

**FACTORS INFLUENCING HONEY PRODUCTION IN MARIGAT,  
BARINGO COUNTY - KENYA**

**BY**

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## **DEDICATION**

I dedicate this work to my dear wife Dorothy, my Children Justine, Mercy, Faith and Dennis, my brothers and sisters, my late parents Mr. Chemwok Chemitei and Mrs. Juliana T. Chemwok for their great love and words of wisdom to me.

## DECLARATION

### Declaration by Student

This thesis is my original work and that all other sources of materials used for this thesis have been duly acknowledged. This thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

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## ABSTRACT

Beekeeping is the maintenance of honey bee colonies in hives. Beekeeping is a viable business that contributes income significantly to many rural households in Marigat, Baringo County. It provides a means of supplementary business and self employment opportunities. Over the years, demand for honey continued to increase while quantity of honey produced declined. The study analyzed the effects of technological, economic, social and institutional factors that influenced quantity of honey produced. The theory of the firm was the theoretical framework of the study. The study adopted a survey design. The research was conducted in Marigat, Baringo County with various regions being sampled to obtain reliable data. Target population of the study was 1,500 bee farmers in the region and a sample size of 134 bee farmers were selected from three divisions. Data was collected using structured interview schedule, group discussion, key informant discussion and observations, analyzed using descriptive statistics and regression. Multiple regression model was estimated by Ordinary Least Squares technique. Results indicated technological, economic, social and institutional factors significantly determined honey production ( $p$  – values ranged between from 0.000 – 0.0203 < 0.05). It was concluded that technological, social, economic and institutional factors affected honey production in Marigat, Baringo County. It is important to encourage beekeepers to diversify income in the farm to include other complimentary activities such as beekeeping and agro-forestry. Farmer to farmer advisory services is strengthened in response for services and collaboration with other partners in promoting beekeeping. Enhance development of the subsector through strong extension, research, conservation and rehabilitation of vegetation with integration of beekeeping. Organize beekeepers for efficient marketing of bee products, establishment of colony multiplication center, distribution and conservation of indigenous honeybee race. Women and youths are encouraged to take up beekeeping enterprise. Develop beekeepers skills and extension agents on bee management. Utilize beeswax through intensive trainings, enhance bee forage production and integrate beekeeping with water harvesting. Modify traditional log hive to include queen excluder - section for improved honey quality.

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## CHAPTER ONE: INTRODUCTION

### Overview

This chapter presents background of the study, statement of the problem, research objectives and research hypotheses, significance of the study, scope and limitations of the study.

### 1.1 Background Information

Beekeeping is one of the more universal agricultural activity. Bees are found all over the world (Adjare, 1990). Bees work a dual agricultural role by both producing honey and aiding in the pollination of flowering crops. Although much work has focused on improving the practice of beekeeping, it is still possible to manage beehives at a very low level of technological and capital input. Their cosmopolitan distribution, multipurpose nature and relative simplicity in management combine to make bees a natural agricultural supplement for many types of farm systems, (Bradbear, Fisher and Jackson, 2002).

Beekeeping is thriving in cities across the world driven by young hobbyists, commercial beekeepers, sideliners and green entrepreneurs (Adjare, 1990). The People's Republic of China is the world leader in honey production and by a significant factor in 2008, with an estimated production of 257,800 metric tonnes (mt). Argentina is estimated to have produced 85,000 mt in 2008, up 6.25 percent from the 2007 volume of 80,000 mt (Table1.1). The majority of that country's production is exported, with their key markets being the United States of America (USA). and Germany, which accounted for 75 percent of Argentina's total shipments. Canada is also among the largest honey producers in the world with 5 percent of production. In 2005, Germany was considered the largest honey

importing country in the world at 92,200 mt followed by the United States at 65,749mt (Table1.1). The rise in the price of honey from the 2002 production season has been a boon to beekeepers with honey to sell, but drought has prevented many producers from benefiting from the price rise. Antibiotics found in Chinese honey in early 2006 have caused a world shortage of honey in export markets with the resultant price rise and as a result other world countries such as Canada have benefited (FAO, 2012). Production trends of honey globally indicated that honey quantities varied significantly over the years as illustrated in table 1.1.

**Table 1.1: Global Honey Production Trends (metric tons)**

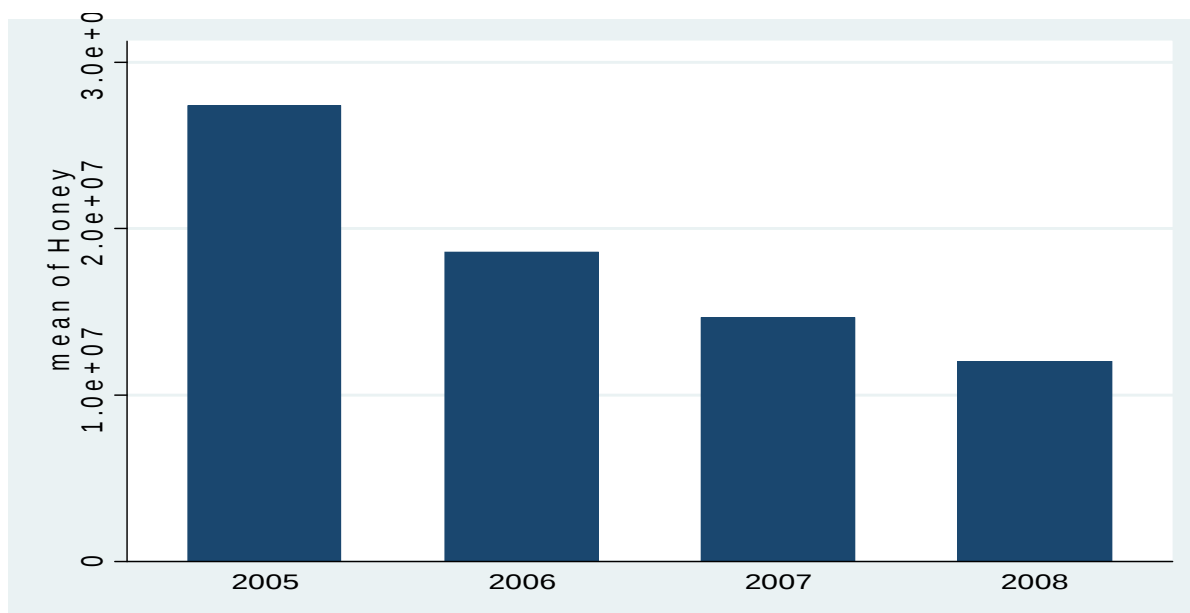
<b>Year</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2010/2009</b>
						<b>% change</b>
Argentin	75,000	98,000	93,000	80,000	85,000	6.25%
a						
Canada	46,083	37,097	31,857	35,387	33,296	-5.91%
China,	210,691	236,283	251,839	254,758	257,800	1.19%
Germany	16,306	20,286	20,409	25,951	22,000	-15.22%
Mexico	55,297	55,323	58,935	59,069	55,189	-6.57%
US	99,930	94,000	99,945	84,335	90,000	6.72%
World	1,188,40	1,234,30	1,246,43	1,255,27	1,270,00	1.12%
	1	8	2	1	2	

**Source:** FAO (2013)

Desertification is a major problem facing many African countries. The land degradation due to desertification has resulted in poor yields and grazing capacity, loss of farmland and rangeland, reduction or disappearance of forests and serious economic difficulties for producers, herders, farmers, beekeepers and the general population. A growing number of amateur beekeepers are adopting various traditional log hives similar to the type commonly found in Africa. Beekeeping can work almost anywhere. It is multi-functional; bees provide honey, a high energy food supplement that can be sold to bring cash into a

small farm. Bees also provide wax, which has almost unlimited uses. Both honey and wax are valued for their medicinal use in traditional cultures. Bees also provide a valuable ecological service through their role as a pollinator (Friedman and Matti, 2007).

Kenya is largely a traditional beekeeping country which is mostly practiced in Arid and Semi-Arid areas with about 10 million people (KNBS, 2009). With the Development of the Kenya Top Bar Hive, by Kigatiira and Morse, (1979), there was need for farmers to adopt movable Bar Technology as a transition hive between the traditional log hive and the Langstroth hive. Unfortunately, technology adoption has been very slow among Kenyan beekeepers. In the past, farmers kept their traditional beehives (log hives), on trees in expansive areas, largely unsettled, tapping nectar and pollen from the wild plant sources. With the farming and charcoal burning system approach, this has been restricted. From the census report (KNBS, 2009), the total hive population in Kenya is slightly less than 2 million hives, irrespective of the type of hive, with traditional log hives leading with over 1.3 million hives and 0.7 million is shared between Kenya Top Bar Hive and Langstroth Hive. Table 1.1 shows that the quantity of honey declined from 27,379,481 Kilogram's in 2005 to 12,036,910 kilogram's in 2008.



**Source:** GoK (2009)

**Figure 1.1 Honey Production Trends in Kenya (Kilogrammes)**

In Kenya, approximately 80 per cent of land is suitable for beekeeping (GoK, 2008 and Hussein, 2001). Yet, the potential of bee keeping and honey production has not been fully tapped in areas where the agro-ecological and climatic conditions as well as the land use patterns are near perfect. Traditionally, lack of market knowledge and the poor quality of honey from rudimentary hives meant that honey was used to produce local liquor. Similarly, beekeepers were prone to exploitation by more knowledgeable middlemen. With the diffusion of its model of sustainable community- based beekeeping, Honey Care Africa (HCA) has been able to provide solutions to overcome these impediments (Najma, 2002).

Marigat in Baringo County is a key producer of honey in Kenya and has enormous potential for beekeeping. Through seminars, workshops, demonstrations and field days, farmers are slowly adopting modern beekeeping practices. Most of the honey produced in the County comes from the traditional *Tugen* log hives. The area has, however, performed

poorly during unfavorable weather conditions. Some of the most well known top-bar hives are the Kenyan Top Bar Hive (KTBH) with sloping sides, the Tanzanian Top Bar Hive, which has straight sides and the Vertical Top Bar Hives such as the Warre or "People's Hive" designed by Abbe Warre in the mid 1900's.

In order to promote diversification in agriculture and reduce poverty in Kenya, beekeeping is one of the major agricultural activities that people need to use as a tool. It offers a great potential for income generation, poverty alleviation, sustainable use of forest resources and diversifying the export base. There is availability of market for bee products both locally as well as internationally or those who wish to continue and it is important to note that pharmaceutical and cosmetic industries utilize bee products such as honey, royal jelly, beeswax to produce cosmetics.

Beekeeping is not an expensive agricultural venture and any bee keeping farmer may save for a short time before investing into beekeeping. Local breweries have high demand for honey which is a significant input in making the local brews. Over the past one decade, the government of Kenya has reduced the number of agricultural extension officers who used to help the farmers a great deal. The few that are remaining are not able to visit most of the farmers on their farms and give personal advice. Most of the bee farmers are also small scale dairy farmers as well and are always busy on the dairy farming activities.

The situation has changed over time and there has been a general increase in both human and livestock populations in the Kenyan rangelands. This has been occasioned by various improvements in infrastructure, water resources and health facilities. Most of the high

potential rangelands have also been alienated for other uses such as game parks and private land leaving less land available for the growing human population.

## 1.2 Honey By-Products and Production Trend in Marigat

The honey by-products and production trend for the period 2005 – 2012 as shown in table 1.2. Between the year 2005 and 2008 there was only one larger Baringo District before it was split into Baringo Central and Marigat in the year 2009. Hive products and production trends showed a general decline in the quantity of honey and the quantity of beeswax harvested in kilograms despite the increase in per unit price per kilogram of honey as shown in table 1.2. From table 1.2 it is evident that honey production declined by 235,100 Kilograms in 2008 compared with the production of 2005 (100 per cent) a growth rate of -37.82 per cent to 62.18 per cent.

**Table 1.2: Honey by-products and production trends**

Year	Honey and By-Product (Kgs)		Unit Price Per Kilogram		Value (KES) (000,000)
	Honey	Beeswax	Honey	Beeswax	
2005	378100	85	87	-	32.89



2006	320000	40	89	-	28.61
2007	220000	10	90	-	19.80
2008	143000	25	95	-	13.59
2009	17675	20	100	150	1.76
2010	17070	-	130	150	2.21
2011	16000	-	300	150	4.80
2012	30000	20	300	150	9.00

Production from 2005 to 2008 refers total output for the larger Baringo District and from 2009 to 2012 relates to production from Marigat Sub County

**Source:** GoK (2013)

Further in the period 2009 - 2012 Marigat was a distinct sub district on its own with hive products and production trends showing a general increase of 12,325 kilograms (30000 – 17675) in the quantity of honey harvested, a 69.73 per cent increase. This was attributed to increased unit price per kilogram as shown in table 1.2.

### **Occupation Rates of Bee Hives in Marigat, Baringo County.**

Table 1.3 shows the occupation rates of bee hives in Marigat. The occupation rates in table 1.3 showed that for all categories of hives that farmers had in the field were occupied to the levels indicated which was less than 100% and the quantity of honey in kilograms per hive harvested twice a year. The Langstroth hives are paired.

**Table 1.3 Bees Occupation Rates in Marigat.**

Type of hive	Occupation rate	Quantity (kg)	Two seasons p.a.
Log hive	70%	8kg/per hive	2
KTBH	20%	18kg/per hive	2
Langstroth	6%	10kg/per hive * 2 hives	2

**Source:** Researcher, 2010

#### **1.4 Problem Statement**

Declining trends of quantities of honey produced has been evident at both global and regional levels with majority of the world producers of honey recording significant decline in quantities of honey produced and exported (FAO, 2012). There has been a general lack of research on the causes of declining quantities of honey produced with available information indicating only the main losers and gainers in terms of quantities produced (JAICA, 2009). This has persisted despite the availability of more knowledge on bee farming at the technical school level and continuous developments that researchers have made in trying to modify the technologies employed in the production of honey (Breeze, Bailey, Balcombe and Potts, 2011).

Decline in quantities of honey produced have also been evident in Marigat despite efforts put in place by farmers and agencies in supporting farmers in the production of honey as evidenced by table 1.2 on honey production and by-products. Farmers in the region have adopted the use of modern technologies in beehive management such as use of the KTBH and Langstroth hives and have received training on bee hive management but decline in honey production persisted. All this have been aimed at eliminating the traditional practices of beehive farming such as use of log hives with low quantity of honey harvested and identifying ways of dealing with problem of low quantity of honey harvested. These declines have been felt by consumers as prices of honey increased tremendously especially in the last two years 2011, 2012 (See table 1.2).

Marigat farmers are endowed with rich indigenous knowledge of bee farming, favourable climatic conditions, abundant natural flora, non-application of agro-chemicals and low funding with increased unit price per kilogram of honey, but still encounter a general honey production decline.

Modern technology has been introduced in the area especially the KTBH and the Langstroth hives but farmers have not adopted the use of these modern technologies but opted to use traditional log hives in production of honey quantities with bee occupation rate of 70 percent and yield of 16 kilograms per hive per year leaving out KTBH with bee occupation rate of 20 percent and yield of 36 kilograms per hive per year of honey and the Langstroth hives bee occupation rate of 6 percent and yield of 40 kilograms of honey per pair of hive per year.

The bee's occupation rate of the modern technology is very low in both cases of KTBH and Langstroth hives as opposed to the bee occupation rate of the traditional log hives. Ironically, the quantities of honey harvested from the modern technology equipments are higher than the quantities of honey harvested from the traditional log hive. The main reason remains unanswered. Therefore, there is need to carryout research in this field to establish the factors that led to this situation on the ground.

Today, 56 million bee hives exists in the world and 1.2 million tons of honey is produced from these hives. One quarter of honey produced is subject to trade and 90 percent of the exports come from nearly 20 honey producing countries (FAO, 2011). World honey production per bee hive is around 20 kg and this amount is 33 kg in China, 40 kg in

Argentina, 27 kg in Mexico, 64 kg in Canada, 55 kg in Australia, 40 kg in Hungary and approximately 16 kg in Turkey.

Bee-keeping in Kenya is practiced in arid and semi-arid areas both by individual small scale farmers and Common Interest Groups (CIGs). Bee keeping can be carried out successfully in 80 percent of the landmass in Kenya (GOK, 2001 and Hussein, 2001). It is especially suitable in arid and semi-arid areas where other models of agriculture are not possible. Bee keeping contributes income as well as food security through provision of honey, beeswax, propolis, bees' venom and royal jelly in medicine.

The country's potential for apiculture development is estimated at over 100,000 metric tonnes of honey and 10,000 metric tonnes of beeswax. However, only a fifth of this potential is being exploited currently (GoK, 2008). Despite this, however, and the downward trend in global production of honey, the Kenyan case has been different. Findings by the Ministry of trade in 2001 indicated that production in Kenya has been steadily growing for instance from 17,259 metric tonnes in 1994, 19,071 in 1996 and 22,803 in 2000 (GoK, 2001). In Kenya, over 90% beekeepers use traditional methods that presumably lead to honey of low quality (Mbae, 1999).

According to the development plan for 1997-2001, honey production is estimated to have been 79 tonnes in 1995, the latest year for which statistics were available at the time of compilation of the plan (Office of the Vice President and Ministry of Planning, undated). Bee keepers earned Kshs.7.2 million from the sale of honey and this compared favourably with other activities in the livestock-rearing sector. Milk, for example, earned farmers Kshs.6.6 million in the same period.

It was expected that earnings could have been higher and lower incomes were blamed on an inadequate marketing infrastructure. Many researchers have been made on economics of honey production (Cicek, 1993; Akdemir *et al.*, 1993, Habibullah, 1995; Wenning, 2001; Chaudhary, 2001) but there is still need for research, especially in local level that is the motivating factor for this research. The focus of this research was to evaluate the socio-economic and technical characteristics of beekeepers through a survey of honey production, organization and marketing problems in Marigat, Baringo County; Kenya.

Despite its numerous benefits and uses to human beings and its importance in the society, very few people are engaged in bee keeping. Consequently, the few people who engage in it as a business are not only skeptical but are also not totally committed to it. Another source of concern is that because of the associated bee-keeping problems, especially the seemingly lack of technical know-how, only little or nothing is known about the level of technical efficiency of the few who practice it. This means that sustainability of bee keeping for honey and production of other products may not be ascertained. This stems from the fact that ability to produce maximum output from a given set of inputs (technical efficiency), given available bee-keeping technology has not been fully understood.

## **1.5 Objective of the Study**

### **1.5.1 The General Objective of the Study**

The general objective of the study was to analyze factors determining honey production in Marigat, Baringo County

### 1.5.2 Specific Objectives

- i. To analyze the effects of technological factors such as log hive, KTBH and Langstroth hive and beekeeping equipment significantly determined quantity of honey produced in Marigat.
- ii. To determine if social factors such as age of the farmer, gender, education level, occupation and family size significantly determined honey production in Marigat.
- iii. To determine if institutional factors such as access to credit facilities, access to extension visits, membership to group, type of market and Farmers' Training Centre's significantly determine honey production in Marigat.
- iv. To determine if economic factors such as land size, land under forest cover, land under crop, price of honey, labour cost and capital cost significantly determine honey production in Marigat.

### 1.5.3 Research Hypotheses

$H_{01}$  : Technological factors such as log hive, KTBH, Langstroth hive and bee keeping equipment do not significantly determine honey production in Marigat.

$H_{02}$  : Social factors such as age of the farmer, gender, marital status, family size, education level, and main occupation do not significantly determine honey production in Marigat.

$H_{03}$  :Institutional factors such as membership to farmer's group, access to credit facilities, type of market, access to extension services and Farmer Training Centres do not determine honey production in Marigat.

$H_{04}$  :Economic factors such as land size, land under crop, land under forest cover, price of honey, cost of labour cost and capital cost do not significantly determine honey production in Marigat.

### **1.6 Justification of the Study**

In the apiculture sub-sector, the national goal is to enhance the production and marketing of honey and other hive products. In order to fulfill this, the country has to maintain a large enough national honeybee population to sustain the supply of honey and other hive products for domestic, regional and international markets. Poor beehive farming practices have led to severe unquantified losses in the beekeeping industry in the country. It is for this reasons that the study sought to evaluate the challenges of the beehive farming practices in Kenya in an effort to help develop suitable policies, solutions and add knowledge to already existing body of literature about bee farming practices. The study will form a new base or foundation for other further studies in the related topics. The study will also identify major challenges facing bee keepers in Marigat.

## **1.7 Significance of the Study**

The study will be of great benefit to a number of stakeholders that includes; farmers, honey processing and hive manufacturing firms, Government and NGOs, researchers and academia.

### **1.7.1 Farmers**

Farmers will be able to identify the type of hive that maximizes on the quantities of honey produced. The study will provide significant information on the factors that affect beekeeping farming in totality in an effort to ensure that farmers produce sufficient quantities of honey.

### **1.7.2 Honey Processing and Hive Manufacturing Firms**

Firms that manufacture hives will know the type of hive that maximizes the quantity of honey harvested and concentrate on the production of the same and firms that do value-addition to honey will advice farmers to buy a specific type that will maximize the quantity of honey produced.

### **1.7.3 Government and Non-Government Organizations**

The Government and Non-Governmental Organizations who are interested in giving financial aid to the farmers by either training farmers or providing financial support for the purchase of hives would be enlightened on the local challenges that beehive farmers face in the local region and advice them on the best hive that maximizes on the quantity of honey harvested.



#### **1.7.4 Researchers and Academia**

The research would add to the already existing body of literature about bee keeping. It would specifically document information on the most effective type of hives that farmers can employ to ensure that they maximize on production of honey. This would enable future researchers build on the knowledge that would be documented.

#### **1.8 Scope and Limitations of the Study**

The study was carried out between the months of October, 2012 and December, 2012. It sought to identify the factors influencing the quantities of honey harvested in Marigat - Baringo County with an aim of proposing policies and solutions to any of the existing challenges faced by farmers. The research targeted bee farmers in Marigat Sub County.

The limitation of the study was related to coverage of the study area. The area was vast and remote. This challenge was mitigated by using agricultural extension officers to administer the questionnaires. There are a number of known Counties that deal with honey production in Kenya. However, the study focused only in Marigat-Baringo County due to budgetary and time limitations.

## CHAPTER TWO: LITERATURE REVIEW

### 2.0 Overview

This chapter reviews beekeeping in the international arena, African region and Baringo, Kenya. The literature also discusses factors affecting beekeeping which include technology, pests and diseases, climatic conditions, human disturbance and beekeeping management practices. It also contains concept of beekeeping, conceptual model and the theoretical framework.

### 2.1 Concept of Beekeeping and Honey Production

Croft (2007) stated that beekeeping is the maintenance of honey bee colonies, commonly in hives, by farmers. A fixed comb hive is a hive in which the combs cannot be removed or manipulated for management or harvesting without permanently damaging the comb. Almost any hollow structure can be used for this purpose, such as a log gum, skep or a clay pot (Tucak *et al.*, 2004). Fixed comb hives are no longer in common use in most places, and are illegal in some places that require inspection for pest and disease problems such as varroa and American foulbrood (Gamez *et al.*, 2004).

A growing number of amateur beekeepers are adopting various top-bar hives similar to the type commonly found in Africa. Top bar hives were originally used as a traditional beekeeping method in Greece and Vietnam. These have no frames and the honey-filled comb is not returned to the hive after extraction like it is in the Langstroth hive. Because of this, production of honey is likely to be somewhat less than that of a Langstroth hive.

Top bar hives are mostly kept by people who are more interested in having bees in their garden than in honey production (Croft, 2007).

Some of the well known top-bar hives are the Kenyan Top Bar Hive (KTBH) with sloping sides, the Tanzanian Top Bar Hive, which has straight sides and the Vertical Top Bar Hives such as the Warre or "People's Hive" designed by Abbe Warre in the mid 1900's. Top-bar hives offer some advantages in interacting with the bees and the amount of weight that must be lifted is greatly reduced because of the hollowness in it. Top-bar hives are being widely used in developing countries in Africa and Asia as a result of the 'Bees for Development' program. There are a growing number of beekeepers in the U.S using various top-bar hives (Logan, 1990).

There is a current movement that eschews chemicals in beekeeping and believes that health issues in bees can most effectively be addressed by reversing trends that disrespect the needs of the bees themselves; Crop spraying, unnatural conditions in which bees are moved thousands of miles to pollinate commercial crops, frequent opening of the hive for inspection, artificial insemination of queens, routine medication and sugar water feeding are all thought to contribute to a general weakening of the constitution of the honey bee, (Logan, 1990).

Practitioners of 'natural beekeeping' tend to use variations of the top-bar hive, which is a simple design that retains the concept of movable comb without the use of frames or foundation. The horizontal top-bar hive, as championed by Hardison *et al.*, (2007), can be seen as a modernization of hollow log hives, with the addition of wooden bars of specific

width from which bees hang their combs. Its widespread adoption in recent years can be attributed to the publication in 2007 of *The Barefoot Beekeeper* by Cicek *et al.*, (1993), which challenged many aspects of modern beekeeping and offered the horizontal top-bar hive as a viable alternative to the ubiquitous Langstroth-style movable-frame hive, (Croft, 2007).

Natural beekeeping is characterized by a willingness to hand most of the control to the bees themselves, and to minimize interference in their hives. Practitioners expect to take honey only when the bees needs have first been taken care of, and the feeding of sugar is discouraged except as an emergency measure. In the United States, the Langstroth hive is commonly used. The Langstroth was the first successful top-opened hive with movable frames, and other designs of hive have been based on it. Langstroth hive was, however, a descendant of Jan Dzierzon's Polish hive designs. In the United Kingdom, the most common type of hive is the British National Hive, which can hold Hoffman, British Standard or popular Manley frames, but it is not unusual to see some other sorts of hive (Langstroth, 1853). Straw skep, bee gums, and unframed box hives are now unlawful in most US states, as the comb and brood cannot be inspected for diseases, (Croft, 2007).

Langstroth hives are known to beekeepers and laymen alike as the box shaped structures so often seen in apiaries. The design was invented in the early 1800s by a Presbyterian minister named L.L. Langstroth and constituted a stroke of genius that revolutionized beekeeping. A Langstroth hive is made up of stacking boxes called "supers," with about 10 frames in each box. The thin wooden frames hold sheets of machine-pressed beeswax or beeswax-coated plastic, called "foundation," upon which the bees build honeycombs.

The supers are where the bees make honey in the spring and summer. These boxes are removed and stored off the hive during the winter (Jodha, 1993).

The bottom one or two boxes are called the “brood nest” and contain honey, pollen and the brood, or larval bees. Eggs are laid in the hexagonal cells by the queen. The eggs then hatch into larvae, which are fed by their adult sisters. The larvae eventually spin cocoons and hatch out as adults in this part of the hive.

This hive is now gaining popularity in a number of different countries but it is not expected to replace the versatile frame hive, particularly when the hives have to be moved to different areas either for the bees to collect nectar for honey production from a different source, or when the hives have to be moved for the bees to pollinate the flowers of different crops such as granadillas, sunflowers and cashew nuts.

The KTBH was developed, as its name implies, in Kenya by Patterson in the 1970's – over 100 years after Langstroth started constructing bee hives with bee spaces and moveable combs. It can be seen as an extension of the Greek Basket Top-bar moveable comb hive theme but it is much easier for the beekeeper to use than the basket hive and it is just as acceptable to the bees.

The combs are built by the bees to fit the shape of the hive body and they are seldom firmly attached to the sloping sides of the hive even when heavy with honey. The bees use a number of adjacent combs for brood rearing. These combs have a fairly small crown of honey above the brood with some cells containing stored pollen between the brood and the honey crown. With a little bit of manipulation (moving) of top-bars with

combs attached, it is quite easy to induce the bees to fill some combs completely with honey only – this makes cropping the honey easy – and to have the bees use other combs mostly for brood rearing, (Jodha,1993). The dimensions of the KTBH can be varied to suit circumstances. For example they can be made longer to accommodate more top-bars and combs where big crops of honey are expected. Experience of beekeeping in a particular area indicated if hives are of a suitable size for the bees and the conditions in a particular area. None of the dimensions of the hive body are critical although it should have a reasonable slope to the sides to minimize the attachment of the combs to the sides, (Muzaffar, 1992).

The top-bar hives need only to be thick enough so that they do not bend with the weight of honey on them. They must, however, be of the correct width to meet the requirements of the bees which are to occupy the hives, (Koirala, 1997).

Modern business environment requires innovation and entrepreneurial spirit, particularly concerning marketing. These characteristics are perhaps not so critical within the regional sector where the market perception of the primary hive products is one of 'all natural and wholesome', with curative and rejuvenative attributes. With an increasing number of 'health and natural' products on the market and more aggressive marketing by the manufacturers of those products, there were more options for the consumers (ICIMOD, 1998).

New exotic pests, parasitic mite infestation, primary and secondary diseases and viral diseases and viruses associated with mite infestation, and Africanized honeybees are all relatively new to the region. The phenomenal spread of mite infestation and associated

secondary diseases and viruses since 1994 has had a significant negative impact on the sector (Collins and Solomon, 1999). While the spread of Africanized honeybees has been much more contained, the impact has been no less traumatic in areas where those bees can now be found. The use of chemicals and pesticides inside hives as part of a treatment regime for disease, viruses and pests brings into focus the real possibility of damaging the delicate equilibrium in the colony, as well as the contamination of hive products. This may eventually affect consumer confidence and perception of the 'wholesomeness' of hive products, (Maskey, 1989).

The traditional way of keeping bees is threatened by the presence of mite infestation. Even elsewhere where Langstroth hives are used there are instances where frames, wax foundation and excluders are not treated as standard inputs. There is the need to find the right balance, one that optimizes the benefits of both worlds (traditional and modern), while simultaneously giving recognition to the realities of the prevailing social and economic conditions in Turkey, (ICIMOD, 1998).

Closely related to the issue of local versus modern beekeeping is the question of technology appropriate for the region. The debate on whether the top-bar hive is more appropriate than rectangular frame hives and consequently whether honey should be removed from the comb by pressing as opposed to centrifugal force is very relevant to beekeeping in the region.

There is also debate whether the top-bar hive is more suited for African honey bees than European bees and whether one system is more appropriate for the small-scale beekeeper and another system for commercial beekeepers, (Koirala, 1997).

Finally is the reduction of foraging areas through commercial and residential development, and more stringent requirements for apiary locations necessitated by the arrival, or in anticipation of the arrival, of African honey bees.

## **2.2 Effect of Beehive Technology on Quantity of Honey Produced**

A significant amount of resources have been spent over time by the Kenya Agricultural Research Institute (KARI) and her partners to develop technologies to raise the standards of living of the farming communities (KARI, 2000). Despite this, the impact of agricultural technology and information on the livelihoods of rural communities has been low and restricted to certain areas, most commonly the high potential areas. This led to the formation of the Agricultural Technology and Information Response Initiative (ATIRI) within KARI. The program was an option to enhance up-scaling of the adoption of agricultural technologies in order to promote food security, poverty reduction and environmental conservation, (Wardell, 2007).

The ATIRI program enabled a greater number of farmers to access appropriate technologies on demand over a wider geographical span in the country. This empowered farmers in the 'less favoured areas' (the arid and semi-arid lands) to access superior technologies for improved livelihood. Among the technologies widely demanded by farmers in the pastoral areas of Baringo County are those for improving honey production. The Langstroth bee hive, an improvement on the Kenya Top Bar Hive (KTBH), since it has a queen excluder and a super compartment, was highly sought for by the bee keepers. The KTBH is in turn an improvement on the Log Hive in the sense that its internal volume was bigger and it has bars to assist the bees start honey manufacturing more easily, (Wardell, 2007).



The traditional log hive is a hollow tube made from wood with both ends partially closed by timber. Bees could access the hive through any of the myriad holes characterizing the hive. The KTBH consisted of waxed bars suspended inside the box. The wax on the bars provided a foundation from which the bees constructed their combs to hold honey and the brood. The Langstroth is similar to the KTBH and differs mainly in the fact that former has two boxes instead of one. The lower box, brood box is separated from upper box by a queen excluder. In this scenario, the queen is restricted to brood box meaning the super box contained honey free from brood.

The architecture of Langstroth is more preferred by bee keepers since it produced honey with best quality (KARI, 2000). However, it could not match KTBH in honey production and bee colonization; in turn KTBH could not compete with log hive in bee colonization. The main challenge was to come up with a bee hive that could maximize advantages of three types in one unit. There are several possible approaches to improvement of African traditional apiculture. Whichever approach is adopted would need to be holistic and preferably integrated with other rural activities. It should not, however, be highly sophisticated and demanding of advanced technology in early stages.

The use of movable frame hives, for example, might not be advantageous in early stages because of the requirements for prepared hive construction components and precision needed in construction. Instead an intermediate hive of top bar type might be a more appropriate early stage intervention. Often known as Kenya Top Bar Hive in Africa - because it was first introduced there in 1960s - such hives, of which there are several

variations have many advantages of movable frame hives but have a lower capital cost and minimal recurrent costs (Bailey, 2001).

A suggested series of activities in support of improvement of apiculture might be: develop new or rehabilitate infrastructure including bee development centres and extension services; carry out a programme of genetic improvement for more docile bees and superior queens and make these available to producers and potential producers; promote participation of individuals and households especially women in beekeeping by creation of awareness benefits of beekeeping through more focused extension programmes with improved delivery; train extension staff in modern methods of beekeeping and honey production and in participatory methods of technology transfer; train farmers in modern methods of beekeeping, honey extraction, processing and marketing; organize wherever feasible beekeepers and honey producers in groups and associations in order to strengthen their position vis-à-vis market and provide assistance in marketing; train local small scale tradesmen to construct modern, yet simple hives of top bar type to promote their self sufficiency and make available these hives for purchase by prospective bee keepers; and assist individual beekeepers, producer groups and associations to obtain or gain access to credit for purchase of bees and equipment, (Nkunika, 2002).

Below are examples of different types of bee hives. Figure 2.1 Traditional log hive; Figure 2.2 Improved Traditional log Hive, Figure 2.3 Kenya Top Bar Hive (KTBH) and Figure 2.4 Langstroth Hive.



**Figure 2.1 Traditional Log Hive**

**Source:** Kapkuikui farmers in Marigat (2013)  
Worker bee section Queen Excluder section



**Figure 2.2 Improved Traditional log Hive**

**Source:** KVDA Workshop, Kabarnet



**Figure 2.3 Kenya Top Bar Hive (KTBH)**

**Source:** KVDA Workshop-Kabarnet (2012)



**Figure 2.4 Langstroth hives**

**Source:** KVDA Workshop – Kabarnet (2012)

Bee keeping constitutes the line of production that makes up agribusiness. It is also referred to as apiculture. Beekeeping, entails rearing or keeping of bees and aiming at exploiting their products that include honey, pollen grain, propolis and comb. Bee keeping has significant economic importance to both primary and secondary agribusiness. Some areas of significance are good to note. According to Carter (2004), scientific tests carried out through agricultural research, have shown that, yield of fruit is considerably increased when powerful stock of bee is allowed access to tree. Honey and

pollen grain also has significant nutritive value. Arabian travelers during middle age (100-1500AD) used honey in preparation of meals (honey wine) (Lewicki, 1974). The earliest practices of bee keeping was characterized by individuals putting on trees as many as 100 hives, made of straws, in a season, Taylor, (1942). Further improvement was made with use of pots so as to achieve honey separation. Bee keeping also has some constraint facing it. The use of fire in harvesting in traditional bee keeping usually result in destruction of trees (Crane, 2004). There is also a marked supply deficit of honey given the fact that a great proportion of honey in market is from traditional hive (Ntenga, 2000). The initial capital required in the establishment of modern bee keeping has hampered efficient honey production (Hilmi, Bradbear and Mejia, 2011). The practice of bee keeping is as old as any other agricultural practice. It has been an alternative source of income to farmers especially in rural communities. Old or traditional bee keeping differs from modern bee keeping in management style. This has influenced output in terms of quality and quantity per annum. Both methods of apiculture are somewhat alternatives since apiculturist or farmer is availed with knowledge of both methods. Apiculture-being an agribusiness enterprise - requires that the most suitable management practice (considering other environmental factor) to maximize output be applied. It has been found to be profitable with little investment made in it (Gurung, 2005).

This study basically sought to identify social – economic characteristics of bee keepers; determine cost and returns associated with modern bee keeping and traditional bee keeping; examine factors affecting technical efficiency of modern and traditional bee keepings; examine some performance indicators and determinants of the enterprise profit of two practices and identify constraints to profitable bee keeping.

### 2.3 Importance of Bee Keeping in Rural Development

Beekeeping also known as apiculture, is the art, science and or business of managing honey bees for the purpose of producing honey, beeswax and other bee products for personal consumption and industrial use. The most important component in beekeeping industry is the bee as it is involved in primary production of bee products. There are four well-known honeybee species in the world namely: *Apis mellifera*, *Apis dorsta*, *Apis cerana* and *Apis floriae*, according to Admassu (2003). *A. mellifera* is native to Europe and Africa, while the rest are native to Asian continent.

The honey bee *A. mellifera* is one of the most successful species in the animal kingdom judged by its ability to adapt to a wide climatic range. It is believed to have evolved in the tropics. It is highly productive and can adapt well in different climatic conditions. Although they are known as vicious and aggressive bees, they are good producers (Matavele, 2007). Beekeeping is an enterprise that offers great potential for development in Swaziland since it is easy and cheap to manage. For farmers to practice beekeeping they require small pieces of land and its quality is less important since beehives are placed on trees (Oluwole, 1999). This enterprise serves as a means of empowering small-scale farmers who have low capital investments (Farinde *et al.*, 2005).

According to Carruthers and Rodriguez (1992), beekeeping provide local people with an economic incentive for preservation of natural habitat enhancing environmental quality thus, labour in rural areas can be utilized especially during dry seasons. Beekeeping is an activity that fits well with the concept of small-scale agricultural development. It is a labour-intensive undertaking, which can be easily integrated into larger agricultural or

forestry projects. Bees not only aid in pollination of some crops used in such projects, but also makes use of otherwise unused resources such as nectar and pollen. Previous studies indicates that beekeeping activity provide benefits in terms of employment, pollination of crops and conservation of biodiversity (Didas, 2005); generates income through hive products and renting bee colonies to pollinate crops (Gates, 2000). Ecological conditions and floral composition, queen quality and resource management were found to be influencing profitability of beekeeping enterprises (Tucak *et al.*, 2004; Cobey, 2001; Jong, 2000). Beekeeping potential was reported to be great in Swaziland given the economically valuable bee races, varied geography and rich floral resources in the country (Güler and Demir, 2005).

Beekeeping is of vital importance in starting and rebuilding of economic activities that would address socio-economic problems such as HIV and AIDS, poverty and unemployment. A range of products produced in beekeeping not only are rich in nutrients but also have medicinal properties, which people may benefit from. In arable farming, bees also improve crop yields through increased efficiency in pollination and also beekeeping diversifies agriculture as it can be integrated with other agricultural activities as well as agro forestry.

Marigat has considerable potential in beekeeping with her rich flora, good ecological conditions and existence of colony. However, beekeeping sector in Marigat has not yet sufficiently utilized the rich natural resources. Beekeeping can play an important role in urban and rural areas as small-scale farmers may produce products such as honey, beeswax, propolis to name but a few and selling them in order to generate income.

Beekeepers encounter different challenges in the course of the practice. The low yield of honey and other beekeeping products such as beeswax and propolis may result from insufficient management practices and lack of adequate training. On the other hand, honey production is affected by climatic conditions and some bee diseases such as Varroa mites and American foulbrood. Honey production is dependent on many factors beyond the beekeepers control and variations of plus or minus 100 percent are usual due to environmental factors (Adjare, 1990). The beekeeper should take these variations into account when planning activities and budgets. But it should be assumed that variations in honey production and occupation of hives will occur even in the best managed apiaries (Adjare, 1990).

Despite the above challenges beekeeping is a viable project in Marigat region and can therefore be said to be true for the whole country since the ecological conditions are similar. It diversifies agriculture and provides employment opportunities in the rural and urban areas as well. Beekeeping requires minimal capital and dependence on foreign technology. It may be concluded that beekeepers in Marigat region produce comb honey but this trend will certainly change as more beekeepers were now getting familiar with the use of improved log hives that eases extraction of honey from combs.

#### **2.4 Factors Affecting Honey Production**

Honeybees have a lot to offer in terms of agricultural products and ecosystem services. However, bees are exposed to a number of threats such as climate change, reduced biodiversity, and invasive species that reduce their quality of health and longevity (UNEP, 2010). The cost of dealing with these problems is increasing for apiarists, thus making



beekeeping business less profitable. According to Adjare (1990), predators, parasites and diseases are some of other factors that affect beekeeping, thus reducing honey production. Since limitations of beekeeping may affect honey production in a way that these may feed on the honeybees, thus decreasing the population hence lowering production.

According to Gamez *et al.*, (2004), poor feeding especially during winter affects honey production. When colony is not well fed, it will leave the area at the same time affect yield. Beekeepers therefore, introduce sugar syrup in their feeds at least six weeks prior to the onset of the first major nectar flow and this may encourage the production of bees that will be at the appropriate age for foraging by the time of the main nectar flow (Gamez *et al.*, 2004). Further literature states that for honey to be increased, it is essential that there should be a well populated colony in areas where there is abundant nectarous flora. This condition is prevails in Marigat Sub County when there is adequate rainfall.

## **2.5 Factors Affecting Bee Keeping**

### **2.5.1 Effect of Age and Gender on Honey Production**

Age can be a factor in beekeeping, during harvest times or hard operations one may find that only young adults are able to do all operations requiring man-power. Some literature depicts that only those individuals who are still at average ages of 20-40 years can be able to harvest honey from trees as opposed to those above 50 years who are not able to do so. Gender is another factor that affects honey production in a country. Take for instance, a lot of women find it difficult harvesting their produce due to bees stings; and may be the

division of labour that exist may limit participation of women in beekeeping (Yahaya and Usman, 2008).

Lack of education can be another factor in honey production in the sense that beekeeping is mainly practiced in rural areas. These areas have people who are less educated in agricultural practices due to the fact that they are unable to get funds for their education thus limiting the harvested honey yields (Yahaya and Usman, 2008).

### **2.5.2 Effect of Labour on Honey Production**

Spender (1994) explained that labour needs for beekeeping and honey production are quite variable. For example, the time spent establishing new hives depends on materials used. In addition, considerable time can be spent simply driving between hive locations. While it is difficult to estimate exact labour times, honey producers should expect to spend at least 5 hours per hive per year caring for bees and harvesting.

Honeycomb processing times varied depending on the type of honey produced. Producers should expect to spend about an hour per hive processing comb honey.

### **2.5.3 Effect of Institutional Factors on Honey Production**

Beekeeping is a widespread activity with a wealth of existing local knowledge and skills. The addition of a little technical information, however, can lead to greatly improved harvests of honey and beeswax. There are many ways to assist honey hunters or beekeepers to build on their resources to create more income by harvesting and processing honey more skillfully, and to obtain better prices by saving and selling beeswax and by making secondary products, (Shane, 2003).

Beekeepers and trainers often lack appropriate training materials - most of the literature discusses keeping European bees in temperate zone conditions. Training is often theoretical rather than practical, placing emphasis on changing the type of hive used without providing practical guidance and follow up. New beekeepers need training in how to work with bees, how to maintain honey quality, how to separate honey from beeswax, how to render beeswax, how to manufacture secondary products and how to

make beekeeping clothes and equipment, (Hisrich, 2005). This is relevant in the current study because honey harvesters should be professional people in handling bees, harvesting quality honey and separation of honey from bee wax.

#### **2.5.4 Effect of Capital on Honey Production**

Access to finance is essential for further development of beekeeping enterprises: for example, successful marketing depends upon the purchase of containers for processing and packaging of products. Credit is necessary for beekeeping associations running collection centre's, buying products from producers and selling honey in bulk. However, significant financial assets are not essential for beekeeping at subsistence level.

#### **2.5.5 Effect of Credit on Honey Production**

In poor societies, lack of credit is a major constraint to everyone concerned with selling and buying honey. Beekeepers with honey to sell expect to receive cash from honey-collection centre or private-sector traders; otherwise they prefer to sell their honey in small quantities in markets to obtain an instant but low cash return. People buying honey need access to credit during the honey season. The lack of credit leads to insignificant volumes of honey being available for sale, no interest from traders and a stagnant industry (Nahapiet, 1998). Similar conditions prevail in Marigat Sub County.

Modern hives use bee waxed frames to attract occupation of bees and thus bee wax sometimes are very difficult to get unless you purchase them from firms or bee farmers

that have semi-refined honey before delivery to the processing firms for further processing and all these needs initial capital for the industry to succeed.

According to Akdemir *et al.*, (1993), the social capital is “the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition”. Because very often entrepreneurs do not have access to extensive information sources, they are backed up by actors in their environment who influence their decision-making process. Social capital contributes to the availability of information, and it has a positive impact on the innovative performance of small and medium-sized enterprises. Social capital fosters trust and decreases barriers to exchange and combination of new knowledge (Nahapiet, 1998). This is linked to the current study in that exchange of ideas between different groups leads to new innovations being introduced in the industry.

#### **2.5.6 Gender Roles in Different Beekeeping Activities**

The relative advantage of beekeeping is that the whole family can be involved in beekeeping activities, (Abebe, Puskur and Karippai, 2008). There are different activities involved in beekeeping such as swarm catching, transferring, hive inspection, honeybee feeding, honey harvesting, honey extraction and marketing. The involvement of household members in different beekeeping activities such as transferring honeybees from traditional to improved box hive or vice versa, swarm catching, honey harvesting and extracting are mainly done by men, whereas, external hive inspection, honeybee feeding, and honey marketing are the activities of women.

Traditional hives have to be hanged on a tree or under the roof, which makes it difficult for women to operate. Perceptions of the farmers was that improved beekeeping activities does not necessarily overload women as the activities in which they are mainly involved like honey extraction, harvesting and transferring are carried out during their free time and are not done on a daily basis. For instance, transferring is done once a year, unless additional hives are introduced or absconded colonies have to be replaced. Honey extraction is done twice a year in the study area. Group discussions revealed that in most cases marketing of honey is done by women. However, previous studies show that income from sale of honey is mainly controlled by (IPMS 2005).

Beekeeping in Africa has faced serious challenges that led to overall decline of quantities of honey produced (NAMC, 2014). Adjare (1990), however, explains that Africa is a suitable region for beehive farming given the suitability of the climatic conditions of the area but the lack of knowledge on the right practices of beehive farming has led to production decline trends of honey produced.

Adjare (1990) states that variations in beehive technologies is responsible for variations in different quantities of honey produced in different regions with new technologies such as KTBH indicating significant increases in quantities of honey in areas they have been adopted but Adjare (1990) on the same, notes that quantities of honey produced with new technologies also varies with climatic conditions. In highland areas he noted to be doing much better than low land areas where hot temperatures on KTBH create unfavorable conditions for bees due to metallic casing. In these regions, bees have opted for traditional log hive technology.

In Marigat, KTBH and Langstroth hives are not doing well in lowland areas because of extreme temperatures that create unfavourable condition for bees because of metallic casing while the same is not true in highland areas where temperatures are not extremely high but moderate, these now explains why bee farmers in lowland area of Marigat are moving away from modern technology to improved traditional log hive or providing grass thatched houses to place the KTBH and Langstroth. Further this is explained by table 1.3 on occupation rates of bees in Marigat.

Finally, Chaudhary, (2001) notes that value of earning from quantities of honey produced has over time recorded an upward trend especially in areas where practice has been consistent. This is explained by table 1.2 on honey production and by-product trends in Marigat where a unit price per kilogram of honey has recorded price increase from 2005 – 2011. But Chaudhary, (2001) notes that economic value of returns from quantity of honey produced cannot be used as a measure of performance of beekeeping as trends are this way due to monopolistic industry that has been created in different regions of beehive farming resulting to unfair price increase. In competitive environment, price increase is hard and economic value from returns may not reflect increasing trends rather a declining trend especially in areas where quantities would be on a decline. In Marigat, demand for honey is high with high prices but price factor is not as a result of monopolistic industry, but supply factor because of low production trends as explained by figure 1.1 on honey production trends in Kenya.

## **2.6 Knowledge Gap**

A lot of research has been done by various institutions to modernize the type of hives and increase honey production. But no single factor has been identified as a factor influencing honey production more than the other. Researchers note that farmers have basic technical information about all modern technologies around, including Kenya Top Bar Hive and Langstroth Hive made from within the bee farmers reach by Government Parastatal - Kerio Valley Development Authority (KVDA) and Kenya Agricultural Research Institute (KARI) but still prefer Traditional Log Hive. Marigat bee farmers have failed to explain why honey production is declining despite efforts to adopt modern technology and increased prices to boost honey production and their living standards.

## **2.7 Theoretical Review: Production Theory**

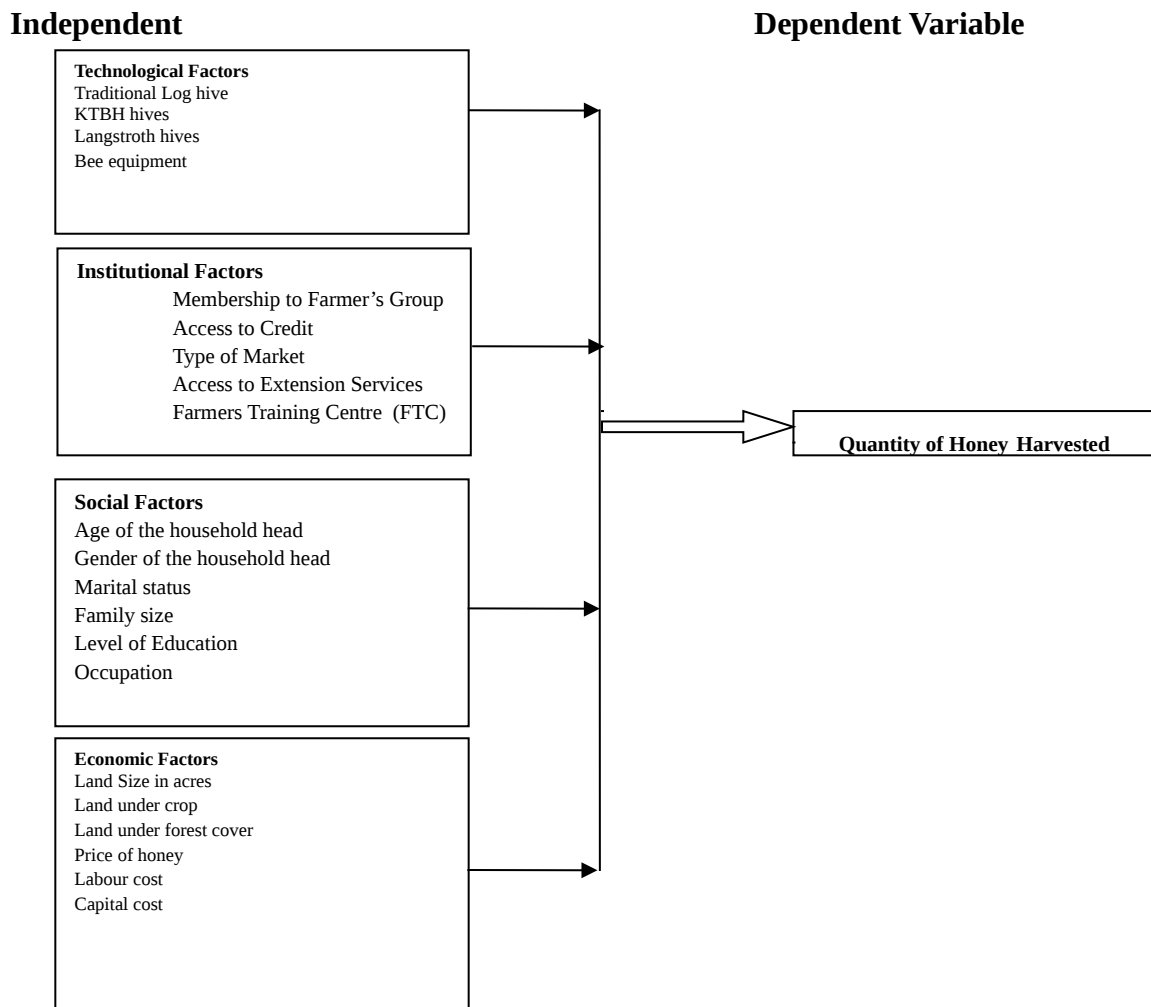
Production theory refers to transformation of inputs into outputs or products, Velasco (2011). An input is a resource that a firm uses in its production process for purpose of creating a good or service.

A production function indicates highest output (Q) that a firm can produce for every specified combination of inputs, while holding technology constant at some predetermined state (Velasco, 2011). Mathematically, we represent a firm's production function as:  $Q = f(L, K)$ ; where Q represents total output, L is labour input and K is capital input assuming one output with two inputs, labour (L) and capital (K). The theory was applied because the objective of the firm is to maximize output and consequently maximize revenue.



## 2.8 Conceptual Framework

Figure 2.6 presents the conceptual framework model. The conceptual framework postulates that honey production depends on technology, institutional, social and economic factors.



**Figure 2.6: Conceptual Framework**

*Source: Authors Conceptualization, (2014)*

## CHAPTER THREE: RESEARCH METHODOLOGY

### 3.0 Overview

This chapter gives a brief description of the study area, research design, target population, sampling procedure, sample size, distribution of the sampled farmers from each division, data collection procedures, data types, econometric specification of the model, data processing and analysis are explained.

### 3.1 The Study Area

Marigat is in Baringo County and was purposively selected for this particular study because it is one of the favourable areas for honey production in Kenya. Other areas that produce honey include Kitui, Machakos and North Eastern. Honey production is expected to have alleviated poverty levels because of its favourable climatic condition, abundant natural flora, non application of agro-chemicals, rich indigenous knowledge of local people, huge honey market locally and internationally.

Marigat covers an area of 1,677.4 km<sup>2</sup> (KNBS, 2009). It borders Baringo Central constituency to the west, Mogotio constituency to the south, Laikipia and Nyahururu constituencies to the east and east Pokot (Tiaty) constituency to the north east.

Marigat's estimated arable land is 215 km<sup>2</sup>; 140.5 km<sup>2</sup> surface water for which lake Baringo covers 130 km<sup>2</sup>, Lake Bogoria 9.5 km<sup>2</sup> and "Lake' 94" which formed itself in 1994 heavy rains, cover 1 km<sup>2</sup>, forest cover is 29 km<sup>2</sup> (GoK, 2012). The rest of the land is categorized as semi - arid and arid, very hilly with steep slopes or rough rocky terrain. Its growth is supported by the Perkerra irrigation scheme where onions, pepper, papaws, rice

seed and maize, among other crops are grown. Administratively Marigat is divided into three divisions, 18 locations and 37 sub- locations with a total population of 73,177 and poverty level of 56 percent (GoK, 2010). It is inhabited by the *Tugen (Samor)* mainly from the upper regions of south, southeast and southwest, the *Njemps (Ilchamus)* mainly from the lowland regions northwards and western region and the Pokot community living in the lowlands of Baringo East (presently Tiaty Sub- County), Baringo County.

The populations of livestock in Marigat are given in table 3.1;

**Table 3.1 Population of Livestock in Marigat, Baringo County**

Animal Type		Number of Animals
Goats	Red Maasai	198,500
	Dairy	45
Cattle	Dairy crosses	2,900
	Beef (Zebu)	60,400
Donkeys		4,100
Camels		17
Rabbits		10
Poultry	Layers	800
	Broilers	100
	Ducks	100
	Turkeys	40
	Geese	40
	Indigenous	96,200
Bee Hives	KTBH	650
	Langstroth	930
	Log hives	25,100

**Source:** GoK (2013).

The LM5 is designated as the semi-arid climatic zone, while the LM6 and IL6 is the arid one. The amount of rainfall is quite inadequate especially for the arid zones. The LM5 is suitable for only drought tolerant crops such as sorghum and millet. The limiting factor to crop production in LM6 and IL6 zones is mainly inadequate rainfall. Therefore rain fed

agriculture is practiced in limited places where moisture is naturally available because of vicinity of Lake Baringo and other natural springs (GoK, 2012).

The area is categorized as arid and semi-arid lands (ASAL) which are ecologically marginal areas with a fragile natural balance between elements of the environment (Gichoria, 2003). ASAL areas have low and variable precipitation, high evaporation rates, sparse to dense vegetation, shallow to deep soils and widely spaced rivers with seasonal flows (Gachimbi, 1995). The altitude of the study area ranges between 900 and 1200 meters above sea level. The soils in the area are mainly moderately to poorly drained, very deep, strongly calcareous, saline and sodic and the texture is fine sandy loam to clay (Gichoria, 2003).

Marketing of local products such as honey (*kumyante*), goat's meat (*beny*), and cultural artifacts is made effective by the surging local and foreign tourists.

### **3.2 Research Design**

Following Masuku, (2013) a descriptive cross-sectional research design was employed in the study with the aim of describing the farmers' characteristics and identifying factors that influenced honey production.

### 3.3 Target Population

That target population included the bee farmers in three divisions (Marigat, Mukutani and Mochongoi). According to Ministry of Livestock in Marigat, Baringo County the estimated total number of bee farmers are 1,500 which constituted target population. The target population is reported in table 3.2.

**Table 3.2: Target population**

Division	Number of Farmers
Marigat	800
Mochongoi	200
Mukutani	500
Total Target Population	1,500

**Source:** GoK 2012

### 3.5 Sampling Procedure

The target population is 1500 beekeepers in Marigat, Baringo County based on a sample frame from the Ministry of Agriculture, Apiculture Section. The study engaged 134 purposively selected beekeepers to capture geographical topography and distribution of population. This helped in ensuring that every member of the population had an equal chance of being chosen in the study (Key, 1997).

#### 3.5.1 Sample Size

The sample size is considered the major part of all statistical analysis. The computation of appropriate sample size is generally considered the most important and most difficult step in statistical analysis. The sample size plays a crucial role in survey, experiments and observations. The sample size employed for the identified target population was scientifically computed using the approach based on precision rate and confidence level (Kothari, 1990).

The formula used is as follows;

$$N = \frac{Z^2 \times P \times Q}{D^2} \dots\dots\dots$$

(3.1)

Where  $N$  was the sample size,  $Z$  Was standard normal value of 1.96 for 5% significance level,  $Q = 1 - P$  proportion of population without characteristics of interest and  $D$  was statistical 5% level of significance = 0.05 ~ estimated error ( $\mu$ ) term acceptable within, of true value. The number of households in Marigat, Baringo County = 15,545. The target population was therefore 1,500 bee farmers. Using the above formula the sample size was therefore computed as follows;  $P = 1,500/15,545 = 0.0965$ .  $Q = 1 - 0.0965 = 0.9035$ .

$$N = \frac{(1.96)^2 \times 0.0965 \times 0.9035}{(0.05)^2} = 133.976 \approx 134$$

Therefore the sample size was 134 farmers.

### 3.5.2 Sampled Farmer distribution in each Division

To select farmers in each division, the researcher employed purposive sampling in a bee farmer group meeting which researcher visited. The distributions of sampled farmers are shown in table 3.3.

**Table 3.3 Ratio sampling for Sample Size**

Division	Number of Farmers	Sampling Ratio	Sample size
Marigat	790	$790/1500 \times 134$	71
Mkutani	508	$508/1500 \times 134$	45
Mochongoi	202	$202/1500 \times 134$	18
Total Population	1,500		134

**Source:** Author's Data, 2013

Systematic sampling ensured that different types of farmers seated in the meeting were selected without bias. The researcher therefore sought to identify dates when bee farmer group meetings were held in every division from Ministry of Livestock and Agriculture in Marigat.

### 3.6 Data Collection Procedures

The data were collected in December 2013 using prepared and pre-tested structured questionnaire (Appendix I). A full understanding of the complexities involved in honey production and the impact they have can only be achieved by mixing methods, such as surveys, qualitative interviews and focus groups discussion (Dick *et al.*, 2004). Accordingly, the data were collected from beekeepers and extension workers in Marigat.

To obtain the relevant information, observations and personal interviews were conducted with beekeepers, extension workers and bee experts.

Observation and key informant discussions were also used to collect information on bee keeping, general view of the respondents on technology and management practices of their apiary. The prices of improved box hives, pure bees-wax and accessories were collected from Kerio Valley Development Authority office. Honey yield price, labour cost and traditional log hive cost was taken from sampled respondents.

### **3.7 Data Types and Sources**

The data types that were collected and used in the analysis were; the technological factors were types of hives (traditional log hive, KTBH and Langstroth hive) and beekeeping equipment. Social factors like age, gender, level of education, occupation and family size. The institutional factors were; access to credit, access to extension visit, group membership, type of market and farmers training centre's (FTCs). The economic factors were land size, land under forest cover and land under crop, price of honey, cost of labour and capital costs. Structured questionnaires were used to gather data on honey production and to get opinion on what can be done to improve honey production.

### **3.8 Specification of the Model**

The analytical framework used in the study was based on the production function. The regression analysis was used to determine the relationship between beekeepers' socio-economic characteristics and honey production. A Cobb-Douglas production function was used to determine factors that influence honey production among beekeepers.



The regression model was specified as:

$$Y = A \prod_1^n X_i^{\beta_i} e^{\mu 1_i} \dots\dots\dots (3.1)$$

$$Y_i = AL_i^\alpha K_i^\beta e^{\mu 1_i} \dots\dots\dots (3.2)$$

The model form is as follows;

$$Y = AX_1^{\beta_1} X_2^{\beta_2} \dots\dots X_n^{\beta_n} e^\mu \dots\dots\dots (3.3)$$

Where:  $0 < \beta < 1$   $Y$  - Honey output in Kilograms  $A_i$  - Constant or intercept;  $\beta^i$  - Regression coefficients (elasticity's of production with respect to resources);  $X_i$  - Independent variables employed;  $e$  - Base of natural logarithm;  $\mu$  - A statistical error term  $i = 1, 2, 3, \dots, n$  and  $n$  - is the sample size.

In the equation, the relationship between output and input equation is non-linear. However through logarithm transformation of model, it became linear. Therefore the model is log- linearized to become estimable in the following format;

$$\ln Y = \ln A + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \dots + \beta_{21} \ln X_{21} + \varepsilon \dots\dots\dots 3.4$$

This allows the model to be estimated using OLS method with the assumption that the residual term is independently distributed from one farm to another with a mean of zero and finite variance. The expected Cobb-Douglas production function that was used is of the form:

$$\ln Y = \ln A + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \dots + \beta_{21} \ln X_{21} + \varepsilon \dots\dots\dots$$

3.5

Masuku (2013) and Halil and Nurey (2007) used a similar model to examine socio-economic factor affecting honey production in Swaziland and Turkey respectively.

**Table 3.4 Apriori Expectations of Variables:**

<b>Variable</b>	<b>Variable Type</b>	<b>Description</b>	<b>Type</b>	<b>Expected sign</b>
$Y$	Dependent	Honey Production (Kg)	Continuous	
$X_1$	Independent	Age of Household Head	Continuous	+
$X_2$	Independent	Gender	Dummy	+/-
$X_3$	Independent	Marital Status	Dummy	+/-
$X_4$	Independent	Family Size	Continuous	+
$X_5$	Independent	Education Level	Dummy	+
$X_6$	Independent	Main occupation	Dummy	+
$X_7$	Independent	Land size	Continuous	+
$X_8$	Independent	Land under crop	Continuous	+
$X_9$	Independent	Land under forest	Continuous	+
$X_{10}$	Independent	Group membership	Dummy	+
$X_{11}$	Independent	Access to credit	Dummy	+
$X_{12}$	Independent	Type of market	Dummy	-
$X_{13}$	Independent	Price of honey	Continuous	+
$X_{14}$	Independent	Access to extension service	Dummy	+
$X_{15}$	Independent	Farmer Training Centre	Dummy	+
$X_{16}$	Independent	Traditional log hive	Dummy	+/-
$X_{17}$	Independent	KTBH	Dummy	+
$X_{18}$	Independent	Langstroth hive	Dummy	+
$X_{19}$	Independent	Bee equipment	Dummy	+
$X_{20}$	Independent	Labour Cost	Continuous	-
$X_{21}$	Independent	Capital Cost	Continuous	-

**Source:** Author's Own Generation 2012.

### **3.9 Data Processing and Analysis**

The analysis of data went through a number of closely related operations namely establishment of categories, application of these categories to raw data through coding, tabulation and lastly drawing statistical inferences. Editing was done to detect errors and omissions thus ensuring that data was accurate, consistent with other facts gathered, uniformly entered, as complete as possible and arranged to facilitate and improve quality of data for coding and tabulation by reading through and correcting any typographical errors that resulted from respondents not having been too careful when responding. Then coding was used to transform categories of data into symbols that were tabulated and counted.

The study adopted both qualitative and quantitative analysis in order to achieve the objective of study. The former used descriptive statistics where graphs, tables and pie charts were used. Descriptive and inferential statistics were used to analyze the data. These included: mean, standard deviation and frequencies; whilst inferential statistics included regression analyses to determine the factors affecting honey production in Marigat Sub County. Data analysis was done using EVIEWS 8.5.

## CHAPTER FOUR: RESULTS AND DISCUSSIONS

### 4.0 Overview

This chapter presents results of surveyed households systematically and discusses findings on how it affects beekeepers as follows: Age of the beekeepers, Educational status, land tenure system, Occupational status, Average household size, effectiveness of beekeeping, practice of beekeeping, major constraints and suggestions of beekeeping, role of gender in beekeeping, beekeeping effects on other household activities, descriptive statistics, regression analysis, ways of improving honey production and major constraints affecting honey production.

### 4.1 Descriptive Statistics

**Descriptive statistic are presented in the following sections;**

#### 4.1.1 Age of the Respondents

Most beekeepers of the study area in age group of 26 to 35 years where 44.78 percent, Young people in age group of 20 to 25 years where 32.09 percent, aged group above 45 years where 12.69 percent and between 36 to 45 years where 10.44 percent.

It was a good sign of creating self-employment. This enterprise will help reduce unemployment and involve youth in the country. These results are consistent with the findings of Quddus 2012, Nsubuga (2000) and Feder *et al.*, (1985). However, results contradicts findings by Cicek *et al.*, (2007), who found that age and education level of producer play a positive role in production of honey in India. We can deduce that gradual

exposure of modern techniques of bee keeping to young people influence their choice of method while aging population remained loyal to method they long understood.

#### **4.1.2 Educational Status of Beekeepers**

Results indicated that most of the beekeepers were educated. It found only 20 percent of beekeepers in the study area had primary level of education. About 33 percent were up to middle level, 40 percent were at secondary school certificate and only 7 percent were higher secondary certificate and above. Bee keepers without basic education constitute majority (50 percent) of bee keepers in the traditional bee keeping system. This can be adduced to simplicity of bee keeping material available locally. The need for basic educational knowledge to learn the intricacy of modern bee keeping was evidence in high proportion of secondary school leavers (43%) who practiced modern bee keeping.

#### **4.1.3 Land Holding Status of Beekeepers**

Landless people (23 per cent) engaged in beekeeping activities in the study area. This showed that bee keeping is not a land based enterprise. Most beekeepers were small scale and had marginal land holding categories. About 76.7 percent of total beekeepers owned land of 0.06 to 20 acres. The average land size was 3.91 acres per beekeeper.

#### **4.1.4 Beekeepers Occupational Status**

In study area, 92 percent of beekeepers were male while 8 percent of beekeepers were female had an occupation of farming, 18 percent of trained females were students of different educational levels and the remaining 74 percent had no occupational status. About 33 percent of female beekeepers were married and 67 percent were single.

#### **4.1.5 Average Household Size**

Results of study indicated that female were more in number in average household size as compared to male. The trend showed female were not interested in bee keeping as compared to males and very few young females were involved in bee keeping activities, they prefer to work at home but some of them were involved in off farm activities. Most male were involved in off farm activities with minimum monthly income. Unemployment exists in the area and most youth were unemployed.

#### **4.1.6 Beekeeping Practice**

Practicing scenario of beekeeping, most of them practiced this activity right from childhood. They graduated into the activity as they grew up with beekeeping as a hobby and societal setup groupings. Most of the female discontinued because of no proper maintenance and time constraint were their main issue whether married or single. Other factors were bees absconding due to different factors; bees were dead due to pests and diseases, charcoal burning, lack of bee forage, bee management problems and improper maintenance of apiaries, honey burger menace, drought and high temperatures inside modern types of hive like KTBH and Langstroth.

#### **4.1.7 Constraints and Suggestions**

Results of the study revealed constraints faced by respondents in the beekeeping activity. The major problem was frequent droughts that drain on colony management during dry

season, diseases and pests (Honey burger, Safari ants') poses a major threat to beekeeping practices, environmental degradation especially charcoal burning poses a threat, poor road infrastructure is a challenge to bee keepers of Marigat and high cost of bee hives to poor beekeepers of Marigat. Another problem was marketing of honey outside and get good price thus limiting them to roadside sales by women and exploitation from middlemen.

#### **4.1.8 Role of Gender in Beekeeping**

The results of the study show gender role in beekeeping activities. The district level data shows variation in the role of gender. According to the perception of respondents, tasks like colonies replacement and queen rearing were done by males and supplement feeding and pest management tasks were easily done by females in Marigat. Also in Marigat colonies replacement and honey extraction were male tasks whereas, supplement feeding and grading or packing were done by female. Similarly beekeeping activities involved both genders at different stages of honey and beeswax processing and marketing. Traditionally, men were responsible for honey harvesting which is normally carried out at night because they are scared of honey bees during the day. The gender distribution showed that practice of bee keeping was somewhat gender sensitive given the larger (92 percent) proportion of male than females (8 percent) bee keepers who practiced both traditional and modern bee keeping respectively.

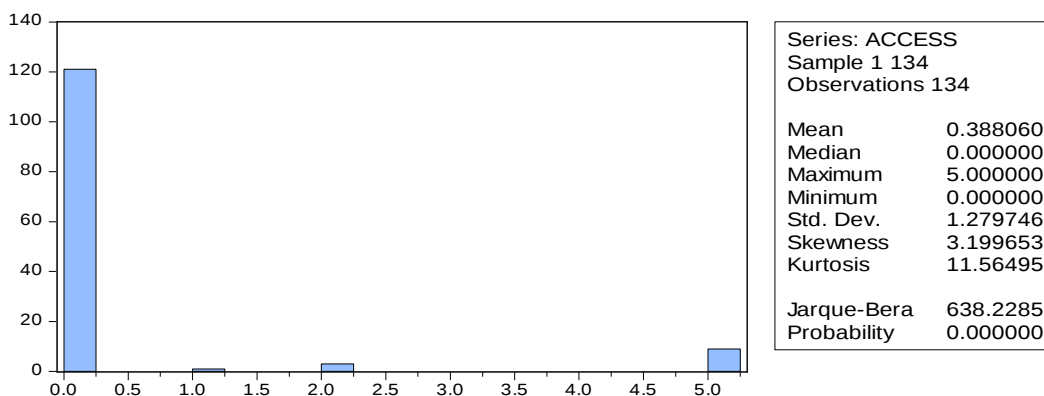
#### **4.1.9 Beekeeping Effects on Other Household Activities**



According to the results 30 percent of the respondents who got beekeeping training were affirmative that, beekeeping affects household activities because this activity needs time and proper maintenance of bees and hives. This was very difficult for female to manage time from household chores.

#### 4.1.10 Access to Credit by Beekeepers in Marigat Sub-County

Figure 4.1 presents histogram for credit access (0) by bee keeping farmers in Marigat. The histogram showed that majority of farmers (120) did not access credit facilities from financial institutions.

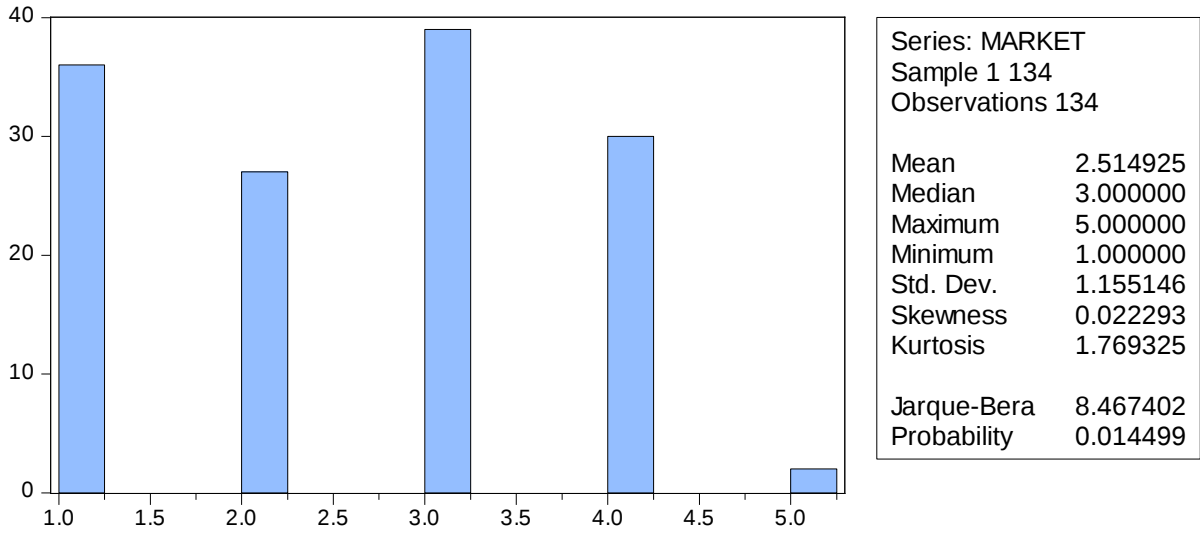


[1 = Credit from Government Institutions; 2 = Credit from Non-Governmental organization; 3 = Credit from Commercial banks 4 = Credit from Micro Finance institution 5 = Credit from Cooperative societies].

#### Figure 4.1: Credit Access by Beekeeping Farmers in Marigat

Source: Research Data, 2015

Figure 4.2 shows where farmers sold their harvested honey. The histogram showed majority of the farmers sold their honey output by road sides; next was to local brewers' followed by sale to organized groups and local consumption. Few farmers sold their honey output to value addition plant. This result was consistent with Berem *et al.*, (2010), who found out that there was low value addition of honey production in Baringo County.

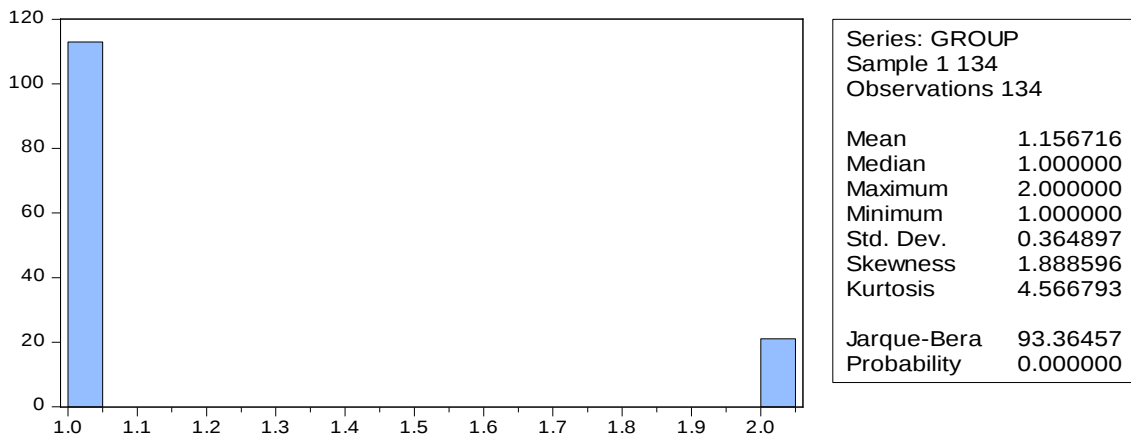


[1 = Sale to Local brewers; 2 = Consume Locally; 3 = Roadsides sales to passersby; 4 = Sale to organized groups 5 = Sale to value addition plant]

**Figure 4.2 where farmers sold their produced honey**

**Source:** Research Data, 2015

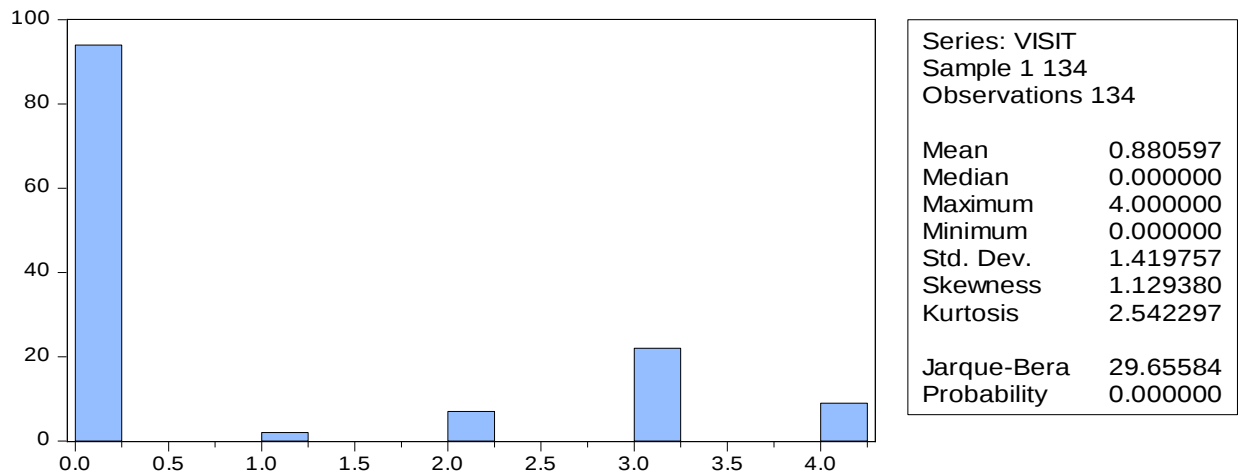
Figure 4.3 shows that majority of the farmers were not members (1) of any farmer group in Marigat because they lacked information on benefits of membership to farmers groups.



**Figure 4.3: Distribution of Farmers' Membership to Groups in Marigat.**

**Source:** Research, 2015

Figure 4.4 depicts that majority of the farmers were not visited by the extension officers (0) followed by a group of farmers visited twice a year (3), once a year (4), once a month (2) and once a week (1) respectively. This may imply that there are few extension officers in Marigat to undertake frequent visits.

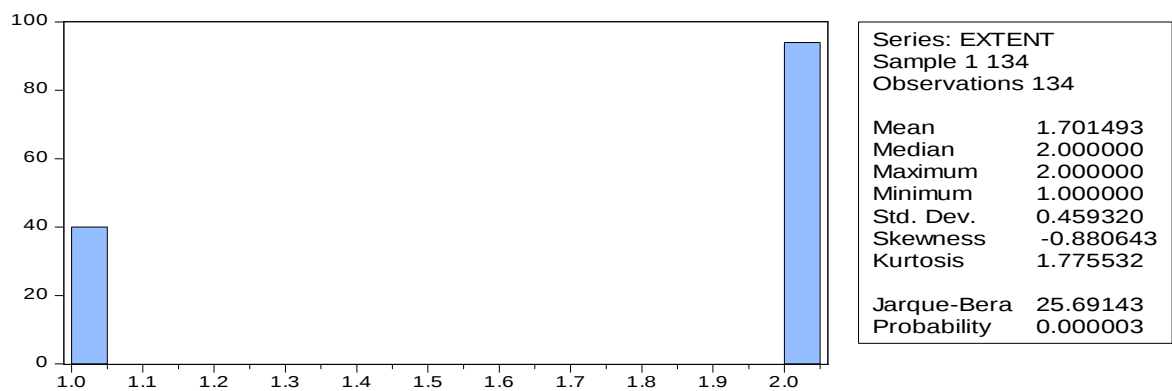


[1 = Once a week; 2 = Once a Month; 3 = Twice a year; 4 = Once a Year]

**Figure 4.4 Frequency of Extension Visits to Farmers in Marigat.**

**Source:** Research Data, 2015

Figure 4.5 exhibits that majority of the farmers did not access extension services (2).

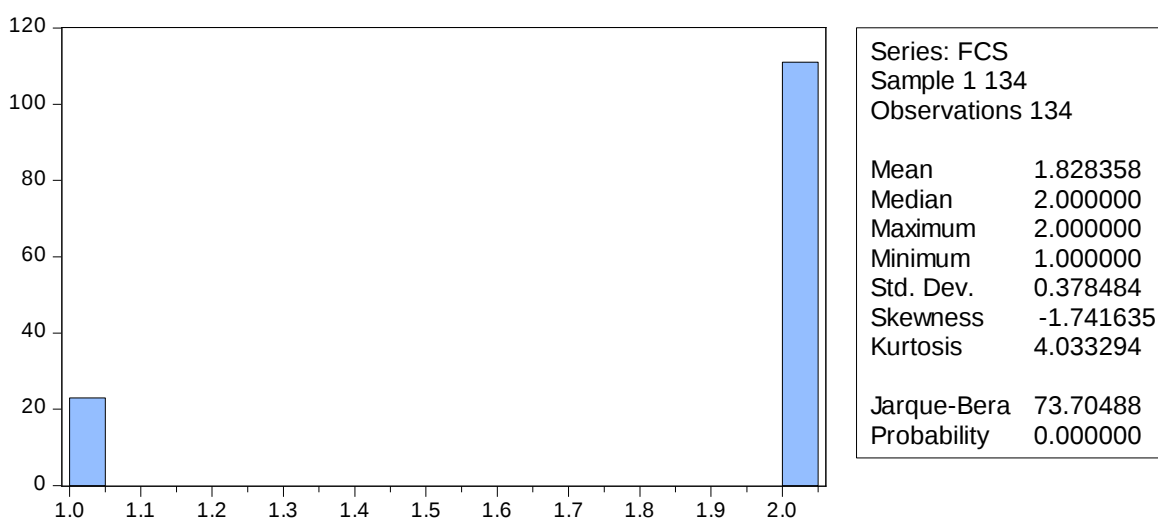


[1 = Access to Extension Services 2 = did not access extension service]

**Figure 4.5 Extent of Government Extension Services in Marigat.**

**Source:** Research Data, 2015

Figure 4.6 displays farmers who are members of cooperative societies in Marigat, Baringo County. The study sought to find out distribution of farmers' membership to cooperative society (1). Majority of the farmers were non-members to cooperative society (2). This was because of lack of information on benefits of being a member to the society.



[1 = Member of Cooperative Society; 2 = Not a member of any cooperative society]

**Figure 4.6 Farmers Membership to Cooperative Societies in Marigat**

**Source:** Research Data, 2015

**4.1.11 Beekeepers Experience**

Result from the distribution of bee keepers according to farming experience shows that farmers with 6 – 10 years of experience constitute the largest proportion (55 percent and 56 percent) of traditional and modern bee keeping respectively. This result shows that large proportion of the bee keepers in the study area had a good experience in bee keeping practices.

**4.1.12 Marital Status**

Distribution of bee keepers according to marital status revealed that large proportions (50 percent) of bee keepers both modern and traditional were married. Result from the distribution of bee keepers' source of labour shows that large proportion of labour source came from both hired and family labour (63 percent and 60 percent) for traditional and modern bee keeping respectively. The distribution of bee keepers according to source of funds shows that large proportion of 75 percent modern bee keeper and 57 percent traditional bee keepers respectively depended on personal savings especially for initial capital. Most bee keepers, modern (75 percent) and traditional (75 percent) hadn't the privilege of being visited by extension workers. This explains why most bee keepers were not well informed on ways of exploiting other potentials of bee keeping such as brand marketing the product and other production intricacies.

#### **4.2 Regression Analysis and Statistical Inference**

Regression results are presented in table 4.1. Results indicated an  $R^2$  of 0.818190 implying that the modeled variables explained 81.8190 of the variation in honey production. The Durbin-Watson statistics was above 1.85 indicating no collinearity in the variables. The overall model was significant F – Statistic 7.470407 with (p – value  $0.0000 < 0.05$ ).

The study sought to analyze the effects of different types of bee hives on quantity of honey produced in Marigat. It was hypothesized that different types of bee hives and beekeeping equipment do not significantly determine honey production in Marigat.

Results indicated that traditional log hive had negative and significant effect on quantity of honey produced ( $p$  – value  $0.0000 < 0.05$ ). This implied that a unit increase in the number of traditional log hives honey production will decrease by -6.959027 units.

**Table 4.1 Regression Results of Honey Production**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Age of Household Head	0.509875	0.107596	4.738775	0.0000
Gender of Household Head	-3.325614	0.513098	-6.481441	0.0000
Marital Status	-0.271688	0.066292	-4.098357	0.0001
Family Size	-0.565502	0.104624	-5.405067	0.0000
Education Level	0.175519	0.036640	4.790411	0.0000
Main Occupation Household Head	-0.722725	0.108336	-6.671113	0.0000
Land Size	1.365542	0.187170	7.295726	0.0000
Land under Crop	-0.760038	0.132765	-5.724700	0.0000
Land under Forest Cover	0.918275	0.140332	6.543585	0.0000
Group Membership	4.424582	0.588111	7.523380	0.0000
Access to Credit	2.692430	0.366438	7.347573	0.0000
Type of Market	-0.431300	0.107300	-4.019564	0.0001
Price of Honey	0.594120	0.144162	4.121206	0.0001
Access to Extension Service	2.146278	0.319943	6.708306	0.0000
Farmer Training Centre	11.72882	1.767008	6.637671	0.0000
Traditional Log Hive	-2.454274	0.352675	-6.959027	0.0000
KTBH	1.906188	0.290941	6.551791	0.0000
Langstroth Hive	2.137773	0.408174	5.237410	0.0000
Beekeeping Equipment	1.832384	0.230397	7.953163	0.0000
Labour Cost	-1.735108	0.241716	-7.178297	0.0000
Capital Cost	-1.115095	0.154023	-7.239773	0.0000
CONSTANT	-14.89673	3.997168	-3.726821	0.0004
FITTED^2	-0.347329	0.049585	-7.004703	0.0000

R-squared	0.818190	Mean dependent var	5.111940
Adjusted R-squared	0.708666	S.D. dependent var	1.510168
S.E. of regression	0.815119	Akaike info criterion	2.711230
Sum squared resid	55.14679	Schwarz criterion	3.814139
Log likelihood	-130.6524	Hannan-Quinn criter.	3.159417
F-statistic	7.470407	Durbin-Watson stat	1.850888
Prob (F-statistic)	0.000000		

**Source:** Research Data, 2015

This is an indication that traditional log hive was associated with high rate of occupation but the quantity of honey harvested from these hives was very low compared with output from other types of hives. KTBH had positive and significant effect on honey production ( $p - \text{value } 0.0000 < 0.05$ ). Therefore if the number of KTBH increases by one unit honey production will increase by 6.551791 units.

There was also positive and significant relationship between Langstroth hive and honey production ( $p - \text{value } 0.0000 < 0.05$ ). This indicated that for a one unit increase in Langstroth hives honey production was expected to increase by 5.237410 units. Results also indicated a positive and significant relationship between honey production and the type of equipment used ( $p - \text{value } 0.0000 < 0.05$ ). It can be inferred that use of modern bee keeping equipments increases honey production. Modern equipments do not destroy honey comb during harvest. From these findings it was concluded that different types of hives determined honey production in Marigat. Therefore based on this finding the first hypothesis was rejected. It was concluded that the types of hives and bee keeping equipment significantly determined honey production in Marigat. These findings are consistent with Vural and Karaman (2010) who found that different type of bee hives and bee keeping equipment were significant determinants of honey production in Saudi Arabia.

The study sought to determine if social factors such as age of the farmer, gender, education level and family size significantly determined honey production in Marigat. Age of the household head was significant and positive ( $p - \text{value } 0.0000 < 0.05$ ). This indicated that age was associated with experience in bee keeping. Education had positive and significant effect on honey production ( $p - \text{value } 0.0000 < 0.05$ ). The possible reason for increased honey production with higher education background could best be that education increases access to information and their knowledge to understand and utilize technology better. The results support earlier studies (Abebe *et al.*, 2008).

The study results shows gender role in beekeeping activities. Results indicated that gender had negative and significant effect on honey production ( $p - \text{value } 0.0000 < 0.05$ ). Results also showed variation in the role of gender. According to the perception of respondents the tasks like colonies replacement and queen rearing were done by males and supplement feeding and pest management tasks were done by females. Similarly colonies replacement and honey extraction were male tasks whereas, supplement feeding, grading/packing and marketing were done by females. A study done in Tanzania showed that beekeeping activities involved both genders at different stages of honey and beeswax processing and marketing. Traditionally, men were responsible for honey harvesting which is normally carried out at night because they are scared of honey bees during the day. Same situation was observed by Qaiser, Ali, Taj and Akmal (2013) in an impact assessment study in Pakistan. Qaiser *et al.*, (2013) concluded that bee keeping was totally gender based activity.



The second hypothesis stated that social factors such as age of the farmer, gender, education level and family size do not significantly determine honey production in Marigat. The results indicated that age of the household head, gender, education level and family size had significant effect on honey production ( $p$  – values 0.0000, 0.0000, 0.0001 and  $0.0195 < 0.05$  respectively). Therefore based on these findings the second hypothesis was rejected and concluded that social factors such as age of the farmer, gender, education level and family size significantly determined honey production in Marigat.

The study determined if institutional factors such as access to credit facilities, access to extension visits, type of market and membership to farmer group significantly determined honey production in Marigat. To achieve this, it was hypothesized that institutional factors such as membership to farmer's group, access to credit facilities, type of market, access to extension services and farmers training centres do not determine honey production in Marigat. Results indicated that access to credit facility had positive and significant effect on honey production ( $p$  – value  $0.0000 < 0.05$ ). It was inferred that for a unit increase in accessing credit increases honey production by 7.347573 units. Access to extension visits was positively and significantly associated with honey production ( $p$  – value  $0.0000 < 0.05$ ). Results also indicated that for a unit increase in access to extension services by farmer honey production was expected to increase by 6.708306 times. Therefore honey production can be increased by increasing the number of extension personnel in the study area. Group membership was positive and significant ( $p$  – value  $0.0000 < 0.05$ ) indicating that honey production was expected to increase by 7.523380 times if group membership increases by one unit. This is an indication that farmers who are members of farmers' group get useful information on honey production. Farmers Training centre's was also positive and significant ( $p$  – value  $0.0000 < 0.05$ ). Type of

market had negative and significant effect on honey production ( $p$  – value  $0.0000 < 0.05$ ). The coefficient indicated that a unit increase in the type of market honey production reduced by -4.019564. This was because most of the farmers in the study area sold their honey to middle men and brokers at low prices. Farmers therefore lack incentives to produce more.

The study examined if institutional factors such as access to credit facilities, access to extension services, group membership, Farmers Training Centre's and type of market determined honey production in Marigat. Results indicated that institutional factors significantly determined honey production.

The coefficient of type of market was negative and significant ( $p$  – value  $0.0000 < 0.05$ ). Price of honey was however positive and significant coefficient ( $p$  – value  $0.0000 < 0.05$ ). Therefore it was inferred that better output price and market information were key incentives for increased honey production and sales. These findings demonstrate the urgent need to strengthen market information delivery systems, upgrade roads in rural areas, encourage market integration initiatives, and establish more retail outlets with improved market facilities in the remote rural villages in order to promote honey production and trade in high value commodities by rural farmers.

From the study findings areas for investment to improve bee-keeping industry in Marigat include: First, provision of improved infrastructure, second processing of honey and its products, Third, Institutional support and technological transfer, fourth, establishment of

quality control inspectorate services and finally value addition through processing and packaging of honey before selling. Distance from farm to point of sale is a major constraint to the intensity of market participation.

The third hypothesis was rejected, therefore it was concluded that institutional factors such as access to credit facilities, access to extension visits, distance to nearest market and membership to farmer group significantly determined honey production in Marigat.

The study sought to determine if there was significant relationship between different types of beehives and equipment and the quantity of honey produced. Results showed that the type of hive used and type of equipment significantly determined the output of honey produced ( $p$  – value  $0.0000 < 0.05$ ). The fourth hypothesis stated that the type of bee hives did not significantly determine honey production in Marigat. Based on the findings of regression analysis this hypothesis was also rejected, therefore it was concluded that different types of beehives and equipment significantly determined honey production in Marigat.

The study also sought to determine if economic factors such as land size, land under forest cover, and income from sale of honey and off-farm income significantly determined honey production in Marigat. Results indicated that land size, land under forest cover and income from sale of honey significantly determined honey production in Marigat ( $p$  – values  $0.0258, 0.000 < 0.05$ ). Based on these results it was concluded that economic factors such as land size, land under forest cover, income from sale of honey and off-farm income significantly determined honey production in Marigat. According to regression analysis this hypothesis was also rejected.

Result of the distribution of farmers according to family size shows that the largest proportion (45 percent and 48 percent) of traditional and modern bee keepers respectively had fairly large families. The result also revealed that the size of family really determines participation in bee keeping both in the modern or traditional technique.

The distribution of bee keepers according to farm size shows that farmers having 5 – 9 hectares constitute the largest proportion (57 percent and 56 percent) of traditional and modern bee keepers respectively (compared to farmers having 10 ha and above). It can hence be deduced that majority of the bee keepers have large land holdings. The reason may be because returns from bee keeping can be used to buy more land which in turn will be used as good site for bee keeping.

The results of regression analysis were consistent with the results of Hetero-Ramsey Reset test jointly. Therefore it was concluded that technological, economic, social and institutional factors jointly determined honey production in Marigat ( $p$  – value  $0.0000 < 0.05$ ).

## **CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS**

### **5.0 Overview**

This chapter deals with summary of findings, conclusions and recommendations.

### **5.1 Summary of Findings**

Different types of hives were analyzed to determine their effect on honey production. Regression results showed that different types of bee hives such as KTBH, Langstroth and Log hive significantly determined honey production. Social factors such as age of the farmer, gender of the household head, marital status, family size, level of education and main occupation significantly determined honey production. Institutional factors such as membership to farmers' group, access to credit facilities, type of market, access to extension services, and training at farmer's training centre's determined honey production. Economic factors such as land size, land under crop, land under forest cover, price of honey, labour cost and capital cost significantly determined honey production.

Beekeepers also faced numerous constraints including inadequate credit, pests and diseases, bee's aggressiveness, environmental degradation, bee absconding, theft, inadequate technical assistance and poor marketing. Some problems in the activities of beekeepers were stated as; deficiency of qualified queen, lack of standards in beehives and materials, using of pesticide, problems in choosing suitable place, inadequate advertising of bee products to consumers and poor marketing channels.

The study therefore calls for Government, NGOs, Commercial Banks and other stakeholders to extend its credit facilities to more beekeepers to increase loan sums and other financial assistances disbursed to beekeepers. Bush clearing through burning of charcoal by the hunters and other forest users during dry season should be discouraged.

## **5.2 Conclusions**

The objectives of this study were to identify determinants of honey production in Marigat. Although involvement of small-scale beekeepers in beekeeping is still at an infant stage, the enterprise showed a great potential in improving livelihoods of farmers. The favourable natural environment and low disease incidence made farmers to be competitive in honey production. Most farmers in the study area used local (Transitional) log hives and further enhanced honey production by using Langstroth because of their high productivity.

The most commonly accepted type of beehive in the region was the traditional log hive. The log hive has been widely accepted in Marigat, but is less productive as compared to the Langstroth hive and Kenya Top Bar Hive (KTBH). It is said to produce between 7 and 9 Kilograms of honey per season which is lower than the Langstroth hive and KTBH which produces over 20 Kilograms and 18 kilograms respectively per season. Generally, the most expensive input in apiculture was cost of hives; it consumed more than 50% of all capital used both in apiculture farming.

The basic target of this study was to determine if there is a connection between old and new types of hives and honey production amount in Marigat and also the socio-economic

analysis of beekeeping in Marigat. According to the econometric analysis results that have been done in this context, while all other variables remain same, 1 percent increase in old type hives will cause a decrease of 2.454274 percent in honey production and 1 percent increase in new modern type of hive will cause a 2.137773 percent increase in honey production. However there were other factors that increased honey production besides from hive types; for example, even though this study empirically determined factors that determine honey production and identified socio-economic factors that determine level of estimated honey production of sampled respondents. The direct variables (inputs), which increased production, were access to credit, advice from extension personnel, age, capital cost, education level, extension visits and membership to cooperative society, land under forest cover and group membership. This implied that the combined effects of the above stated direct variables brought about a substantial increase in beekeeping output in Marigat. This also meant that consistent availability of these inputs will ensure commensurate bee-keeping products in the study area.

Results from socio-economic characteristics of respondents in the study area showed that married men currently dominate honey production. Results also showed that bee-keepers who were bee farmers were more productive than those who kept bees as a secondary occupation. The implication of these results is that increased and sustainable honey production would be achieved through young producers who can devote their full time to honey production since age was positive and significant.

### **5.3 Recommendations**

The following recommendations have been drawn from the study: First there are opportunities to improve livelihoods of smallholder farmers through beekeeping. Farmers

need to gain more knowledge in beekeeping in order to improve honey production. This could be done through special trainings by government extension officers. Training of farmers by Farmers Training centres also need to be intensified. Farmers also need to increase colony size of their beekeeping enterprise and use more of improved traditional log hives, provide grass thatched shelters for Langstroth hive and KTBH or researchers to look for bad conductors of heat and replace the metallic casing used to cover top parts of modern hive because they are not highly productive.

Second, the region should shift from establishing more colonies to replacement of absconded colonies and strengthening existing colonies so that they can yield better results. Third, the beekeepers should be equipped with bee management skills to enable them perform all management activities through use of modern bee equipments.

Fourth, there should be improved extension programmes or organization of co-operatives and training in the use of modern hives and hiving techniques are also required. Fifth, there is need to increase the number of extension personnel in the region as number of beekeepers is high. Proper management practices need to be enhanced and intensified to facilitate production increase per unit; otherwise the viability and potentiality of beekeeping will continue to be a long and endless dream.

Sixth, Government and other stakeholders should consider training bee farmers on personality trait enhancement so as to give them an edge in marketing their products and aggressively seek for financing options.

Seventh, residential training should consider age factors and literacy levels when inviting people for residential training for instance in artisan courses which involves carpentry,



the interest and experience of each beekeeper in that particular subject to be trained must be considered. This will help bee farmers to make improved beehives using available local material.

Eighth farmer to farmer advisory services should be strengthened through promotion of farmers' groups in response to demand for services. The extension personnel should enhance collaborations and work with other stakeholder partners to build their beekeeping capacity and to improve reaching farmers.

Ninth Inter Governmental units should be established to collect data from on-farm research into different aspects of beekeeping in the Kenyan context and share this information with others to fill knowledge gaps in Kenyan beekeeping.

Lastly, although bee-keepers were found to be generally fairly productive, there is room for improvement in use of available resources under a guaranteed and conducive environment. This could be attained through contract production to guarantee market and stabilize price of honey. The environment in essence should guarantee availability of resources (including productivity in increasing inputs), product prices, which do not fluctuate and introduction of modern bee-keeping equipments.

#### **5.4 Suggestions for Further Studies**

This study recommends that private concerns of making improved hive technologies should carry out a study to come up with strategies of lowering cost of hives to enable

more beekeepers to access them cheaply to encourage growth of beekeeping and honey production industry in Marigat Sub County and Kenya at large.

There is need for research on economic impact of honey price fluctuations and failure of women in beekeeping industry to become self-reliant and mitigated high levels of support.

There is need for research to characterize how socio - ecological factors can shape variability in honey bee floral resource abundance and quality across land covers.

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## APPENDIX I

### QUESTIONNAIRE FOR FARMERS

#### **Introduction**

Dear Respondent

I am a postgraduate student at Moi University in the School of Business and Economics, conducting a research on the Analysis of Factors Influencing Honey Production in Marigat, Baringo County, Kenya. This research is part of the Moi University requirement for the award of Master of Science in Agricultural Economics degree. I therefore humbly request your participation and cooperation in filling this questionnaire.

The information is for academic purposes only and will be held with confidentiality it deserves.

You are kindly requested to assist in attainment of the study objectives.

Thank you in advance for the assistance.

**Kindly tick where appropriate (√).**

#### **(1) Personal Attributes**

- i). Name of the Respondent (Optional) .....
- ii). Sub County .....
- iii). Division .....
- iv). Location .....
- v). What is your age .....
- vi). Gender of head of household: (a) Male [ ] (b) Female [ ]
- vii). Your relationship to the household head: Spouse [ ] Child [ ] Servant [ ]

viii). Marital Status: Married [ ] Single [ ] Widow [ ] Widower [ ] Divorced [ ] Separated [ ]

- ix). Family Size .....
- x). How many dependants were living with you in the last one year .....
- xi). Highest level of education: Pre-Primary school [ ] Primary school [ ] Secondary

school [ ] College [ ] University [ ]

**(2) Socio-Economic Factors**

- i) What is your main occupation?

Civil servant [ ] Self Employed [ ] Farmer [ ] Businessman/woman [ ] Unemployed [ ]

- ii) If you are a farmer, what farming activities are you engaged in? Cattle rearing  Goats/Sheep rearing  Bee Keeping  Agricultural crops  Fishing  Poultry  Others
- iii) How many of the following livestock do you own? Cattle  Goats/Sheep  Poultry  Beehives
- iv) What is the size of your land in acres.....
- v) What size of your land in acres is under Cattle/Goats/Sheep/Poultry.....
- vi) What size of your land in acres under crop production .....
- vii) What size of your land in acres under forest cover for bee forage .....
- viii) If you don't have land under forest for beekeeping practice, where do you place your bee hives? Government forest  Private forest
- ix) How long have you been practicing bee keeping (years)
- x) Who harvests your honey? Yourself  Family members  Hired Worker

- xi) Are you a member of any group that engages in bee keeping? Yes  No
- xii) If Yes, describe the type of activities that you do together as a group

.....

- .....
- xiii) Land utilization in acres to: a) Grazing land ..... b) Cultivated land ..... ..  
 c) Forest cover..... d) others.....

### **3.0 Institutional Factors**

- i. Do you use credit in your bee keeping business? Yes  No
- ii. If yes, where do you access beekeeping credit from? Government Institutions   
 NGO  Commercial Banks  Microfinance institutions  Cooperatives
- iii. Where do you sell your harvested honey? Local brewers  Consume locally at  
 home  Roadsides sales  Sale to organized groups  Sale to value addition  
 plant

On average, what is the price per kilogramme per year of honey? Kshs.....

iv)What was average price per kilogramme per year of honey one year ago? Kshs

v) Is there Government Extension services guiding you on the best beekeeping practices? Yes [ ] No [ ]

vi) If yes, how frequent do they visiting your beekeeping farm? Once a week [ ] Once a month [ ] Twice a year [ ] Once a year [ ] other's specify [ ]

- vii) How do you rate the advice given? Not useful  Useful  Difficult to understand  
 Very useful



- viii) Did you attend beekeeping training at Farmers Training Centre (FTCs)? Yes [ ]  
No [ ]
- ix) If yes, was the training beneficial to you? Not useful [ ] Useful [ ] Difficult to  
implement [ ] Not difficult to implement [ ]
- x) Are you a member of Farmer Co-operative Society? Yes [ ] No [ ]
- xi) If yes, how beneficial is it to you?  
Very beneficial [ ] Not beneficial [ ] Beneficial [ ]

#### (4) Technological Factors

- (i) What type of hives do you have? Traditional log hives [ ] KTBH [ ] Langstroth  
hives [ ] others specify .....
- (ii) How many hives do you have of the following? Traditional Log hives [ ] KTBH [ ]  
Langstroth hives [ ] others [ ]
- (iii) Where do you obtain your bee keeping equipments? Make them myself [ ] Buy from  
neighbours [ ] Donated by NGO [ ] Donated by the Government [ ]
- iv). How much do you spent harvesting honey per year on average on: Traditional Log  
hives Kshs [ ] KTBH Kshs [ ] Langstroth hives Kshs [ ]  
On average, how much Capital did you spent on bee farming on the following hives:  
Traditional log hives Kshs [ ] KTBH hives Kshs [ ] Langstroth hives Kshs [ ]
- vi) What type of hive do you prefer? Traditional log hives [ ] KTBH hives [ ]  
Langstroth hives [ ]
- vii) Why do you prefer your choice of hive? Very high yielding [ ] High occupation  
rate greater than 70% [ ] Low temperatures for bees [ ]
- xii) What problems do you encounter with your hives? Bee Pests and disease [ ]  
High temperature caused by iron sheet top cover leading to low occupation of  
the modern improved hives [ ] Frequent droughts [ ] Environmental  
degradation

others (specify)

viii) Why do you prefer bee keeping? None application of agro-chemicals

Favorable climatic conditions  Abundant natural flora

ix) What is the occupation rate of bees in your farm with the following hives?

a) Traditional Log Hives: 1) Less than 30%  2) Between 30% - 70%

3) Greater than 70%

b) KTBH Hives: 1) Less than 30%  2) Between 30% - 70%  3)

Greater than 70%

c) Langstroth Hives: 1) Less than 30%  2) Between 30% - 70%  3)

Greater than 70%

d) Others 1) Less than 30%  2) Between 30% - 70%  3) Greater than

70%

x) How many times in a year do you harvest your honey? a) Once  b) Twice

c) Three  d) Four

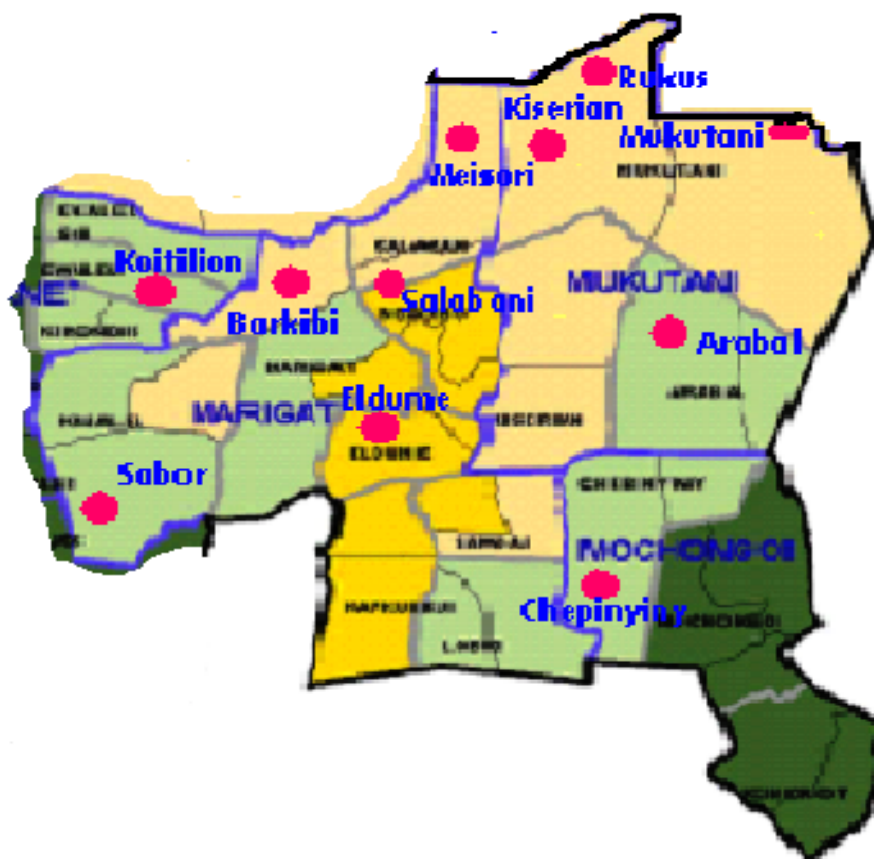
a) On average, how many kilograms of honey per hive per season did you

harvest from: Traditional log hive ..... KTBH

hive.....





Langstroth hive ..... Other hives .....

**APPENDIX II:  
MAP OF MARIGAT, BARINGO COUNTY LIVELIHOOD ZONES**







### Legend

#### Administrative Boundary

-  District Boundary
-  Division Boundary
-  Location Boundary
-  Sub Location Boundary

#### Livelihood Zones

-  Agro-Pastoral
-  Irrigated Cropping
-  Mixed Farming
-  Pastoral

