficus natalensis*	Common
46	*Ficus sycomorus*	Common
47	*Flacourtia indica*	Common
48	*Gmelina arborea*	Very common
49	*Grevillea robusta*	Common
50	*Grewia flavescens*	Common
51	*Grewia herbacea*	Common
52	*Hymenocardia acida*	Common

Appendix G1: Some Species of Vegetation Found in Traditional Authority Nthiramanja

Serial	Species of vegetation	Frequency
53	*Indigofera arrecta*	Common
54	*Jacaranda mimosifolia*	Common
55	*Jasminum fluminense*	Common
56	*Khaya anthotheca*	Common
57	*Khaya nyasica*	Common
58	*Kigelia africana*	Common
59	*Kirkia acuminata*	Common
60	*Lannea discolor*	Common
61	*Lantana camara*	Very common
62	*Lonchocarpus capassa*	Common
63	*Ludwigia erectum*	Common
64	*Mangifera indica*	Very common
65	*Manihot esculenta*	Very common
66	*Margaritaria discoidea*	Common
67	*Markhamia obtusifolia*	Common
68	*Maytenus senegalensis*	Common
69	*Melia azedarach*	Common
70	*Morus alba*	Common
71	*Musa paradisiaca*	Very common
72	*Oxytenathera abyssinica*	Common
73	*Panicum maximum*	Very common
74	*Parinari curatellifolia*	Common
75	*Parkia filicoidea*	Common
76	*Pericopsis angolensis*	Common
77	*Phyllanthus ovalifolius*	Common
78	*Phyllanthus reticulatus*	Common

Appendix G1: Some Species of Vegetation Found in Traditional Authority Nthiramanja

Serial	Species of vegetation	Frequency
79	*Piliostigma thonningii*	Common
81	*Polysphaeria lanceolata*	Common
82	*Pseudolachnostylis maprouneifolia*	Common
83	*Psidium guajava*	Very common
84	*Psychotria mahonii*	Common
85	*Rauvolfia caffra*	Common
86	*Rhus longipes*	Common
87	*Ricinus communis*	Common
88	*Sclerocarya birrea*	Common
89	*Senna alata*	Common
90	*Senna floribunda*	Common
91	*Senna petersiama*	Common
92	*Senna siamea*	Very common
93	*Senna singuena*	Common
94	*Senna spectabilis*	Common
95	*Sida acuta*	Very common
96	*Solanum penduriforme*	Very common
97	*Sorghum dochna*	Very common
98	*Sporobolus molleri*	Very common
99	*Tabernaemontana elegans*	Common
100	*Terminalia sericea*	Common
101	*Terminalia ivorensis*	Common
102	*Thevetia peruviana*	Very common
103	*Toona ciliata*	Common
104	*Trichilia emetica*	Common
105	*Triumfetta rhomboidea*	Common
106	*Turraea nilotica*	Common

Appendix G1: Some Species of Vegetation Found in Traditional Authority Nthiramanja

Serial	Species of vegetation	Frequency
107	*Vangueria infausta*	Common
108	*Vernonia glabra*	Very common
109	*Vitex doniana*	Common
110	*Ziziphus mucronata*	Common

Appendix G2: Some Species of Vegetation Found in Traditional Authority Chimaliro

Serial	Species of vegetation	Frequency
1	*Faidherbia albida*	Common
2	*Acacia goetzei*	Common
3	*Acacia polyacantha*	Common
4	*Afzelia quanzensis*	Common
5	*Albizia glaberrima*	Common
6	*Annona senegalensis*	Common
7	*Apodytes dimidiata*	Common
8	*Azadrachta indica*	Common
9	*Azanza garckeana*	Common
10	*Bambusa vulgaris*	Common
11	*Bauhinia petersiana*	Common
12	*Breonia salicina*	Common
13	*Bridelia micrantha*	Common
14	*Carica papaya*	Common
15	*Casmiroa edulis*	Common
16	*Clausena anisata*	Very common
17	*Combretum microphyllum*	Common
18	*Commiphora africana*	Common
19	*Cordia abyssinica*	Common
20	*Cussonia arborea*	Common
21	*Dalbergia arbutifolia*	Common
22	*Dalbergia boehmii*	Common
23	*Delonix regia*	Common
24	*Dichrostachys cinerea*	Common
25	*Diospyros lycioides*	Common
26	*Diospyros squarrosa*	Common

Appendix G2: Some Species of Vegetation Found in Traditional Authority Chimaliro

Serial	Species of vegetation	Frequency
27	*Dombeya rotundifolia*	Common
28	*Ehretia goetzei*	Common
29	*Eleusine indica*	Very common
30	*Erythrophleum suaveolens*	Common
31	*Erythrina abyssinica*	Common
32	*Eucalyptus spp*	Very common
33	*Ficus sycomorus*	Common
34	*Flacourtia indica*	Common
35	*Flueggea virosa*	Common
36	*Gmelina arborea*	Common
37	*Grewia flavescens*	Common
38	*Bridelia micrantha*	Common
39	*Terminalia sericea*	Common
40	*Trema orientalis*	Common
41	*Khaya anthotheca*	Common
42	*Lantana camara*	Very common
43	*Lippia javanica*	Common
44	*Lonchocarpus capassa*	Common
45	*Lonchocarpus bussei*	Common
46	*Mangifera indica*	Very common
47	*Margaritaria discoidea*	Common
48	*Markhamia obtusifolia*	Common
49	*Maytenus senegalensis*	Common
50	*Melia azedrach*	Common
51	*Musa paradisiaca*	Common
52	*Oreobambos buchwaldii*	Common
53	*Oxytenanthera abyssinica*	Common

Appendix G2: Some Species of Vegetation Found in Traditional Authority Chimaliro

Serial	Species of vegetation	Frequency
54	*Panicum maximum*	Very common
55	*Pericopsis angolensis*	Common
56	*Piliostigma thonningii*	Common
57	*Psidium guajava*	Very common
58	*Rhus longipes*	Common
59	*Sclerocarya birrea*	Common
60	*Albizia lebbeck*	Common
61	*Senna petersiana*	Common
62	*Senna singuena*	Common
63	*Senna spectabilis*	Common
64	*Sida acuta*	Very common
65	*Steganotaenia araliacea*	Common
66	*Stereospermum kunthianum*	Common
67	*Strychnos spinosa*	Common
68	*Toona ciliata*	Common
69	*Trichilia emetica*	Common
70	*Vangueria infausta*	Common
71	*Vernonia adoensis*	Common
72	*Vernonia colorata*	Common
73	*Vitex doniana*	Common
74	*Ziziphus mauritiana*	Common
75	*Ziziphus mucronata*	Common

Appendix G3: Some Species of Vegetation Found in Traditional Authority Chikumbu

Serial	Species of vegetation	Frequency
1	*Acacia goetzei*	Common
2	*Annona senegalensis*	Common
3	*Bambusa vulgaris*	Common
4	*Brachystegia spiciformis*	Common
5	*Brachystegia utilis*	Common
6	*Breonia salicina*	Common
7	*Bridelia micrantha*	Common
8	*Carica papaya*	Common
9	*Casimiroa edulis*	Common
10	*Citrus sinensis*	Common
11	*Cordia abyssinica*	Common
12	*Dalbergia melanoxylon*	Common
13	*Dombeya rotundifolia*	Common
14	*Eucalyptus spp*	Common
15	*Euphorbia pulcherrima*	Common
16	*Ficus sycomorus*	Common
17	*Flueggea virosa*	Common
18	*Gmelina arborea*	Common
19	*Grewia micrantha*	Common
20	*Julbernardia globiflora*	Common
21	*Khaya anthotheca*	Common
22	*Lantana camara*	Common
23	*Mangifera indica*	Common
24	*Maytenus senegalensis*	Common
25	*Musa spp*	Common
26	*Oxytenathera abyssinica*	Common

Table G3: Some Species of Vegetation Found in Traditional Authority Chikumbu

Serial	Species	Frequency
27	*Parinari curatellifolia*	Common
28	*Persea americana*	Common
29	*Piliostigma thonningii*	Common
30	*Plumeria alba*	Common
31	*Psidium guajava*	Common
32	*Pterocarpus angolensis*	Common
33	*Raphia farinifera*	Common
34	*Senna siamea*	Common
35	*Terminalia sericea*	Common
36	*Thevetia peruviana*	Common
37	*Vitex doniana*	Common
38	*Ziziphus mucronata*	Common

Appendix G4: Some Species of Vegetation Found in Traditional Authority Mabuka

Serial	Species of vegetation	Frequency
1	*Acacia polyacantha*	Common
2	*Agave sisalana*	Common
3	*Annona senegalensis*	Common
4	*Bambusa vulgaris*	Common
5	*Bridelia micrantha*	Common
6	*Cajanus cajan*	Common
7	*Carica papaya*	Common
8	*Casimiroa edulis*	Common
9	*Citrus sinensis*	Common
10	*Cordia abyssinica*	Common
11	*Diplorhynchus condylocarpon*	Common
12	*Ekebergia capensis*	Common
13	*Erythroxylum emarginatum*	Common
14	*Eucalyptus spp*	Common
15	*Ficus natalensis*	Common
16	*Ficus sycomorus*	Common
17	*Gmelina arborea*	Common
18	*Heteromorpha trifoliata*	Common
19	*Kigelia africana*	Common
20	*Lantana Camara*	Common
21	*Mangifera indica*	Common
22	*Melia azedarach*	Common
23	*Musa spp*	Common
24	*Oxytenathera abyssinica*	Common
25	*Persea americana*	Common
26	*Phyllanthus reticulatus*	Common
27	*Psidium guajava*	Common

Appendix G4: Some Species of Vegetation Found in Traditional Authority Mabuka

Serial	Species of vegetation	Frequency
28	*Saccharum officinarum*	Common
29	*Senna siamea*	Common
30	*Senna spectabilis*	Common
31	*Tephrosia vogelii*	Common
32	*Toona ciliata*	Common
33	*Trichilia emetica*	Common
34	*Vangueria infausta*	Common

Appendix H: Plates

Plate1: Modern Hive

Plate 2: Clay Hive

Plate 3: Bark Hive

Plate 4: Log or Tree Cavity Hive

Plate 5 : Cave Hive