KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

KUMASI, GHANA

Value Chain and Economic Analysis of Honey Production in Nkwanta North and South Districts of the Volta Region

by

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BSc. (Hons) Agriculture Technology

A Thesis Submitted to the Department of Agricultural Economics,

Agribusiness and Extension, College of Agriculture And Natural Resources

in Partial Fulfilment of the requirements for the degree of

MASTER OF PHILOSOPHY

in

AGRICULTURAL ECONOMICS

NOVEMBER, 2015

DECLARATION

I, Jakpa Mamebi Moses, author of this thesis titled "Value chain and economic analysis of honey production and distribution in Nkwanta North and South Districts of the Volta Region" do hereby declare that this submission is my own work towards the MPhil and that, to the best of my knowledge, it contains no material previously published by another person, nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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DEDICATION

I dedicate this work to Almighty God for my life and my loving family for the support throughout my education.

ACKNOWLEDGEMENT

I am very thankful to God for the wisdom and uncommon favour in my professional and academic carrier. I also acknowledge some deserving personalities who in diverse ways contributed to the success of this research work.

First of all, I greatly appreciate the patience, time, constructive criticism and contribution of my supervisor Dr. Kwasi Ohene-Yankyera. He has not only given academic guidance but, has also imparted to me the spirit of determination, confidence and independence.

I am most grateful to the Head of Department; Dr. Dadson Awunyo-Vitor, my Internal Examiner; Dr. Robert Aidoo and the entire staff of Agricultural Economics Department for their invaluable suggestions that resulted to the successful completion of this research work. I also acknowledge the work of Oku Kojo George for reading through the work for the necessary corrections.

My profound gratitude goes to my loving brothers, Yaw-Kumah Findi and Alexander Kwame Takri for their financial support and advice. My deepest personal appreciation goes to David Zigah Esela, Bertrand Yosangfo, Musah Labaran and Latif Apassongo for their continuous encouragement during the investigation process.

Finally, I am highly indebted to my wife; Aurelia Boakye-Ansah and my two kids Caroline Findi and Prince Findi for the sacrifice and spiritual support in prayers during the academic and research work.

ABSTRACT

This research analyzed the honey value chain in Nkwanta North and South districts of the Volta region of Ghana with focus on the return on investment (ROI) and major constraints in the beekeeping business. A total of 20 beekeeping communities were purposively selected and 200 beekeepers chosen by systematic sampling method. Snowball sampling method was used to select 50 brokers, 40 wholesalers and 60 retailers totaling 350 respondents. SPSS and Excel were used to analyze the data. The results showed that about 70.6% of the respondents were males. The average age was 40.7years with household size of 5.64 and about 61.1% had formal education. Respondents who were trained in beekeeping business represented 60% with 1-5years experience in beekeeping and 64.3% were members of beekeeping associations. The major actors in the honey value chain were producers, processors, brokers, wholesalers and retailers. Four honey distribution channels were identified but major quantity of honey passed through herbal medicine (38%) and about 54% of the beeswax was used for baiting honeybees. Five marketing channels were identified but about 35% of bee products were mostly sold to wholesalers. The study identified three major types of beehives: clay-pot, KTBH and Langstroth but the common type was KTBH (84.5%). Langstroth hive was more productive with an average annual quantity of 18.70kg per beehive per season. Comparison of yield difference between Langstroth and KTBH was significant at 1% level which means the type of beehive used by beekeepers contributed to the honey yield difference. Economic analysis of beehive types showed that it was more profitable producing with Langstroth hive than KTBH with TR of GH₵122.59, NP of GH₵96.09 and about 362% ROI per hive per season which was also significant at 1% level. Also, producers whose raw material was comb honey obtained higher ROI of 128% compared to processors (53%), wholesalers (23%) and retailers (26%) which was significant at 1% level. The honey value chain was governed by non-codified type of information (62%) where buyers only communicated the requirement to suppliers but did not share the cost of upgrading producers' skills to meet the requirements. The most encountered constraints during honey production using Kendall's Coefficient of Concordance were lack of finance for expansion followed by lack of technical assistance with 68% agreement at 1% significant level. The most encountered marketing constraints were competition from imported honey followed by lack of proper records on marketing of bee products with 56% agreement at 1% significant level. The study therefore recommends an increase in supply of Multy-chamber Langstroth hives, capacity building in the use of centrifugal extractors for processing to ensure honey production in both major and minor seasons and the buying of honey combs directly at the farm gates to increase actors' returns on capital investment.

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LIST OF ACRONYMS

MEANING	ACRONYMS
Acquired Immune Deficiency Syndrome	AIDS
Adventist Development and Relief Agency	ADRA
Fixed-Comb Hive	FCH
Food and Agriculture Organization	FAO
Foreign Investment Advisory Service	FIAS
Ghana Statistical Service	GSS
Heifer Project International	HPI
Human Immune Virus	HIV
Institute of Agricultural Research for Development	IARD
Kenyan Top-Bar Hive	KTBH
Kwame Nkrumah University of Science and Technology	KNUST
Ministry of Food and Agriculture	MoFA
Movable Frame Hives	MFHs
Mud-Block Hive	MBH
Multi-Chamber Hives	MCHs
Non Governmental Organization	NGO
Non Traditional Forest Products	NTFP
Nkwanta North District	NND
Nkwanta South District	NSD
Return on Investment	ROI
Single-Chamber Hives	SCHs
Statistical Package for Social Sciences	SPSS
Stichting Nederlandse Vrijwilligers	SNV
Tanzanian Top-Bar Hive	TTBH
Technology Consultancy Centre	TCC
Technology in the Service of mankind	TechnoServe
Value Chain Analysis	VCA
Wildlife Division of Forestry Commission	WDFC
Women and Development Project	WADEP

CHAPTER ONE

INTRODUCTION

1.1 Background of honey production from Beekeeping

Over the years African governments have laid emphases on the promotion of various types of small-scale income generating activities to create jobs for the people (Oluwatusin, 2008). The need to solve unemployment situation in Ghana and improve the standard of living by increasing the income level of the populace had led to the promotion of various types of small-scale income generating activities such as beekeeping (Abdulai et al., 2012). According to Paterson (2006), beekeeping is a sustainable form of agriculture that can provide rural people with a source of much-needed income and nutrition and with advanced apicultural skills and equipment the beekeepers can produce a wider range of bee products such as honey, beeswax, propolis, pollen, venom, and bee brood. The technological evolution of beekeeping is the keeping of bees in “traditional” hives made of any kind of suitable, locally available material such as mud, clay, tree trunks, bark of tree, straw and gourds (Krell, 1996). The more intensive beekeeping practice in recent times is based on Movable-Frame Hives (MFHs) and virtually all honey in the international market still comes from this type of beekeeping (Paterson, 2006).

The industry that began in Ghana as traditional honey hunting from wild colonies before 1979 has largely been replaced by beekeeping (Aidoo, 2005; Paterson, 2006). As a result, the total honey yield has increased over the years from 236,795kg in 2007 to 428,836kg in 2008 and total beewax yield from 34,552kg to 60,031kg with corresponding total farm gate income from US$619,455 to US$1,076,378 during the same period (Akangaamkum et al., 2010). This is because Ghana’s agro-ecological conditions are considered suitable for the production of honey and in the transitional zones which includes Nkwnata North and South Districts of the Volta Region; higher honey production has been recorded with 34kg per beehive per annum as compared to the national average yield of 14kg per beehive per annum (Ahmed, 2014).

Beekeeping sector is therefore worthy of an in-depth study due to its economic and ecological importance to the people. For economic benefits, beekeeping serves as one of the possible options to the small-holder farmers in sustaining their livelihood through the use of honey as food and for income (Nuru, 1999). Honey which is the major product from beekeeping is not only useful as food supplement (Krell, 1996), it is now increasingly being used in the treatment of various diseases such as wound dressing (Ankra, 1992; Molan, 1992; Cooper et al., 1999; Molan, 2001; Ige, 2010; Molan, 2012). Pollen and its analysis in honey is of great importance for quality control and helps to ascertain whether honey is adulterated or not (Lieux, 1981; Barth, 1990; Kerkvliet et al., 1995; Terrab et al., 2003; Ohe et al., 2004). In 2008 the average contribution of honey production to a beekeeper's annual income in Ghana was about 23% (Akangaamkum et al., 2010) and by 2009 the overall household income to families involved in the honey sector was about 37% (Nyntsikor, 2009). In 2014 the return on investment analysis on beekeeping in part of Ghana was 281% demonstrating the profitability of the sub-sector (Ahmed, 2014).

Ecologically, bees are important pollinators and are known to be useful in helping fallow plots regenerate and increase yields of various food crops. Studies have established that the average raw cashew nut yield per tree per season increased from 4.2kg to 9.1kg representing 116.7% in Ghana and from 2.16kg to 6.75kg which is also about 212.5% in Benin as a result of pollination by honeybees (Adzanyo and Andre, 2012). There is also ready market both locally and internationally for bee products with underlying market opportunities given to producers to explore (Paterson, 2006). Even though there is little emphasis on the production of beeswax and other by-products in the country because the domestic market is underdeveloped, beeswax alone has over 120 industrial uses with ready markets in Ghana and abroad (Nyatsikor, 2009). In 2011 the European Union (EU) certified Ghana to join other African countries accredited to export honey to the EU market (Ahmed, 2014). This implies that the international market for honey is expanding and Ghana is expected to meet the supply gap by increasing the volume of trade and quality of production.

However, the type of beehives used in honey production and methods of harvesting, processing and packaging play a vital role in the quantity and quality of honey. According to Aidoo (2005), the quality of honey on the Ghanaian market has a direct relationship with the source of production (from wild hunters or beekeepers) and method of extraction that is either traditional or modern methods. Abdulai et al. (2012) reported that Ghana depends mostly on importation of honey from other countries to meet domestic demand because the locally produced honey was of poor quality and sometimes adulterated as a result of the crude harvesting techniques. An investigation of the honey sub-sector based on the value chain and economic analysis was relevant to ensure efficient production and marketing of bee products for higher returns on actors' investment.The value chain analysis (VCA) is a method for accounting and presenting the value that is created in a product or service as it is being transformed from raw inputs to final product consumed by end users (FIAS, 2007). VCA evaluates which value each particular activity adds to a product and not just a random compilation of machinery, equipment, people or money but the arrangement into systems to produce something for which customers are willing to pay a price (Porter, 1990). VCA assesses the factors influencing honey industry performance, access to markets and the requirements of end markets (Porter, 1985).

1.2 Problem Statement

In recent years there has been increasing interest in the development of beekeeping projects in areas with production potential for honey and other bee products. Therefore, beekeeping sector has been identified by several development organisations in the country as one of the agricultural sub-sector with the potential for high income and employment generation for poverty reduction. One example is the Ghana Office of SNV; Netherlands Development Organisation that provides beekeepers with financial, advisory or technical support to implementing organizations in poverty alleviation (Subbey, 2009). The Technology Consultancy Centre of KNUST also played a leading role through improved beekeeping by introducing the Kenyan Top-Bar Hive in Ghana (Aidoo, 2005). The interventions in the honey value chain sought to increase production, income and employment levels through job creation. Indeed, records have shown that the yield and income levels of actors have increased significantly over the years in some areas of the country. With technical assistance from Farm-Serve Africa, the beekeepers in Tamale made remarkable harvest with improved beekeeping methods which increased their incomes by 50% during the long dry season in 2000 (Conrad, 2003).

However, the capacity of beekeeping to generate high incomes and ensure sustainable employment among the rural population in Ghana for poverty reduction has fallen short of its potential. A survey on the Ghanaian market in Accra recorded about 7 made-in-Ghana honey brands against 18 imported brands even though the Ghanaian ones were less expensive (SNV, 2006). Analysis of the demand and supply relation indicates an excess demand over supply in the main consuming markets in Ghana (Akangaamkum et al., 2010). An export order of 1000tonnes of honey per annum could not be met meanwhile 30tonnes was imported into the country annually (Nyatsikor, 2009). This is because the traditional type of beehive technology used for honey production is not efficient in sustaining continuous and high honey production due to minimal protection from wind, rainfall and invaders such as ants resulting in low yield and poor quality (Paterson, 2006). Honey market is rather more dependent on the quality of the product offered to consumers (Paterson, 2006). Akangaamkum et al. (2010) reported that excess demand for imported honey could be accounted for by several factors including lack of market information; weak rural-urban linkages, poor rural infrastructure and the general perception of the poor quality of locally produced honey contributed to low competitiveness. Krell (1996) found out that different management and harvesting techniques can influence the final quality of honey which can lead to contamination. Early harvesting can affect the moisture content of honey due to immature comb thus reducing the market value of bee products (Krell et al., 1988). Filtration by gravity and dripping methods of processing leads to higher moisture content whilst hand pressing method results in cloudy honey (Marieke et al., 2005b).

A study on the honey industry in Ghana have shown that there was a general lack of information on the sub-sector with regards to production, income and employment levels in the Volta Region from 2004 to 2008 including the study area (Akangaamkum et al., 2010). This poses a challenge in accurately assessing the impact the honey sector contributes to actors in the value chain in terms of returns on capital invested and to national development. An economic analysis using value chain approach to such an important sector like beekeeping was necessary to provide information on the costs and returns on investment of actors and strategies for upgrading of the value chain to ensure efficient production and marketing of products for the benefit of all actors in the industry. Therefore the main research question was: how could the performance of the major actors in the beekeeping sector be enhanced through upgrading of the value chain and addressing constraints faced by actors in the industry? Specifically: How is the honey value chain mapped and governed? Which beehive types and technology are used in honey production? Is there any significant difference in yield of beehive types and return on investment of actors? What feasible upgrading strategies are available for improving actor's performance to address their constraints? The answers to these questions were what the study sought to find.

1.3 Main Objective

The main objective of this study was to analyse the honey value chain and evaluate the costs and returns on investment of value addition in the beekeeping industry.

The specific objectives of the study were:

1) To develop a map of the honey value chain and find out the distribution channels.

2) To investigate the technology used in honey production along the value chain.

3) To estimate annual yield of beehive types and evaluate costs and returns on investment.

4) To study information governance and feasible upgrading strategies in the chain.

5) To analyse the major constraints faced by value chain actors in the honey industry.

1.4 Central Hypothesis

The central hypothesis of this study was that beekeeping is profitable and the performance of beekeepers could be enhanced through upgrading of the value chain and addressing the constraints faced by major actors.

Table 1.1: The specific hypotheses of the study

HYPOTHESES	SOURCE
Profitability in value addition is higher when the raw material is comb honey than when the raw material is processed honey.	Malaa et al. (2004)
It is more profitable to produce honey with Langstroth hive than Kenyan Top-Bar Hive.	Oluwatusin (2008)
The technology used in the value chain has a direct impact on possible upgrading strategies.	Rutgers (2010)

Source: Survey data, 2012.

1.5 Justification of the Study

African economies are increasingly confronted with changing food and commodity markets, due to globalization, trade liberalization and urbanization with changing consumer preferences (Hoeffler, 2006). This poses new opportunities but also challenges to small-scale producers, traders and processors along the agricultural value chains. The value chain is increasingly seen as an important development framework with upgrading as an instrument for improving value chain performance (Hoeffler, 2006). The 2000 World Bank report indicated that one of the measures which offer promising opportunities for accelerated rural growth and poverty reduction is to focus on value addition for wider market accessibility. The value chain analysis has considerable merit in highlighting the constraints at each stage of value addition and can thus be used to develop integrative policy recommendations that could address the constraints along the value chain. Busch (2000) opined that the increased focus on product safety and quality attributes has served to enhance the role of process standards which is often a key vehicle for product differentiation. This is because honey trade is significantly being influenced by food quality standard requirements and the determinants of the volume of trade in honey and its by-products especially in the developed countries (Hoeffler, 2006). Therefore, the future of honey in international trade is tied to the development of good quality honey for exports through value chain studies (Hoeffler, 2006).

The result of the study was expected to provide information on key indicators which would guide the partners in the development of appropriate interventions and strategies for the honey value chain as well as provide benchmarks against which the impact of intervention programmes could be measured. Small business opportunities could be created for non-beekeepers to improve their household income. This is because a profitable beekeeping enterprise according to Paterson (2006) has a knock-on effect on the wider community including people who trade in bee products and equipment. The work also adds to the knowledge on the application of value chain and economic analysis to beekeeping sector in Ghana and serves as reference material for other researchers and a basis for further research in the honey industry.

1.6 Scope of the Study

This study focuses on the application of value chain analysis in honey production based on the four main dimensions described by Gereffi and Korzeniewiz (1994) as input-output structure, geographical territory covered, governance and institutional framework. The input-output structure involves the backward supply of inputs to beekeepers and how those inputs are used efficiently to obtain outputs. The geographical coverage focuses on mapping the value chain, identifying the major actors and value-adding activities undertaken at each step. The institutional framework specifies the local, national and international conditions that shape each activity within the value chain. Governance explains the power relationships that regulate quality standards through information flow along the chain.

1.7 Orgaisation of the Study

This research work is divided into five chapters. The first chapter deals with introduction, problem statement, the objectives, scope of the study, hypothesis and justification of the study. The second chapter involves the review of literature from related research works by other writers on honey production and value chain analysis. The third chapter deals with the study area and the methodological approach to the study which includes the types and sources of data, questionnaire design, sampling technique and size and the methods used to analyze data. The fourth chapter presents the results and discussions of the empirical research. The fifth and final chapter draws conclusion from the study and recommendations for upgrading of the honey value chain and suggestions for further research in honey production.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this chapter, the debates and issues discussed in relevant literature and references to key articles, journals and related books concerning honey production from beekeeping, value chain and economic analysis in the world, Africa and Ghana was reviewed. The chapter is divided into three parts with the first part introducing the meaning and development of beekeeping. The second part deals with the theoretical framework of value chain analysis whilst the final part concerns the factors influencing industry performance and constraints of the honey sector.This helps to understand the present state of honey value chain in the study area and enables the synthesis of results so that meaningful conclusions and recommendations could be made based on key findings.

2.2.1 Meaning and Development of Beekeeping

Apiculture is the practice of beekeeping (Paterson, 2006). Beekeeping can generally be defined as the practice of keeping and managing bees in colonies for honey and wax production, pollination of flowering plants and for recreational and other economic purposes (Oluwatusin, 2008). Bees are insects in the order Hymenoptera and the family Apidae and have been classified worldwide into two identifiable species as stingless bees (meliponini) and *Apini* for the stinging bees (Karikari and Kwapong, 2007; Kwapong et al., 2013). The stingless bees are the European honey bees known as *Apis cerana* (Cairns, 2002; Smith, 2003). Africa is the original home of the stinging bees referred to as *Apis mellifera* (Paterson, 2006). Bees are known as “golden insects” as their products such as honey, beeswax, propolis and royal jelly are relatively non-perishable and very useful to man (Maurice, 2006).

According to Tessega (2009), beekeeping which is today practiced over a greater area of the earth's surface passed through three different stages of development. It started from honey hunting for wild colonies based on local knowledge with product orientation largely for home consumption as food, drink and medicine. The second stage was traditional beekeeping (forest and backyard) based on extension supported beekeeping mainly to increase honey production as a contribution to food security with less emphasis on the quality of marketable products. The third stage was improved or modern beekeeping based on integrated and innovative knowledge and beekeeping management interventions with emphasis on improving the quality of market-oriented products along the value chains. These developments were based on the levels of beekeeping knowledge, investment, product orientation and the types of beehives or technology developed at each stage of the beekeeping activities (Meaza, 2010).

2.2.2 Technology in Beekeeping

The technological evolution of beekeeping relates to the types of beehives used in honey production (Subbey, 2009) and the management techniques employed by producers. Beekeeping properly started in Ghana like any other place when people realized that the hunting for honey from the wild colonies was not sustainable so various technologies were adopted to sustain the industry. Therefore, producers learned to safeguard the bee colonies found in hollow tree trunks or rock caves with some amount of care and supervision (Crane, 1992). This practice resulted in traditional beekeeping using traditional hives made from the locally available materials such as straw baskets, logs, remnants of clay pots and hollowed-out gourds (Krell, 1996; Oluwatusin, 2008). These hives are classified under the fixed comb hives (FCHs) and either hanged from the branches of trees in the forest or entirely open hives with combs drawn down from tree branches resulting in backyard and forest beekeeping methods (Fichtl, 1994). The FCHs, so called because honey combs are attached to the top and sizes of hives and the beekeeper cannot remove and replace them therefore they are referred to as primitive form of beekeeping since only one end of the hive such as the clay pot hive could be opened (Tessega, 2009). FAO (1986) reported that of all the regions considered, tropical Africa has the oldest tradition of beekeeping still with primitive beehives.

The transitional system of beekeeping is intermediate between traditional and modern beekeeping methods (Segeren, 1995; Nicola, 2002) and referred to as Moveable-Comb Hives (MCHs).The type of beehives used under this technology include: Kenya top-bar hive (KTBH), Tanzania top-bar hive (TTBH) and Mud-block hives (MBH).The idea behind the design of top-bar hive was to allow individual combs to be removed, inspected and returned to the hive without disturbance to the honey comb. It is named KTBH because it was further developed in Kenya during the Oxfam Beekeeping Pilot Project in 1967 as an improvement of the traditional log hive type after it was pioneered at Sparsholt College in England (Paterson, 2006).

The modern system of beekeeping is the keeping of honeybees in Moveable-Frame Hives (MFHs) such as Dandant, Zander and the Langstroth hives (Tessega, 2009). Although MFHs are recommended for experienced beekeepers that want to optimize honey production, the KTBH has proved to be most suitable because of its low cost and the fact that the beekeepers or local carpenters can easily construct (Tessega, 2009).The various types of beehives are designed as either Single-Chamber Hives (SCHs) or Multi-Chamber Hives (MCHs) based on acquired knowledge (Paterson, 1988). The SCHs consist of only one unit in which bees maintain their brood nest and honey stores. MCHs on the other hand consist of more than one unit; the additional units, known as chambers, boxes or supers, are intended for either brood or honey. Assefa (2009) however stipulated that African honey is mostly gathered rather than produced. This means that private sector modern beekeeping with Langstroth hives and inputs including out of season feeding and use of disease prevention measures is largely unknown in sub-Saharan Africa. Migratory beekeeping is the basic technology in production which involves movement of colonies of beehives for better forage in honey production, for crop pollination and to protect bee colonies from certain seasonal diseases (Nuru, 2002). Harvesting technology involves the timing of harvest preferably to as late as possible especially until after the end of the honey flow (Marieke et al., 2005a). Centrifugal honey extraction method is the modern technology in processing honey where the empty combs can be returned into beehives for another production season to begin (Marieke et al., 2005b).

2.2.3 Honey Production Trend

According to Addaquaye (2006) in Akangaamkum et al. (2010), the global honey production has been increasing steadily over the years until recently when production in leading continents began to stagnate due to changing weather conditions and the emergence of bee diseases, but the world honey production is currently estimated at 1,394,000mt and growing between 2% and 3% per annum. Records on productivity in beekeeping throughout the world showed that production per hive is very high in countries with developed apiculture industry. Although, average honey production per hive is 20 kg throughout the world, countries like China (33kg), Argentina (40kg) Mexico (27kg), Canada (64kg), Australia (55kg) and Hungary (40kg) have very high production per hive Akangaamkum et al. (2010).The leading world producer of honey is China (267,000mt) followed by USA (110,000mt) and Argentina with 98,000mt (Aidoo, 2005). However, at the continental level Asia and Europe produce 60% of the world's honey (Akangaamkum et al., 2010).

Ghana's agro-ecological conditions are considered suitable for the production of honey in all regions especially the West African honeybee; *Apis mellifera adansonii* which is better adapted to the tropical conditions of the country (Akangaamkum et al., 2010). Since 1970, significant strides have been made by NGOs in the honey sub-sector through various interventions like the introduction of modern beekeeping technologies, training and the provision of beekeeping equipments. Therefore, the number of people involved in modern beekeeping has been improving resulting in an increase in the quantities of honey production. Akangaamkum et al. (2010) have reported that honey production in Ghana has been increasing over the years from 236,795kg in 2007 to 428,836kg in 2008 and total beeswax production also increased from 34,552kg to 60,031kg during the same period with about 52,883 beehives. Subbey (2009) has also observed a general increase in the farm gate price of honey per gallon in all the regions investigated in Ghana (Ashanti, B/A, Northern, Upper East and West) from GH₵18.00 in 2005 to GH₵20.00 in 2006, GH₵22.00 in 2007 and GH₵24.00 in 2008. The total farm gate income from honey production also increased from US$619,455 in 2007 to US$1,076,378 in 2008 (Akangaamkum et al., 2010). As a result, average contribution of honey production to beekeeper's annual income increased from 23% in 2008 to about 37% in 2010 (Nyatsikor, 2009; Akangaamkum et al., 2010)

2.2.4 Related Studies on Honey and Wax Production from Beehive Types

It is argued that the traditional beehives are not efficient in sustaining continuous and high honey production due to minimal protection from wind, rainfall and invaders such as ants and lizards which steal and kill the bees and though the cost of such hives is low, productivity is also low with less than 13kg of honey per annum (Paterson, 2006). Therefore, honey from traditional and top-bar hives is reported to have higher moisture content than honey collected from improved beehives (Tessega, 2009). A report on national honey production in Ethiopia is estimated at an average of 8.94kg of honey and 0.95kg wax per hive per year (Tessega, 2009) and an average of 6kg per hive/year is reported by Assefa (2009). The annual average honey yield from the Volta Region of Ghana was 4kg per beehive whilst the national average yield per beehive in Ghana was estimated at 14kg per/hive/annum (Akangaamkum et al., 2010). Subbey (2009) in a study of the honey industry in Ghana reported that a beekeeper using one hive with extractors and beekeeping equipment would obtain 3 gallons (21kg) of honey from the second year but no reference was made to any specific beehive type. The design of KTBH is relatively simple with lifespan of 20 years and production between 20-26kg of honey per year in an ideal condition (Paterson, 2006). An average amount of 10.66kg per hive/year of crude honey is estimated and 8% of beeswax/kg of honey from KTBH in Ethiopia (Tessega, 2009). An annual estimated honey production capacity per KTBH in Ghana is 21kg and 2.6kg beeswax (Akangaamkum et al., 2010) and 34kg/beehive in transitional zone (Ahmed, 2014).

The Langstroth hive is similar to the KTBH except that instead of top-bars there are frames in which bees build their combs hence the name Movable-Frame Hive (MFH). The MFHs are the most advanced hive design that is used in large-scale commercial beekeeping throughout the world (Assefa, 2009). The national estimated average yield of pure honey from MFH in Ethiopia is 19.92kg per hive/year and the amount of beeswax produced is 1-2% per kilogram of honey yield (Gezahegne, 2001). An annual estimated production capacity of 35kg per hive/annum is reported in Ghana (Akangaamkum et al., 2010). The MFHs employs appropriate materials and used higher level of technology in larger colony management that could give higher yield and quality honey. They also require high investment cost and trained man power and are recommended for experienced beekeepers that want to optimize outputs. Tessega (2009) suggested that an intensive training is needed for beekeepers with no formal education before distributing movable frame hives. Adjare (1990) however, argued that for technical and economic reasons, most African countries are not yet in the position to use MFHs and for them KTBHs are the best alternatives.

2.2.5 Harvesting of Bee Products

The honey combs need to be harvested before bees consume them for further colony development but sufficient quantities have to be left to provide for the basic needs of the colony. According to Marieke et al. (2005b), beekeepers who want to harvest beeswax as well need to leave a strip of 1cm on the top-bar or frame as a foundation comb for the colony but if producers want only honey then centrifugal honey extractors are used. Krell (1996) noted that different management and harvesting techniques can influence the final quality of honey. For instance, the timing of harvest could affect the moisture content of honey due to immature comb thus reducing its market value (Krell et al., 1988). For good quality honey and to promote further development of a bee colony, one should leave harvesting to as late as possible especially after the end of the honey flow. At this point in time there is less brood in the honey combs to increase the moisture content (Marieke et al., 2005a). Bad management practices such as excessive or inadequate use of smoke during harvesting would give honey a smoky odour resulting in contamination of honey comb with microscopic soot (Krell, 1996). Therefore, the harvesting methods involves the use or without the use of smokers in harvesting honey combs. After comb harvesting the next step that precedes honey processing is the comb selection referred to as sorting. This involves eliminating the pieces of comb with pollen, bee brood and the removal of life bees from the ripe honey comb.

2.2.6 Processing of Bee Products

Honey processing begins with uncapping of honey comb which consists of the removal of the thin wax layer that seals the honey cells. Processing proceed by breaking the honey combs into smaller pieces and placing them in a container for honey to drip through a medium leaving the wax behind. The separation of honey from wax is a method commonly referred to as extraction (Marieke et al., 2005a). The various methods available for extraction of honey during processing are filtration by gravity, hand pressing, machine pressing radial and centrifugal extractors. The best for quality honey is to extract the fresh honey as soon as possible after collecting the combs from the beehive (Marieke et al., 2005b). According to Malaa et al. (2004), the methods of processing such as dripping, floating and hand pressing of honey combs are considered to be traditional methods and still at the artisan stage. Marieke et al. (2005b) argued that the dripping and floating methods (filtration by gravity) often leads to a higher moisture content especially in the rainy season whilst the hand pressed honey is less clear because of the mixture of impurities such as wax, pollen and bee brood. Centrifugal extraction method is reported to be the best and good for processing honey combs from top-bar and movable frame hives except radial extractors which honey from top-bars cannot be centrifuged (Marieke et al., 2005a). Akangaamkum et al. (2010) identified four main methods of honey extraction in Ghana: hand-squeezing, solar extraction, cold extraction and centrifugal extraction. They however lamented that honey harvesting and extraction methods by beekeepers in Ghana were very basic and generally undertaken with minimal specialised equipment such as honey press, hydrometer or refractometers for testing moisture content.

Honey is exposed to the danger of contamination, since the surface area of contact with the environment is very large. In other words, honey is hygroscopic in nature and thus has the tendency to absorb and hold atmospheric moisture (Krell, 1996). Therefore, honey should be processed in a closed environment where bees and other insects cannot enter. The next step in value addition is honey purification which is the removal of any impurities such as wax particles, other debris and air bubbles incorporated during extraction. There are two practical techniques for honey purification that is settling and straining (Krell, 1996). The first method, settling involves leaving the honey in a suitably large container, so that impurities can separate according to their specific weight, that is, air bubbles, wax particles, insect pieces and other organic debris float to the surface while mineral and metallic particles drop to the bottom. The surface scum can be removed carefully, or honey can be drawn off near the bottom for bottling without disturbing either surface scum or bottom sediment. Settling velocity varies with particle size (the smallest settle the slowest), container size and honey viscosity, that is, moisture content and temperature (Krell, 1996).

The second method involves straining where the honey is refined by heating, filtering and packing it into jars (Marieke et al., 2005b). Straining serves the purpose of removing all fine materials, including pollen, in order to delay crystallization for as long as possible so as to improve presentation of products and shelf-life to make export possible. Honey in this state according to Krell (1996) is the preferred quality for supermarkets and other large marketing chains which want a product with a long shelf-life in a homogeneous liquid state. The marketable primary bee products are honey, beeswax, pollen loads, propolis, royal jelly, bee venom, bee brood, bee bread and live bees (Marieke et al., 2005a). Some of these products could be consumed or used in the state in which they were produced by the bees whilst other products form only a part of all the ingredients of another product. These products are often referred to as value added products from beekeeping (Krell, 1996). Another product is the colony itself which is used for pollination of flowering plants by setting a bee colony in or close to a plantation or crops. Increased in fruit and seed yield is often reported to be many times greater than the honey production from the same field (Marieke et al., 2005a).

According to Paterson (2006), beeswax is a good cash crop since it would keep indefinitely and it has fairly high weight-to-value ratio. However, in developing countries with traditional beekeeping methods, records showed that beeswax is often wasted and if is rendered, most is subsequently exported and only relatively small proportions are used by local manufacturers (Adjare, 1990). Of all the primary bee products beeswax has been, and remains, the most versatile and most widely used material especially in medicinal practices and in creams and lotions (Krell, 1996).The dried venom is used for medicinal purposes especially in immunizing people allergic to bee stings (Paterson, 2006). Propolis is a gum-like substance that bees use to seal up any cracks in the hive or used as antibiotic properties for wound dressing and when chewed it is said to alleviate mouth ulcers and toothache (Paterson, 2006). Royal jelly mixed with honey is used in apitherapy and for treatment of stomach, liver and digestive problems. For external use, royal jelly is added to creams and salves to enhance or preserve the beauty of the skin and also stimulate the formation of healthy tissue and hair growth (Krell, 1996). Apart from primary products, marketing derived products is noted as another way of diversifying bee products for more profits to beneficiaries. For example, honey with royal jelly or honey mixed with pollen or propolis powder can fetch a better price than the two products marketed separately (Marieke et al., 2005b).

2.2.7 Packaging and Marketing of Bee Products

According to Petarson (2006), although packaging does not improve the quality of the product itself, it does add value in the form of packaging small quantities for hotels, airlines and special gift packages for occasions. This is because the price setting of a product is determined by demand, availability, quality, special character, package, origin and function (Marieke et al., 2005b). Honey is packaged in different containers such as glass jars, clay pottery, metal and plastic containers. Krell (1996) noted that for most retailing of pure honey, the preferred packing material is glass followed by plastic container and for large quantities, metal containers coated with beeswax is preferable. The directive from *Codex Alimentarius Commission* (1995) indicates that if foreign matter, such as wax, sticks, bees, brood, pollen, and particles of comb is present in honey, sample should be heated to 40^{o}C in water-bath and strained through cheesecloth in hot-water-funnel before package in 250 ml bottle. Besides, any identifiable quantity of honey delivered for distribution at one time should have common characteristics such as origin, variety, type of packing, packer or consignor and markings by the sampling official.

The bottle or package for honey should be leak proof and airtight so as to safely contain the product, but also present the product in an attractive form, enticing the consumer to buy it (Krell, 1996). Labels also have to provide all legally required information and preferably a lot number to help the producer track down any problems. All confections, independent of size, have to be labelled correctly, according to local laws. In addition to the legally required information, some information may be provided to the consumer on the various uses of the particular product. According to Crane (1970), Moguel et al., (2005), Edessa (2007) and Assefa (2009), the major factors that influence the quality of honey which may result in honey fermentation are: high temperature, types of beehives used, methods of harvesting, careless handling of honey, length of storage of honey and moisture content greater than 21%. Krell (1996) argued that honey readily absorbs odour of all kinds therefore, containers which previously contained toxic chemicals, any oils, household cleaners, gasoline, any other non-food or non-drinkable should never be used for storing any bee products even after coating with paint, plastic or beeswax so as to achieve a longer shelf-life. However, according to Akangaamkum et al. (2010) about 80% of processors in the Volta region of Ghana relied on recycled containers for packaging their honey for sale.

The producers sell their bee products either extracted or not extracted directly in smaller quantities to users (consumers or retailer trade) or in large volumes to traders (wholesalers) or a larger honey company (honey packer) where the later refines and package into jars for local and export markets (Marieke et al., 2005b). According to Subbey (2009) and Akangaamkum et al. (2010) there are two main honey markets in Ghana, the domestic market which is further classified into rural or urban markets and export market. However, Akangaamkum et al. (2010) stressed that the export market has largely not been exploited and as at 2010 there has not been records on honey export from Volta Region and so producers mostly sold honey to processors, wholesalers, retailers and consumers. The key factors attributable to marketing bee products are quality, continuity and sustainability. Therefore, bee products should be free of residues from organic or inorganic chemicals like antibiotics, acaricides or insecticides used for agricultural activities and also free from foreign particles (Marieke et al., 2005a).

Marketing or distribution channels are the path or alternative roots of product flows from the farm gate to the consumer (Kohls and Uhl, 1990; James et al., 1991). The length of this path depends on the product and the number of participants involved in the channel. Most producers do not sell their goods directly to the final users; between them stand a set of intermediaries performing a variety of functions. For Cairns (2002), the more steps that are eliminated along the chain the better for the producers in reducing transaction cost. Most scholars seem to distinguish between a marketing and distribution channels based on product flow and intermediaries along the chain. According to Tessega (2009), the intermediaries constitute a marketing channel or a trader channel which includes the wholesalers, retailers and brokers. The distribution channel is the flow of goods and services from the origin (producer) to the final destination where they are being used for various purposes such as for pharmaceutical or herbal medicine and or the brewery industry (Assefa, 2009). A study of the marketing chain in the Volta Region shows that about 84% of producers sold their honey to middlemen such as processors, wholesalers and retailers (Akangaamkum et al., 2010)

2.2.8 Importance of Beekeeping Sector

Beekeeping sector has both economic and ecological importance to the people who are directly or indirectly engaged in it (Cairns, 2002). For economic benefits bees are non-traditional forest product (NTFP) which has low impact on land use and thus beekeeping contributes to the wider rural economy through trade (Paterson, 2006). The average contribution of honey production to a beekeeper's annual income in Ghana in 2008 was about 23% (Akangaamkum et al., 2010). An income analysis of honey and its by-products in Ghana in 2009 reported about 37% of overall household income to families involved in the sector (Nyatsikor, 2009). Records showed that in the northern part of Ghana, beekeepers made remarkable harvest with improved beekeeping methods which increased their household incomes by 50% during the long dry season (Conrad, 2003). Beekeeping is believed to play a significant role and one of the possible options to the smallholder farmers in order to sustain their livelihood. It does not only serve as a source of additional income, but also quite a number of people entirely depend on beekeeping and honey selling for their livelihoods. Nuru (2002) indicated that honeybee and their products provide direct cash income for beekeepers. Beekeeping is also a complementary enterprise to virtually all farming enterprises and provides insurance against any risk and uncertainty that could result due to inclement weather, pests and disease attack on crops or animals of farmers (Fadare et al., 2008).

Honey is a source of food and consumed at household levels in its state as liquid, crystallized or comb and also as substitute for sugar in tea or porridge as supplementary food for lactating mothers and as an appetizer (Kimbi et al., 1998). Honey is not only useful as food supplement; it is now increasingly being used in the treatment of various diseases such as wound dressing (Ankra, 1992; Molan, 1992; Cooper et al., 1999; Molan, 2001; Ige, 2010; Molan, 2012). Value addition to other by-products like pollen and its analysis of honey is of great importance for quality control and helps to ascertain whether honey is adulterated or not (Lieux, 1981; Barth, 1990; Kerkvliet et al., 1995; Terrab et al., 2003; Ohe et al., 2004).

Ecologically, bees are important pollinators and are known to be useful in helping fallow plots regenerate and increase yields of various food crops (Cairns, 2002). The greatest value of honey bees lies in their capacity for plant pollination which increases fruit and seed production of many crops (Paterson, 2006). A study on the integration of beekeeping and its impact on raw cashew nut yields indicated a significant raw cashew nut yield increase by 116.7% that is from 4.2kg to 9.1kg per tree/season in Ghana and 212.5% which is 2.16kg to 6.75kg per tree/season in Benin as a result of pollination by honeybees. Most beekeeping operations are practiced within cultivated areas in forest due to the dependence of crops and trees on honeybee pollination. Agricultural crops and forest vegetation are important sources of food for both stinging and stingless honeybees since they are flower visitors and pollinators. Honey has both use-value (self consumption) and exchange-value (honey sold for profit), but Cairns (2002) argued that beekeeping has more exchange value than used value hence most people entirely depend on beekeeping as a business.

Keeping bees prevents hazards such as bushfires associated with hunting for honey and hence discourages deforestation. Therefore, bees are mostly protected through beekeeping and hence their total extinction is prevented. The beekeepers could produce a wider range of hive products such as honey, beeswax, pollen, propolis, royal jelly, bee venom, bee brood and bread with advanced apicultural skills and equipment (Paterson, 2006). Beekeeping provides an economic reason to retain natural habitats and is also a suitable activity for resource-poor farmers in the tropics for a number of reasons including: useful valuable commodities, making good use of wasteland, suitable activity for all age groups, needs little daily attention, easy to learn basic beekeeping techniques, encourages networking through associations, making use of local materials to stimulate local trade, no competition for nectar by any other livestock and no need for supplementary feeding (Paterson, 2006).

In industries honey is used as an important ingredient in the pharmaceutical industry, food preservative, honey-beer and medium of preparation of honey wine and confectioneries. Honey is an anti-biotic which is used as medicine by traditional healers and in conventional medicine honey is used as carrier for other drugs (Lema, 1997; Liseki, 1998). It is on record that honey mixed with other ingredients, cures coughs, stomach ulcers, malaria and burns (Ntinga and Mugongo, 1990). Honey is used to improve assimilation, chronic intestinal cases such as constipation and liver disturbances Armon (1980) and in its pure state honey helps against infections, promotes tissue regeneration and reduces scaring (Dumronglert, 1983). Honey is also used in moistening and nourishing cosmetics creams (Krell, 1996). Beeswax is used in pharmaceutical industries as a coating for drugs or pills or as a mixture with drugs to function as a time release mechanism (Krell, 1996).

2.2.9 Policies and Institutional Support for Beekeeping in Ghana

According to Akangaamkum et al. (2010) the absence of a national policy on the development of the honey sub-sector appears to be a major reason for lack of coherence in the industry. Similarly, Nyatsikor (2009) also noted the lack of a national policy on beekeeping as a huge drawback to the development of the sector and the response remains low, though MoFA and other developmental orgainisations such as HPI and SNV are all providing support in terms of management and technical training, equipment supplies and funding to make the industry attractive. Beekeeping cuts across two key sectors thus Food and Agriculture and Forestry or Lands and so policies in these sectors are expected to provide the enabling framework for the honey sub-sector. Akangaamkum et al. (2010) in a review of the regulatory and policy environment suggests that there is currently no national legislation, policy or strategy that directly regulates apiculture in Ghana, but general policies and strategies that have some remote impact and consideration for the honey sub-sector. For example, the current national agriculture policy direction and strategies, which place emphasis on some major crops and sub-sectors, have resulted in the neglect of sub-sectors such as beekeeping which are considered small and irrelevant.

There is to a large extent no focus on honey in the regional and district agriculture directorates and as a result there is currently no data on honey which is considered a "negligible" sub-sector (Akangaamkum et al., 2010). However institutional support from individual organisations in poverty reduction programmes such as SNV, HPI, WVI, ADRA, WADEP, TechnoServe, Peace Corps, Farm-Serve Africa and Wildlife Division constantly supported beekeepers in funding, advisory and capacity building through training. In 2010 Heifer Project International (HPI) made an initiative for the development of a draft policy on beekeeping which was submitted to the Ministry of Food and Agriculture, but is yet to be developed into a national policy by the Ministry (Ahmed, 2014).

2.3.1 Evolution and Development of Value Chain Analysis

Value chain analysis is a concept in business management that evolved from the "*filiere and Wallenstein's concept"* and developed by a French economist in the 1960s (Rutgers, 2010)).

In the *filiere*, the main idea was to highlight and map out specific physical commodity flows and relationships within a sector including key stakeholders in domestic markets (Raikes, etal., 2000; Kaplinsky and Morris, 2001).The *filiere* concept was an analytical tool for empirical agricultural research whose main objective was to increase efficiency through identifying flows of physical inputs and services required in the production of a final product as well as the actors involved (Christin, 2006).The approach was used to gain more understanding of economic processes in production and distribution chains in agricultural commodities such as analysis of the production of cocoa in the developing countries formally under French colonization(Nugraha, 2007). The *filiere* concept has been criticised for its static character with regards to relations and weak emphasis on governance (Raikes et al., 2000). In 1974, Wallenstein's concept of 'commodity chains' was developed upon the principles of world systems theory where the world's nations were classified into two separate groups; core and periphery with the core dominating the world through capitalist system and exploits the periphery to sustain itself due to inequalities in power relations (Rutgers, 2010).

By mid 1980s the modern Value Chain Analysis (VCA) was developed by Michael Porter and popularized in his 1985 seminal work, "Competitive Advantage" as an instrument for identifying the value of each step in the production process (Porter, 1985). Porters VCA was established during an era of intense competition where strategic management became important for the survival of businesses and it was the theoretical framework that enterprises used to detect their resources of competitive advantage (Nangole et al., 2011). The generic form of Porter's value chain is:

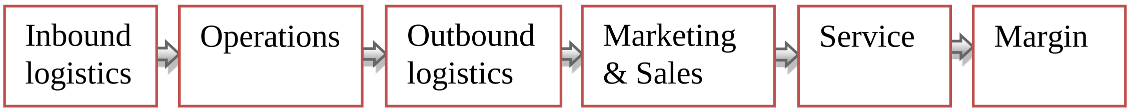

Figure 2.1: Porter's generic value chain

Source: Roduner, 2004; Nang'ole *et al.*, 2011.

According to Van den Berg et al. (2009), inbound logistics are primary activities which directly contribute to add value to the production of goods and service whilst outbound logistics are support activities with indirect effect on the final value of the product. Roduner (2004) found that the primary and support activities offer the customer a level of value that exceeds the cost of the activities resulting in a profit margin. The weakness of Porter's approach according to Fasse et al. (2009) was its restriction to the firm level activities neglecting the analysis of upstream or downstream activities beyond the industry. This paved way for the launching of the Global Commodity Chain Approach (GCCA) which was derived from the earlier Wallenstein's commodity chain (Gereffi and Korzeniewiz, 1994). Within this framework was the development of the four core dimensions through which a value chain could be analysed holistically thus input-output structure, geographical territory covered, institutional framework, and governance (Gereffi and Korzeniewiz, 1994). Another concept which is not of interest to this study was the development of GCC concept into the Global Value Chain (GVC) Concept reflecting a more dynamic view of value chain governance (Sturgeon, 2008; Gereffi et al., 2005).

2.3.2 Theoretical Framework of Value Chain Analysis

This research focuses on Porter's value chain analysis based on the separation of economic activities into value adding activities and evaluation of the value each particular activity adds to bee products through the four key elements of GCC approach of Kaplinsky and Morris (2001). The input-output structure describes the supply of inputs to producers and how the inputs are used to improve the products (Rutgers, 2010). Geographical coverage that involves the mapping of the value chain and the extent to which actors are spread along the source-make-deliver approach (Eva, 2006). Governance which identifies the conditions under which key or lead agents incorporate subordinate agents through their control of market access and information and the power relationship that regulates quality standards along the value chain (Christin, 2006). Institutional dimension which recognizes that value chains are not ‘closed systems’ since actors acquire external inputs in terms of skills and extension services from technical research institutes and are influenced by trade unions, NGOs and driven by national governments or international organizations through policies and social structures as value chain supporters (Nugraha, 2007).

A look at Messner’s (2002) concept of the world economic triangle based on the assumption that actors, governance and regulation systems determine the scope of action to take to improve a particular commodity is important. According to Roduner (2004), product improvement is based on upgrading the entire economic triangle theory (actors, governance and regulation systems) in the value chain. The focus of this research was the theory of the “sub-sector” introduced by Shaffer in 1970 and based on Porter’s value chain analysis. According to Staatz (1997), sub-sector involves a set of actors with their activities and rules in governing the production, processing and distribution of an agricultural commodity. The agriculture sector is divided into sub-sectors like the beekeeping sector which is defined in terms of the end product produced and covers all the distribution channels for this end product (Mitchell et al., 2009). Focusing on the sub-sector concept but using the value chain perspective is more appropriate for the study of the beekeeping industry since Belcher (2009) proposed that different Non-Traditional Forest Products (NTFP) originating from the same source such as honey, wax and propolis each could be classified as separate value chains. This is based on the premise that researchers using the value chain approach and analysis need to combine with more analytical methods to go beyond case-specific conclusions and ensure comparability across sites and applications (Rich et al., 2011).

This study goes beyond just a sub-sector analysis to using the approach taken at the Institute of Development Studies at the University of Sussex (IDS) targeting on development, although it was not limited to agriculture but had been applied to agricultural commodity studies (Karl et al., 2009). The IDS approach to VCA has four components which begin with mapping the actors participating in the production, distribution, marketing, and sales of a particular product including profit and cost structures, flow of goods, employment characteristics and the destination and volumes of domestic and foreign sales (Kaplinsky and Morris, 2001). IDS also examine the impact of upgrading within the chain which involves improvement in quality and product design, access to new markets, and diversification (Mitchell et al., 2009). An analysis of the upgrading process includes an assessment of the profitability of actors within the chain as well as information on constraints that are currently present and further addresses the innovation capability of actors, ensuring continuous improvement in product and process (Karl et al., 2009). Finally, IDS identifies the distribution of benefits of actors in the chain through analysis of value-added so that one can determine who benefits from participation in the chain and which actors could benefit from increased support.

2.3.3 Review of empirical studies of Value Chain Analysis

Hoeffler (2006) in his application of the value chain analysis in promoting Kenyan potato found out that value chains of the newly emerging export crops in Africa are driven by foreign companies because markets for farm inputs often fail and the farther a farm is from an urban centre, the less likely is adequate access, availability or affordability of farm inputs along the macro (government), meso (associations) and micro (individuals) levels. Ruben et al. (2006) found that scattered smallholder producers with limited storage facilities, policy failures, poor infrastructure, and more than often, massive capacity problems affect quality and marketable quantities of the produce and so the market value of most produce is subjected to very limited negotiation while selling individually to middlemen at the farm gate. Marieke et al. (2005b) found that the value chain and marketing of bee products begin with the beekeeper where the quality of the products is determined and the processed honey is either marketed directly to consumers or through the middlemen (wholesalers and retailers).

Verina (2009) in analysis of the hidden costs and values of NTFP exploitation in Congo identified two types of chains in value chain mapping namely the product chain which relates to production and processing roots of the product whilst the market chain determines the actual market value of the product. Belcher (2009) found that different NTFP originating from the same source such as honey, wax and Propolis each could be classified as separate value chains where product chain and market chain could be found within each individual commodity. According to Kaplinsky and Morris (2001) in the handbook of value chain research found that a series of actors or stakeholders from input suppliers, producers, processors to exporters and buyers form the channels of the value chain map. Akangaamkum et al. (2010) in a report of the honey industry in Ghana identified the key actors that form typical honey value chain as beekeepers/producers, processors, wholesalers, retailers and consumers, but depending on the structure of the market chain with about 84% sale to retailers. According to Farooq et al. (2007), value chains generally include three or more of the following: producers, processors, distributors, brokers, wholesalers, retailers and consumers.

Tessega (2009) in the analysis of honey production and marketing systems in Ethiopia identified beekeepers, honey and beeswax collectors, brewers, processors, retailers and exporters as the key actors in the value chain of the honey sub-sector with three principal channels: processors, exporters and beeswax channels. However, Beyene and David (2007) noted that whilst the processors and exporters channels begin from the beekeepers, the beeswax channel start from the brewery industry and are complex and interconnected with absence of organized marketing channel, lack of formal linkages among the actors and characterized by informal export through country visitors. Heiko (2007) argued that excessive numbers of middlemen and traders in a value chain contribute to delays in transporting the produce to the market and reduce profits of the value chain participants. However, Cairns (2002) in her study on honey production in Mexico found that the more steps eliminated along the value chain the better for producers in reducing transaction cost so as to increase beekeepers profits. For Kohls and Uhl (1990) and James et al. (1991) the length of this path along which products are sold depends on the product and the number of participants involved in the channel.

2.3.4 Related studies on Economic Analysis in a Value Chain

Springer (2008) described economic analysis of value chains as the assessment of chain performance in terms of its economic efficiency by quantifying the overall value added generated by the chain, the cost of production, marketing, profitability and returns on investment made by value chain actors. Berem et al. (2011) in their study of value addition in honey and poverty reduction in Kenya reported that a household that adds value to its honey was guaranteed higher prices as processed honey fetched about 300% higher prices than crude honey and thus increases the household income. Oluwatusin (2008) studied the costs and returns in modern beekeeping in Nigeria and concluded that it was more profitable to produce honey with Langstroth hive than with Top-Bar hive but the labour cost accounted for about 70% and 64% of the total variable cost for Langstroth and Top-Bar hives respectively with a positive return on capital invested. Ojo et al. (2009) found N3.58 return on every naira invested in onion production indicating a profitable business. Adinya et al. (2011) in estimation of efficiency of small farmers in Cross River State of Nigeria also reported a positive figure of N0.14 returns on every naira invested in snail farming which shows a profit from the business.

Muhammad et al. (2006) in a comparative analysis of the beekeeping industry and crop production in Adamawa State of Nigeria found that beekeeping was a more profitable form of sustainable income for small-scale farmers with N9.12 naira return on capital invested compared to N 0.40 for crop production. In their study, labour accounted for about 45.1% of the total costs of beekeeping whilst Nweke and Winch (1980) earlier documented labour as a major limiting factor in peasant agriculture in Nigeria accounting for over 70% of the total cost of production in most farming operations in rural settings. Arene (1995) found labour as the most expensive farm input in a labour intensive economy like Nigeria. Ahmed (2014) in his study of the cost structure and return on investment in apiculture for honey and beeswax production in Mampong Ashanti Municipality reported ROI of 281% and 79.58% labour cost when KTBH was used for beekeeping activities. According to Akangaamkum et al. (2010) in a review of the honey industry in Ghana estimated an annual average income per beekeeper in the Volta Region at US$91.00 equivalent to GH₵127.00 and national income at US$98.00 equivalent to GH₵137.00 per beekeeper with Net Returns of GH₵158.00 and GH₵300.00 respectively. Subbey (2009) found that the minimum number of beehives that generate the best economic returns is 3 beehives and so a beekeeper with 3 beehives could obtain a profit of GH₵18.50 in the first year of production GH₵81.50 and GH₵168.50 in the second and third years of honey production respectively.

Crawford (1997) and Smith (1981) argued that for any rational trader to stay in business and expand it he should be price efficient by considering all cost incurred and profit margin in his price determination strategies. This concern the cost involved to put a kilogram of honey on the market. As a rule of thumb the Net Profit is normal if and only if the Return of Net Profit to Total Cost is equal to or greater than the minimum interest rate of the credits accessible to traders (Tomek and Robinson, 1990; Malaa, et al., 2004). A profit margin greater than the minimum interest rate of the area is an indication of economic efficiency (Scarborough and Kydd, 1992) and price efficiency (Crawford, 1997; Smith 1981).This rule was applied in the analysis of the profitability of honey marketing chain in Cameroon by Malaa et al. (2004) and found that the raw material used has an effect on the return of the net profit to total cost made by the organisation. Therefore the results showed that when the raw material was comb honey the mean annual return of net profit to total cost was 75.9% and when the raw material was partially drained honey the mean annual return of net profit to total cost was 46.5%. They then concluded that profitability was higher when the raw material was comb honey than when the raw material was partially drained-honey but added that though the profitability varied with respect to the form of raw material, their levels were still greater than the 18% minimum interest rate of the area which was an indication of economic efficiency (Scarborough and Kydd, 1992) and price efficiency (Crawford, 1997; Smith 1981).

2.3.5 Governance and Upgrading in the Value Chain

Value chain analysis is not only about the activities a firm operates but also takes into consideration governance and its effects on actors' activities in the chain (Belcher, 2009).

According to Gereffi and Korzeniewics (1994), governance highlights the authority and power relationships which determine how financial, material, information and human resources are distributed within a value chain. Nugraha (2007) in his study of the application of value chain analysis in development of milk cluster in Indonesia, indentified governance in a value chain by three information types flowing from the consumer (buyer) to the producer (supplier). These include: information about buyer requirements, technical assistance and signal of conformity to standards. Information about buyer requirements in either codified or non-codified forms explain how the backward suppliers are forced to comply with what buyers want. Information on technical assistance measures the transfer of technology, capacity building, financial investment and advisory services undertaken to enable the suppliers meet the defined requirements. Finally information on signal of conformity to standards comprises of a system in which producers can measure their performance against the requirements set by the buyers (Nugraha, 2007).

Upgrading the value chain comprises all efforts to improve inefficiencies discovered in the previous steps (Nugraha, 2007). In a study to integrate the local value chains into the global value chains, Humphrey and Schmitz (2002) proposed that firms can pursue the objective of upgrading through four major typologies; product, process, functional and inter-sectoral or chain upgrading. Product upgrading introduces new products or improves measures that lead to quality products and make them more desirable to the consumer to earn a higher unit price such as compliance with food safety, environmental and social standards (Gibbon, 2001). Process upgrading introduces measures that result in an increase in production efficiency and a reduction in the costs of production like introducing improved technology (Ponte et al., 2009). Functional upgrading is realized by changing the mix of activities conducted in-house to enter a new, higher value-added level in the value chain such as moving from production to processing or eliminating low value activities or producers selling directly to exporters rather than selling to intermediaries (Laven, 2010). Inter-sectoral or chain upgrading is used to identify which new value chain is integrated within the business or entering a new marketing channel in the value chain like smallholders beginning to sell bee products to domestic herbal or brewery industries as well as to local consumers (Dunn et al., 2006). This study focused on a two main dimensional method proposed by Gibbon (2001) where the sources of capabilities that make upgrading strategies possible were identified and then the conditions and directions that lead to improved situations were examined and developed for the honey value chain upgrading.

2.3.6 Factors Influencing Value Chain Performance

According to Giel et al. (2011), value chain performance is enhanced by policies and projects that increase the scale of operations; improve service provision to various actors, develop capacities to comply with buyer-driven quality requirements or address the process of value creation and value distribution. World Bank in 2001 reported gender issues as a major hindrance to modern development as men tend to dominate functions whilst women occupy the lower nodes due to lack of adequate income, limited skills, limited access to education, training and market information. Similar findings on gender issues by Lema (1997) shows that the initial capital needed to start beekeeping is very little but it effectively limits participation of most women in the rural areas in beekeeping activities. According to Kaplinsky and Morris (2000) barriers like access to capital and technology influence people’s and especially women’s participation and benefits from value chains. Often women have lower access to capital and technologies than men which decrease their participation in levels of the value chains (FAO, 2011). Subbey (2009) reported 78.2% male dominance in honey production, Akangaamkum et al. (2010) recorded only 32% female beekeepers whilst Ahmed

(2014) found about 91.7% male beekeepers in Mampong Ashanti of Ghana. Yusuf et al. (2014) in their study of creating youth employment through modern beekeeping in Nigeria reported about 93% dominance in beekeeping but attributed this to the aggressive nature of the West African honeybee *Apis mellifera*.

A study by Jayne et al. (2007) cited in Berem et al. (2011) indicates that access to land played an important role in rural household welfare since it provides households an opportunity for various productive investments. Land is not only used directly for beekeeping activities but also an important form of collateral for formal credits (Fletschner and Kenney, 2011). However, in Sub-Saharan Africa it is reported that women own about 15% of all lands available for agricultural activities (FAO, 2011). Even though Paterson (2006) reported that beekeeping is suitable for all age groups, Mulugeta (2009) argued that beekeeping entails risks but older people are risk averters whilst similar reports by Berem et al. (2011) shows that older people participates less in a value chain because they are less energetic and therefore engaging in activities that require more energy like beekeeping is reduced. Earlier reports by Asa (2003) and Joel (2007) indicated that people in age groups of 41-60years were more economically active and independent than those in the age group of less than 21years and above 60years. Oluwatusin (2008) found ages between 31-40years as active age group whilst Adinya et al. (2011) reported that people aged between 21-50 years were within economically active group.

Household size also has a positive influence on the participation of actors in value chain activities. According to Mulugeta (2009) and Berem et al. (2011) large family size usually implies availability of labour provided that majority or all the family members were within the age range of active labour force of 15-64years. Mulugeta (2009) opined that Experience improves the farmer's skills in production and increases their chances of using modern techniques. Farmers with higher experience appear to have often full information and better knowledge and are able to evaluate the advantage of any technology adopted. Oluwatusin 2008) and Ahmed (2014) noted that more experienced farmers could predict the future outcome of their production with some probability by considering the performance of past years. According to Cairns (2002) and Berem et al. (2011), actors in groups are a form of social capital and a key instrument for exchange of ideas. Hence, beekeepers benefit both economically and socially if they belong to groups since they may have easy access to skills and information which in turn enables them to diversify their income sources and value addition is one such off-farm activity. Moreover, collective marketing allows small-scale beekeepers to spread the costs of marketing and transportation and also improves their ability to negotiate for better prices on their produce. In many rural areas, producers acting individually face high transaction costs because they deal in smaller quantities. It is farmer organizations that help in reducing transaction costs of producers (Doward et al., 2004).

Extension service is also another crucial factor for successful and appropriate promotion of beekeeping activities in the rural areas. According to Aidoo (1999), extension and regulatory programmes like technical support, training of beekeepers to improve skills and information, providing support services such as quality assurance for marketing, effective management programmes for pest and disease control, provision of appropriate harvesting, processing and packaging facilities have played important roles in helping beekeepers succeed. Adequate information on market demand and supply, product price and safety issues is necessary for an efficient beekeeping industry. Actors with better market information raise the probability of participation decision for potential households to add value to their product (Goetz, 1992; Astewel, 2010). Assefa (2009) reported access to credits, extension contact and marketing information as most important factors that promote honey production and marketing along the value chain. Education is also an important factor in the performance of value chain actors. According to Adekunle (1978) as cited in Adinya et al. (2011), both technical and commercial education broaden the farmers/marketers intelligence and form the bases for vocational training and also enables the farmers to perform the farm activities/tasks intelligently which contributes to the quality of final product. The type of information flowing from consumers to producers along the value chain is a key determinant of the capacity building intervention to upgrade the value chain (Nugraha, 2007). Supplementary feeding of bees such as sugar in a ratio of 2:1 (2parts sugar and 1part water) has proved to be an important management factor that is used as bait material to attract bees, reduces absconding rate, increases production and income of beekeepers indirectly (Liseki, 1997).

2.4 Constraints in the Honey Value Chain

The constraints in honey value chain can be categorized into production and marketing constraints. Akangaamkum et al. (2010), in a synthesis report of the honey industry in Ghana found that the key honey production constraints were lack of enabling regulatory policy framework, lack of technical assistance, frequent occurrence of bushfires, lack of finance for expansion, pests and diseases whilst the constraints in marketing were related to lack of detailed market information, high transportation costs, inaccessibility to market centers and a disconnect between major honey users such as pharmaceutical companies. Subbey (2009), found that the greatest challenge to the development of the honey industry in Ghana during a baseline study of the value chain of honey sub-sector were lack of access to financial resources, weak organizational structures, unresolved land usage rights, inadequate infrastructure and modern technologies for post-harvest storage and processing of primary agricultural products. Ahmed (2014) in a study of the cost structure and return on investment in Apiculture for honey and beeswax production identified inadequate equipment, lack of technical assistance, absconding of bees and lack of capital as constraints facing beekeepers in Mampong Ashanti Municipality of Ghana.

Berem et al. (2011), in a study of value addition in honey and poverty reduction in Kenya found that inadequate infrastructure, low quality product and low earnings were major constraints in value addition to honey. Oluwatusin (2008) reported that the major constraints in analysis of the cost and returns in modern beekeeping for honey production in Nigeria were lack of capital followed by lack of technical assistance, bush burning, inadequate equipment and bee aggressiveness. Malaa et al. (2004) in their studies on honey marketing in Cameroon found that lack of transportation to expand sales, slow turnover rate, lack of capital to pay suppliers on delivery and lack of packaging materials where the marketing constraints to the organisations. According to Kimbi et al. (1999), due to lack of capital most beekeepers could not afford to buy some beehives such as modern hives which have been found to be appropriate for beekeeping.

Tessega (2009) found out that lack of modern equipment followed by honeybee poisoning by agro-chemicals, shortage of bee forage, drought, pests and predators were the major constraints in honey production and marketing systems in Ethiopia. According to Assefa (2009), the major problems confronting honey production and market chain analysis were similar to findings by Tessega (2009) and include: shortage of bee forage due to drought, absconding honeybee, diseases and pests and lack of beekeeping equipment in their order of priority. Joel (2007) found lack of appropriate equipment, storage facilities, packaging materials, obsolete technologies, poor handling of bee products, inadequate extension services, poor research facilities and insufficient statistical information as the constraints faced by actors in the beekeeping industry in Tanzania. Masalu (1997) opined that inefficient beekeeping extension services were among the most critical problems across Africa hence, goods and services of the sector were still low in quality and quantity. Yusuf et al. (2014) in their study on creating youth employment through modern beekeeping in Nigeria have identified pests and predators, absconding of bees, indiscriminate bush burning, hive destruction by wild animals and pilfering as the major challenges confronting beekeepers maximum production. These factors were also identified by Yirga and Ftwi (2010) as the challenges confronting beekeepers in a related study of beekeeping for rural development in Ethiopia. However, Dowswell (1993) argued that financial institutions are often reluctant to make credits in cash accessible to producers for purchasing modern processing equipment due to the general risk involved in agricultural activities.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the methodological procedures used during the research work to achieve the objectives. These include the location of the study area, population size and choice of the area, methods of data collection and analysis of the data.

3.2 The Study Area

Nkwanta North District (NND) is located between latitude 7° 30'N and 8° 45'N , longitude 0° 10'W and 0° 45'E and shares boundaries with Nanumba South District to the North, Republic of Togo to the East, Kpandai District to the West and Nkwanta South District to the South (GSS, 2014). The district capital, Kpassa is located 270km to the South of Ho, the regional capital and has a surface land area of approximately 1,510km^2 which is about 7.13% of the total land area of the Volta Region (GSS, 2014). The 2000 national population and housing census indicated that the district has a population of about 60,517 making up of 29,738 (49.14%) males and 30,779 (50.86%) females with a growth rate of 3.0% as compared to the regional figure of 1.9% and national 2.7% (GSS, 2000). Nkwanta North District form part of the tropical zone which is characterised by double maxima rainfall with two seasons namely wet and dry seasons. The mean annual rainfall is between 922mm to 1,874mm with annual temperature ranging from 52° F (11° C) and 103° F (39° C) and records relative humidity between 70% and 80% for dry and wet seasons respectively (GSS, 2014). The vegetation type lies in the transitional zone covered by Savannah Woodland and Grassland and favours tree crops such as mango, cashew and oil palm; cereals like maize, rice, millet and guinea corn, legumes such as beans, cowpea and soya beans and livestock like cattle, sheep, pigs and goats (GSS, 2010).

Nkwanta South District (NSD) on the other hand is located in the North Eastern section of the Volta Region and lies between Latitude 7° 30’N and 8° 45’N and Longitude 0° 10’W and 0° 45’E and share common boundaries with Nkwanta North District to the North, Republic of Togo to the East, Krachi East District to the West and Kadjebi District to the South (GSS, 2014).The district capital of Nkwanta South is Nkwanta with a total land area of about 3,026km^2 and the population size from the 2010 national population census stood at117,878 with 58,482 (49.6%) males and 59,396 (50.4%) females with annual growth rate of 4.4% compared to 1.8 and 2.5% for regional and national respectively (GSS, 2010). Generally, the district is characterized by double maxima of rainfall making up of major and minor seasons with annual rainfall ranging from 883.8mm and 1,676mm and mean annual temperature between 11°C and 39°C (GSS, 2014). There are three distinct ecological zones in Nkwanta South District namely Semi-Deciduous Forest (45%) to the South, Transitional/Savannah Woodland (30%) in the middle belt and Savannah Grassland (25%) to the North. The vegetation zones favour the cultivation of tree crops such as cocoa, oil palm, mango and cashew; cereals like maize, rice and millet, root crops such as cassava and sweet potato, tuber crops like yam and cocoyam, legumes like groundnuts, soya beans and cowpea and livestock such as cattle, sheep, goats and pigs. This implies that the study area is agrarian and melliferous flora is common for the keeping of honeybees to enhance pollination of crop plants. Below is a pictorial map of the Volta Region showing the study area; Nkwanta District now sub-divided into Nkwanta North and South Districts.

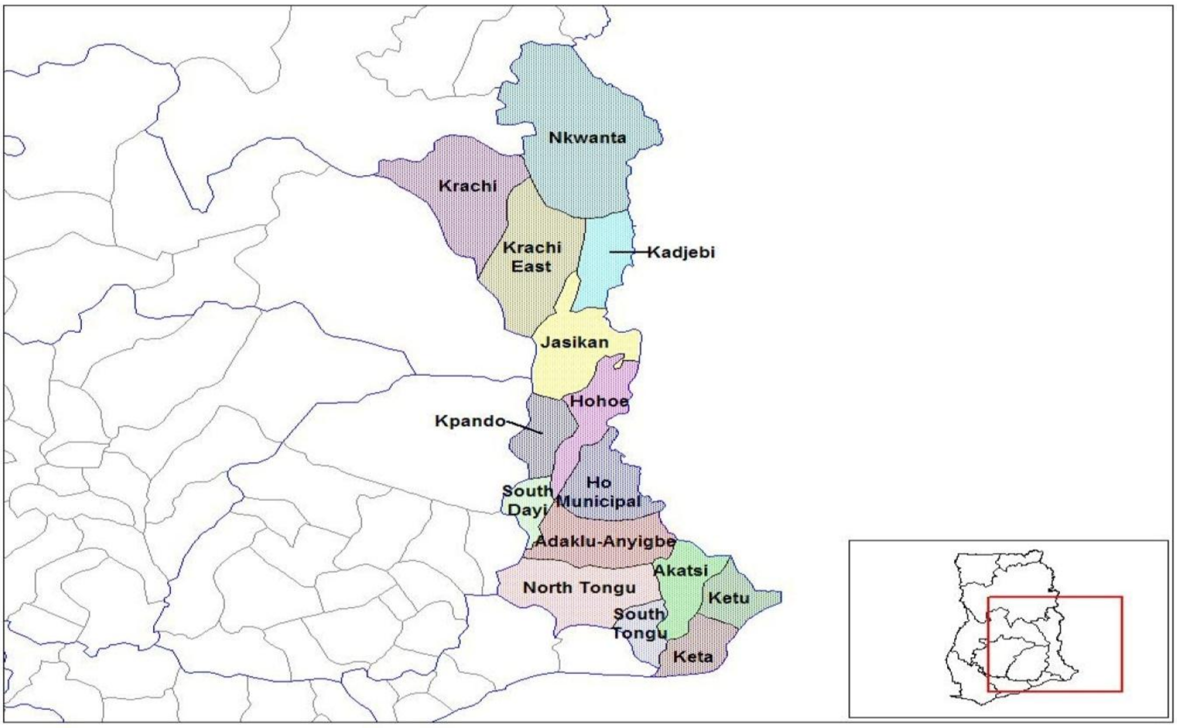

Figure 3.1: Map of the Study Area

3.3 Choice of the Study Area

Nkwanta North and South Districts of the Volta region were chosen because, a personal interview with the manager of the Kyabobo National Park; Mr. Ahmed Boampong shows that with the establishment of the Park in 1992 by the Wildlife Division of the Forestry Commission (WDFC), most of the people's farmlands were captured. Therefore, beekeeping was an alternative livelihood since the office of SNV identified the industry as one of the priority sub-sector with high income earning potentials for poverty reduction (Subbey, 2009). According to the manager, Kyabobo National Park has a total land area of 220km^2 with 9 surrounding 'free' communities and shares its borders with *Fasao Malfakasa* Park of Togo and river 'Kue' as the boundary. He indicated that Nkwanta North and South Districts form part of the catchment areas where SNV was supporting managers of the National Park and other institutions with funding to supply beehives to farmers. The ultimate goal was to conserve, manage and protect the natural resources (wildlife, forest and watershed) through the building of local community support for wildlife conservation. This approach helped in reducing the high incidence of poaching, illegal logging and encroachment on the national park for farming activities.

Therefore, WDFC in collaboration with, MoFA, WVI, HPI, WADEP and HIV Youth Club were supporting beekeepers with inputs and equipment (beehives, smokers and harvesting gears) to produce honey in large quantity for both local and export market. Some of the producers were also trained in apiary management and setup with technical and supervisory role in honey production. The honey processing machine was also located in one of the districts; Nkwanta South to enable the processing of large quantities of honey for sale. The sustenance of the industry depended on the establishment of a revolving fund for other beneficiaries through deposits from repayment of the inputs supplied. An enabling environment was created for beekeeping activities since bee colonies were protected from bushfires and pesticide poisoning due to bad farming practices. According to the manager of the Kyabobo National Park, the type of bees kept in the area was identified by Forest and Wildlife Department as the West African honey bee, *Apis mellifera adansonii.* A personal interview with the Liaison Officer of the Park also showed that Nkwanta North and South Districts had about 600 beekeepers. A total of 400 beekeepers were trained (250 males and 150 females) and 200 beekeepers untrained.

3.4 Season of Honey Production

In both Nkwanta North and South Districts of the Volta Region like any other part of Ghana, there are two main seasons in honey production thus major and minor seasons. The major harvesting season of honey combs is spread over a five month period within the year beginning from January and ending in May. Even though the minor season begins from October to December, a personal interview with key informants indicated that none of the beekeepers in the study area harvested their honey combs during this period. Harvesting of honey combs was done only during the major season. In beekeeping, timing of the harvest is very important because bees produce honey for their own consumption especially during the rainy season. Therefore, honey is normally harvested at a time when bees have not gone into hibernation in the beehive and this period is the major honey harvesting season. At this time bees are able to go out for flower nectar during the bloom (the period when plants produce flowers) to produce more honey for the colony. Beekeepers past experience in beekeeping shows that those who harvested their honey combs previously during the minor seasons only recorded poor yield and in most cases empty honey combs. Therefore, some fallow period have to be left during the minor season for the bees to collect nectar to produce enough honey for the major harvesting season.

3.5 Method of Data Collection

Various research techniques were employed to collect data for the study. The study began by finding sources of data and then questionnaire were designed. It continued with a personal field observation where key informants were also used to get first hand information. The final data was collected through a personal interview with the respondents. The data collection focused on issues such as demographic characteristics, funding, labour used, training and information received, credits obtained, beehive yield, total sales and cost incurred in honey production. The interviewers involved those who had experience in honey production and marketing in the study area and had formal education from SHS to Tertiary level. They were recruited and trained on the techniques of data collection after they had been made aware of the objectives of the research work and content of the questionnaire. This helped in arriving at a comprehensive result which represents the true situation in the study problem.

3.6.1 Types and Sources of Data

The relevant information regarding the objectives of the study was obtained from both primary and secondary sources. Based on the objectives of the research, both qualitative and quantitative primary data were collected from beekeepers, wholesalers, retailers and brokers. The information was based on practices in honey production and value addition to bee products. The secondary information was from both published and unpublished sources. These include the use of the library, internet, books on beekeeping for confirmation and final adjustments. The study also made use of information from the centralized institutions such as the District Assembly, Forest and Wildlife Commission, WADEP, WVI, Kyabobo National Park and churches for accuracy and validity.

3.6.2 The Questionnaire Design

The study made use of both open-ended and closed-ended questions. Two types of questionnaire were used for the research work; self-administered and personal interview questionnaire. The target respondents for the self-administered questionnaire were the input suppliers such as WADEP, WVI, HPI, HIV/AIDS Youth Club, MoFA, Forest and Wildlife Commission and the Kyabobo National Park. The questionnaire was given to them to be filled unaided and was collected a week later. The personal interview questionnaire targeted the beekeepers, brokers, wholesalers and retailers. The questionnaire was divided into three sections based on the objectives of the research work. The first section was about the socio-economic characteristics of the targeted respondents. The second section concerned value chain analysis whilst the third and final section involved constraints in honey production. The researcher traced and made a personal contact with all the respondents individually either at their various homes or work places for information on demographics financial and logistical support.

3.6.3 Personal Field Observation

This method was employed as a tool to gather qualitative data as real as they were in the study areas. It was applied in identifying some felt community problems related to availability or non-availability of roads, water, electricity, financial institutions, types of beehives used, harvesting and processing equipment or machines and the distance to processing and marketing centers. It also helped to realize some of the changes in the areas and other discoveries which were mentioned or not mentioned by the respondents. This method was used to cross-check respondents' answers to questions that were posed by the researcher based on physical resource base of the study areas.

3.6.4 Key Informants

This tool was used to gain access to first hand information about beekeeping, the beekeepers and the beekeeping communities. People who were known to have some knowledge in beekeeping were contacted. Discussions were held with various individuals in the study area such as the Assemblymen, unit committee members, Teachers, Agric extension agents and leaders of various religious groups for general information on beekeeping.

3.6.5 Personal Interview

A personal interview was conducted with the input suppliers such as WADEP, WVI, HPI, MoFA, WDFC and HIV/Youth club to solicit information on their activities with the beekeepers. On the other hand, the individual beekeepers were also personally interviewed to obtain information about their beekeeping activities relating to value addition to bee products. The various actors in honey production such as producers, brokers, wholesalers and retailers were also interviewed on how the bee products were distributed and marketed.

3.6.6 Sampling Technique and Size

This study made use of two forms of sampling techniques; non-probability and probability sampling. Purposive and snowball sampling methods under the non-probability sampling technique and the systematic sampling method under the probability sampling technique were employed. Purposive sampling method was used to select two beekeeping districts with 20 beekeeping communities. About 6 villages from Nkwanta North District and 14 villages from Nkwanta South Districts were purposively selected (see figure 3.1). Using the list of beekeeping population obtained from the office of MoFA in Nkwanta, systematic random sampling method was employed to select 200 beekeepers from the 20 communities. Based on the order of arrangement from 1-600 beekeepers according to the list obtained from MoFA, a sample fraction was decided ($\frac{n}{N} = \frac{200}{600} = \frac{1}{3}$). A regular sample interval was determined (K=$\frac{N}{n} = \frac{600}{200} = 3$). A random number was selected between 1-3 for a start and at a regular interval of 3, every 3rd beekeeper on the list was chosen as part of the sample. This continued until the last number which is 600 was selected to get the sample size of 200 beekeepers.

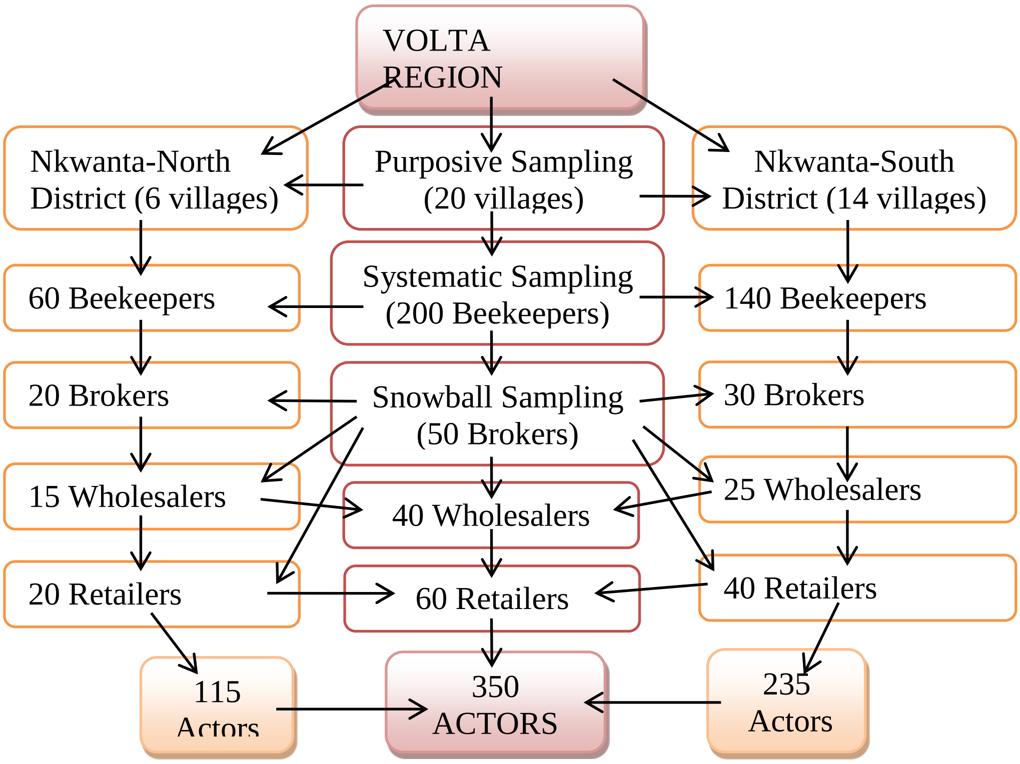

Figure 3.2: Sampling procedure of beekeeping communities and actors

Finally, snowball sampling method was used to select the brokers, wholesalers and retailers. This method was carried out after identifying the 200 beekeepers who met the criteria for inclusion in the sample. The subsequent sample which was 50 brokers was based on referrals from initial informants; the producers (beekeepers). They directed the forward actors they supplied their honey for further distribution. The selection of 40 wholesalers was based on referrals by either the producers or brokers. Finally, the selection of 60 retailers was based on referrals by the producers, brokers or wholesalers bringing the total sample size to 350 respondents. The sample frame was the list of beekeepers from beekeeping communities in both Nkwanta North and South Districts which was provided by the office of MoFA. Many actors in honey production were chosen from Nkwanta South District because beekeepers hives were protected from bushfires due to the establishment of the Kyabobo National Park which discourages bush burning but most of the beekeepers in Nkwanta North District had their beehives burnt by bushfire.

3.7 Method of Data Analysis

In this study, both descriptive and econometric methods of data analysis were employed. Descriptive statistics like frequency distribution, percentages and arithmetic mean were used to describe the socio-economic characteristics of actors, honey output, resources used and the proportion of cost in the value chain. The "traditional" method of Return on Investment (ROI) analysis was used to assess the profitability of value addition participants whilst independent sample t-test was used to compare the mean difference between yields of Langstroth hive and KTBH in the two districts. Kendall's Coefficient of Concordance (KCC) was used to analyse the constraints of value chain actors. The computer programmes used for data analysis were Excel andSPSS with results presented in tables and figures.

Return on Investment (ROI) is a performance measure and evaluation metrics used to calculate the efficiency of an investment or to compare the efficiency of a number of investment (Malaa et al., 2004; Muhammad et al., 2006; Fadare et al., 2008; Ojo et al., 2009; Adinya et al., 2011; ROI, 2011; Botchkarev and Andru, 2011). ROI profitability measures the level of Net Profit as a return to Total Cost. This is given by the formular:

ROI=$\frac{\sum finRet(j)-\sum Cost(j)}{\sum Cost(j)} \approx$ ROI = $\frac{Financial\ returns\ (Net\ Profit)-Cost\ of\ Investment}{Cost\ of\ Investment}$

The value-adding efficiency (VAE) was used for measurement of productivity to determine the value-added per unit of labour cost (FIAS, 2007). Value-adding efficiency is given by:

$$VAE = \frac{\text{Total Value Added}}{\text{Labour Cost} + \text{Depreciation}}$$

ROI analysis was used to test hypothesis 1 for analysis of the profitability of major actors in the honey value chain to make informed policy decisions on the industry. Value-added (Net Profit) refers to the proceeds obtained from the sale of the entire beekeeping enterprise outputs if they dispose of all their products (honey and wax measured in kg) at the farm gate price less the total cost. In honey production, apart from the cost of transportation which run throughout the various actors from producers to retailers, beekeepers variable cost items includes the cost of bait materials, maintenance of beehives, smoking materials, part payment for inputs (beehives) and labour for harvesting honey combs. Processors variable cost items were the cost of honey comb, rent of processing equipment and the cost of extraction of honey and processing of beeswax. Wholesalers' variable cost items were the cost of crude honey and wax and straining of honey whilst retailer's variable cost items were the cost of processed honey and wax and bottling of honey. ROI is a number in the range of +∞% for outstanding results and down to -100% for an investment losing money. ROI of 100% means that the amount of return equals the amount of the money invested or gaining the same amount as profits and -100% means no returns or the gains have been used to pay for cost of investment.

The fixed cost or indirect cost items involve depreciation of the set of tools and equipment used in honey production. This was valued as depreciation on equipment such as beehives, protective gear, smokers, sieves and wax extractors. Depreciation was calculated by the straight line method. The straight line method of depreciation is the process by which a company allocates a tangible assets cost over the duration of its useful life (Raymond, 2002). The straight line depreciation method charges cost evenly throughout the useful life of a fixed asset. This depreciation method is appropriate where economic benefits from an asset are expected to be realized evenly over its useful life. This method is expressed as:

$Depreciation\ per\ annum = \frac{\text{Cost}-\text{Residual Value}}{\text{Useful life}}$, Where:

Cost is the initial acquisition or construction costs related to the asset as well as any subsequent capital expenditure. Residual value is the estimated proceeds expected from the disposal of an asset at the end of its useful life. Useful life is the estimated time period that the asset is expected to be used starting from the date it is available for use up to the date of its disposal or termination of use and expressed in units of years or months.

The independent sample T-test was used to compare the means of two independent groups in order to determine whether there was statistical evidence that the associated population means were significantly different. This is a parametric test that was used to compare the mean yield, NP and ROI of Langstroth and KTBH. The difference between means allows one to test for a statistical significance between two population means drawn from independent samples which are assumed to be normally distributed with equal variances (Welch, 1947; Hinkle et al., 2003, Green et al., 2003, Huck, 2004; Tabachnick et al., 2007; Howell, 2007). The test statistic for an independent samples t-test with assumed equal variance is denoted 't' as follows:

t = $\frac{\bar{X}_1-\bar{X}_2}{SP\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}$where:$SP$ = $\sqrt{\frac{(n_1+1)S_1^2+(n_2-1)S_2^2}{n_1+n_2-2}}$

$\bar{x}_1$ =mean of first sample, $\bar{x}_2$ = mean of second sample,

n_1 = first sample size, n_2 = second sample size

S_1 = standard deviation of first sample, S_2= standard deviation of second sample

Kendall's Coefficient of Concordance (KCC) was used to rank the constraints in beekeeping. This is a descriptive statistical measure of agreement or concordance for data comprised of 'K' sets of ranks, where K > 2 (Feigin et al., 1980; Lian et al., 2001; Legendre, 2005; Grzegorzewski, 2006; Miroslav et al., 2009). It is used to identify and rank a given set of constraints into the most pressing one to the least pressing one. The constraint with the least score is ranked as the most pressing one whilst the one with the highest score is ranked as the least pressing one from values of 1-10. The total score is then used to calculate the KCC 'W' to assess the magnitude of agreement or disagreement among responses. When perfect agreement exists between the values of the ranking variable, W = 1 and when maximum disagreement exists, W = 0. KCC does not take negative values and is thus bounded on the interval, $0 \leq W \leq 1$. As the coefficient (W) increases, there is greater agreement among observers. 'W', called KCC provides a measure of total agreement within the group of 'K' observers as follows:

Let $R_1,.....,R_n$ denote column totals. i.e.

$$R_j = \sum_{i=1}^{k} R_{ij} \quad \text{..........} 1$$

Then the Kendall's Coefficient of Concordance (W) is given by:

$$W = \frac{12}{K^2 n(n^2-1)} \sum_{j=i}^{n} \left[R_j - \frac{K(n+1)}{2} \right]^2 \quad \text{..........} 2$$

Where:

Rj = Column totals which represents sum of ranks

K = Number of rankings or variables ranked (constraints)

n = Number of judges (beekeepers) to do the ranking (respondents).

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This section provides findings of the research on honey value chain in Nkwanta North and South Districts of the Volta Region. The study was divided into three sections based on the objectives of the study. The first section concerns the socio-economic characteristics of respondents which include the age, gender, marital status, education and experience in beekeeping. The second part deals with application of value chain analysis to beekeeping sector which involves mapping the honey value chain and economic analysis which also involves quantifying the value-added to determine the returns on investment. The final section talks about the constraints facing major actors in the honey value chain.

4.2 Analysis of Socio-Economic Characteristics of Respondents

The value chain activities of the honey industry in the study area was mostly dominated by the male population (70.6%) over their female counterparts (29.4%) similar to reports by Subbey (2009) 78.2%, Akangaamkum et al. (2011) 68% male and 32% female in Ghana and Yusuf et al. (2014) 93% male dominance in beekeeping which was attributed to the aggressive nature of the West African honeybee *Apis mellifera*. Besides, the females argued that the beekeeping activities coincided with their household chores as most of the beehive management activities were done late in the evening and early in the morning when they were often busy at home. As a result, some female beekeepers had given their beehives to their husbands since about 76% of them were married and others to relatives like their sons, brothers or uncles (see table 4.1). The supply of beehives to people who were married was based on trust and the fact that production would continue if the two were separated either by death or divorce.

Table 4.1: Socio-economic characteristics of respondents in the value chain

Variable	Frequency (n=350)	Percentage (%)	Min	Max	Mean
Gender					
Male	247	70.6			
Female	103	29.4			
Age			20	68	40.71
20 – 29	80	22.9			
30 – 39	88	25.1			
40 – 49	95	27.1			
50 – 59	52	14.9			
60+	35	10.0			
Marital status					
Single	64	18.3			
Married	266	76.0			
Divorced	3	0.9			
Separated	4	1.1			
Widowed	13	3.7			
Religion					
Christianity	264	75.4			
Islamic	26	7.4			
Traditional	60	17.2			
Years in formal education			0	22	6.66
Level of education					
No formal education	136	38.9			
Basic education	109	31.1			
Secondary education	74	21.1			
Tertiary education	31	8.9			
Household size			1	20	5.64
1 – 5	171	48.9			
6 – 10	152	43.4			
11 – 15	24	6.8			
16 – 20	3	0.9			
Experience in beekeeping			2	20	5.79
1 – 5 (little experience)	199	56.8			
6 – 10 (average experience)	120	34.3			
11 – 15 (experienced)	22	6.3			
16 – 20 (more experienced)	9	2.6			

Source: Survey data, 2012

Besides, beekeeping involves ownership of land which females do not usually have land according to the tradition of people in the area. For them only males had land where they could site their beehives for honey production. With regards to age, the study shows a normal age distribution of the respondents in the study area with mean age of 40.7 years found within the ages of 40-49 years. The pattern of age distribution in the study area followed a normal trend involving all age groups in the honey value chain which agreed with earlier study by Paterson (2006) that honey trade was a suitable activity for all age groups. The youngest beekeeper was 20years with a percentage increase in beekeeping population with increasing number of years; it reaches a peak between 40-49 years and then begins to decline with time as respondents approach the oldest age of 68 years. This corresponds with the national age dependency ratio which shows the relationship between the populations aged 0-14 and 65years and above and the working-age between 15-64 years in a population (GSS, 2010). Similar active age groups were reported by Asa (2003) and Joel (2007) between 41-60years Oluwatusin (2008) from 31-40years and Adinya et al. (2011) between 21-50years. Therefore majority of respondents (27.1%) found within the working-age group indicates a more economically active age group capable of enhancing the financial capacity of their families through honey trade to enhance their household welfare.

In terms of religious affiliation in the study area, all the three major religions in Ghana were involved in beekeeping practice. However, Christianity formed the predominant religion in the beekeeping industry since about 75.4% of the beekeepers were Christians which agreed with national figure by GSS (2012) that the predominant religion in Ghana was Christianity representing 71.2% of Ghanaian population. With the educational level, about 38.9% of the beekeepers had not received any formal education which was relatively higher than the national figure of 38.4% (GSS, 2010). The involvement of this group of people in honey trade implies self-employment in the informal sector as a source of job creation for the youth. Respondents who obtained formal education had an average of 6.7years in schooling which was higher than the school going age of 5.1years in Ghana (GSS, 2012). Majority of the beekeepers (48.9%) had smaller households which were within 1-5 people per household. The mean household size of 5.6 was also relatively higher than the national average of 4.4

people per household (GSS, 2010). This confirms Mulugeta (2009) and Berem et al. (2011) that large family size usually implies availability of labour provided majority of the family members fall within the active labour force of 15-64years. It has been argued that a more experienced producer could predict the future outcome of production with some precision by considering the performance of past years. In this study, majority of the respondents (56.8%) had between 1-5years experience in honey trade. This was consistent with a report by Oluwatusin (2008) and Ahmed (2014) that respondents who had experience between 1-5years were new in honey business and therefore had little experience. The mean experience of 5.8years in the beekeeping business rather revealed an average experience(6-10) of respondents in the honey trade.

4.3 Economic Activities in the Value Chain

Honey production in the study area started with hunting for honey in the wild but with the establishment of the Kyabobo National Park in 1992, domestication of bees was initiated mainly through training of the beekeepers (60%) as seen in table 4.2. The training was based on beehive setting, colony management, processing, packaging and marketing. This is in line with a report by Aidoo (2010) that extension and regulatory programmes like technical support and training have played important roles in helping beekeepers to succeed. In order to access credit facilities many associations were formed along the value chain from honey production to marketing and about 64.3% were members of beekeeping association similar to Oluwatusin (2008) who reported 75% majority being members of association. Group membership is found to be a social capital and a key instrument for exchange of ideas and so members benefit both economically and socially if they belong to groups because the government and other donor agencies target not individual beekeepers but beekeeping groups in granting loans.

Table 4.2: Economic activities in the value chain

Activities	Freq (n=350)	Percentage (%)	Min	max	mean
Starting honey business					
Through training	210	60.0			
Inheritance from parents	55	15.7			
Own initiative	85	24.3			
Supply of inputs					
MoFA	22	6.3			
WADEP	81	23.1			
WVI	63	18.0			
HPI	66	18.9			
Wildlife	56	16.0			
HIV/AIDS Youth Club	10	2.9			
Own source	52	14.8			
Membership of association					
Member	225	64.3			
Not member	125	35.7			
Source of capital					
Personal savings	178	50.9			
Relatives	25	7.1			
Banks	10	2.9			
Credit unions	55	15.7			
Susu collectors	82	23.4			
Amount of credits (GH₵)			300	1500	750
Interest rate on credits (%)			15	35	25
Form of credit available					
In-kind (inputs)	190	54.3			
In-cash	160	45.7			
Acquisition of equipment					
Rental	280	80.0			
Own source	70	20.0			
Type of labour used					
Hired	155	44.3			
Family	96	27.4			
Both hired and family labour	99	28.3			

Source: Survey Data, 2012

Capital is very important in honey industry for acquisition of beehives and other equipment. The major source of capital for most respondents was obtained through their personal savings (50.9%). Other actors accessed an average of GH₵750.00 credits from banks, susu collectors and credit unions at 25% average interest rate per annum. This was consistent with Kaplinsky and Morris (2000) and FAO (2011) that barriers like access to capital and technology influence people’s participation and benefits from value chains. However, majority of the actors in the value chain (54.3%) received credits in kind which was in the form of beehives and other equipment for processing honey. An NGO known as WADEP was one of the input suppliers that supplied most of the inputs (23.1%) such as beehives and accessories, honey extractors and packaging materials to actors along the honey value chain. Beekeepers that were unable to acquire their own equipment resulted in about 80% of them renting for a fee. These were all sources of employment to the youth in the study area because most of them had undergone training in honey comb harvesting when they were not directly involved in beekeeping business. During the harvesting time they were either directly involved in the harvesting of honey or indirectly renting their harvesting equipment such as smokers, harvesting knives, cutlasses and honey extractors to producers and processors for a fee. This is what Paterson (2006) referred to as the 'multiplier effect' in beekeeping as most people are indirectly employed from the upstream supply chain of the sector. Finally, the labour used most in beekeeping activities in the area was about 44.3% hired labour.

4.4.1Mapping of the Honey Value Chain Actors and their Functions

The honey value chain in the study area begins from input supply with beekeepers that produce honey and other by-products as the entry point until the product gets to the final consumer at the households, hotels, canteens and restaurants. The two most important features about governance in the honey value chain was the flow of products and services from producers to end consumers and also the flow of information and income from the buyers to the suppliers as rewards. This was consistent with Joel (2007) that the total value-added was equivalent to the total value of all services and products produced in the economy for consumption and investment, net of depreciation. However, there was a weak information flow from buyers to producers due to the cost involved (see figure 4.1).

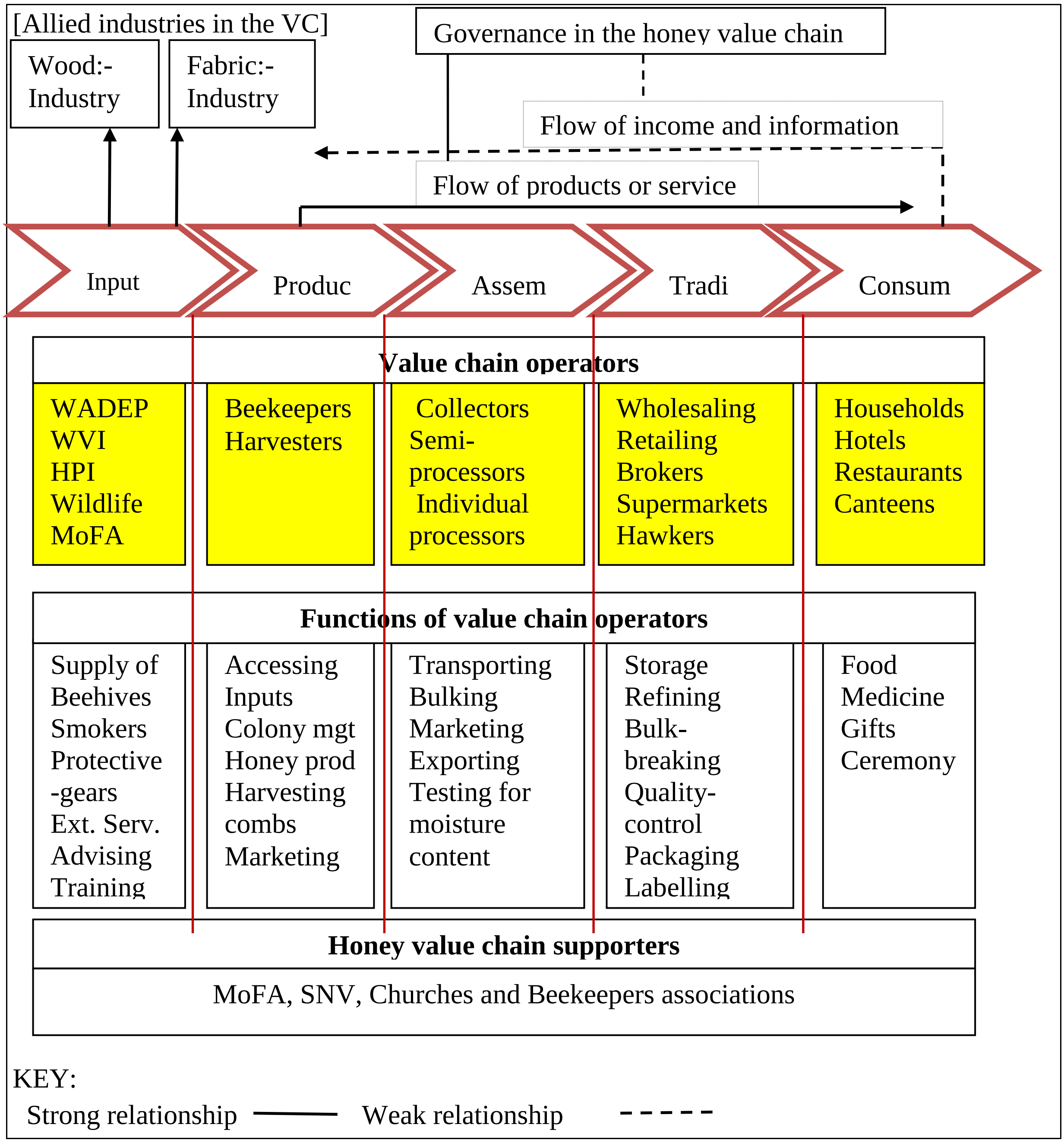

Figure 4.1: Map of the honey value chain actors and functions

Source: Survey data, 2012

The actors identified in the honey value chain were value chain operators such as input suppliers (WADEP, MoFA, WVI, Wildlife and HPI) who supply beekeeping equipment through allied industries like wood (carpenters) and fabric (fashion designers). The beekeepers were the producers who were owners of beehives and perform the entire primary tasks of baiting, colony management, harvesting the products and supply to different buyers at various markets. Among the value chain operators were people not directly involved in honey production but went for training in honey comb harvesting and the carpenters and fashion designers who also supplied beehive equipment like beehives and protective gears. These services created jobs for the unemployed youth indirectly involved in beekeeping in the area commonly referred to by Paterson (2006) as a multiplier effect. Honey value chain supporters were the government through MoFA, SNV, Churches and beekeeping associations who offered financial, training and advisory services to the actors.

4.4.2 Mapping of the Bee Product Chain

Honey is distributed along four main channels in the value chain whilst beeswax goes through two main channels. In figure 4.2 a total quantity of 34602.50kg honey and 3296.39kg beeswax were produced from both Nkwanta North and South Districts. Out of the total quantity of honey, a greater volume of 13148.95kg (38%) goes into processing of herbal medicine for Apitherapy. This confirms a study by Akangaamkum et al. (2010) that the use of honey in the local communities in Ghana is largely for medicinal purposes and to a small extent for nutrition. A greater quantity of the beeswax produced 1780.05kg (54%) was used for baiting honeybees into the beehives. The honey distribution channels began with primary processors but with a weak relationship between the semi-processing level and honey quality control because actors did not have hydrometers or refractometers to test for the moisture content of honey. Therefore, the study agrees perfectly with Akangaamkum et al. (2010) that honey harvesting and extraction methods by beekeepers in Ghana were very basic and generally undertaken with minimal specialised equipment such as honey press, hydrometer or refractometers for testing honey moisture content.

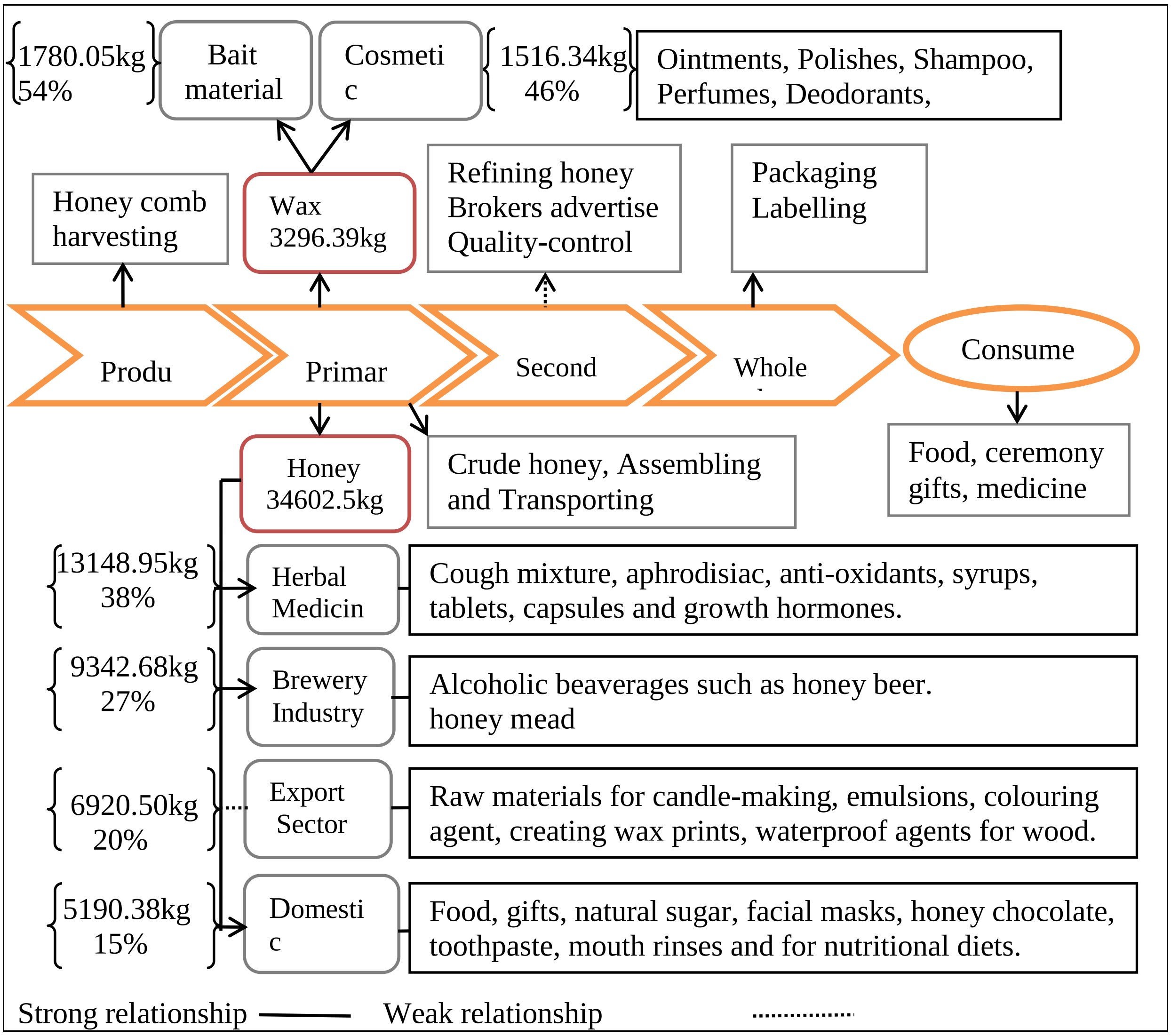

Figure 4.2: Value chain of bee products

Source: Survey Data, 2012.

Similarly, the beeswax channel also began with semi-processors but since most of the beeswax was not produced at the brewery industry, mead drink which is obtained from remnants of honey combs was less processed. The more appropriate way is the case where beeswax channel begins at the brewery industry where products such as honey mead and beer are produced for additional income (Tessega, 2009). Apart from beekeeping, some of the producers advanced to the next stage of the value chain as honey comb collectors and semi-producers due to the low price on comb honey. Even though some quantity of honey 6920.50kg (20%) was reported to have been exported to other neighbouring countries such as

Togo and some foreign countries like USA, Australia and Italy, the relationship was a weak one because the products did not go through the proper procedures that could be recorded by the authorities. This confirms the reports that the export market has largely not be exploited and from 2004 to 2008 there were no records on honey export from Volta Region of Ghana (Akangaamkum et al., 2010).

4.4.3 Mapping the Honey Marketing Chain

After harvesting, the bee products are usually extracted and sold as semi-processed in the form of chunk honey (honey mixed with comb) or processed honey (crude honey). The only marketable by-product in the study area was the beeswax. These two products (honey and wax) were sold through five marketing channels. From figure 4.3 the highest quantity of bee products thus 12110.86kg representing 35% was sold from the processor to the wholesaler whilst about 3460.25kg (10%) was used for domestic purposes such as food, beverages, gifts, ceremonies and for traditional medicine. This agreed with Akangaamkum et al. (2010) that about 84% of processors' honey in the Volta Region of Ghana was mostly sold to the middlemen (processors, wholesalers and retailers). Large volume of honey was sold to the wholesaler because an NGO known as WADEP; women wholesale organisation with financial assistance from SNV had established honey processing plant that refined large quantities of honey with direct link to other markets. Some of the women in the organisation also bought from the wholesale point and formed the retail group or joined other individual retailers by buying from the processors directly. The brokers found their way into the marketing channel because of the nature of roads in the study area. The brokers advertise individual brands of honey produced by the beekeepers (who double as processors) and also bought honey or beeswax for wholesalers or retailers on contract bases.

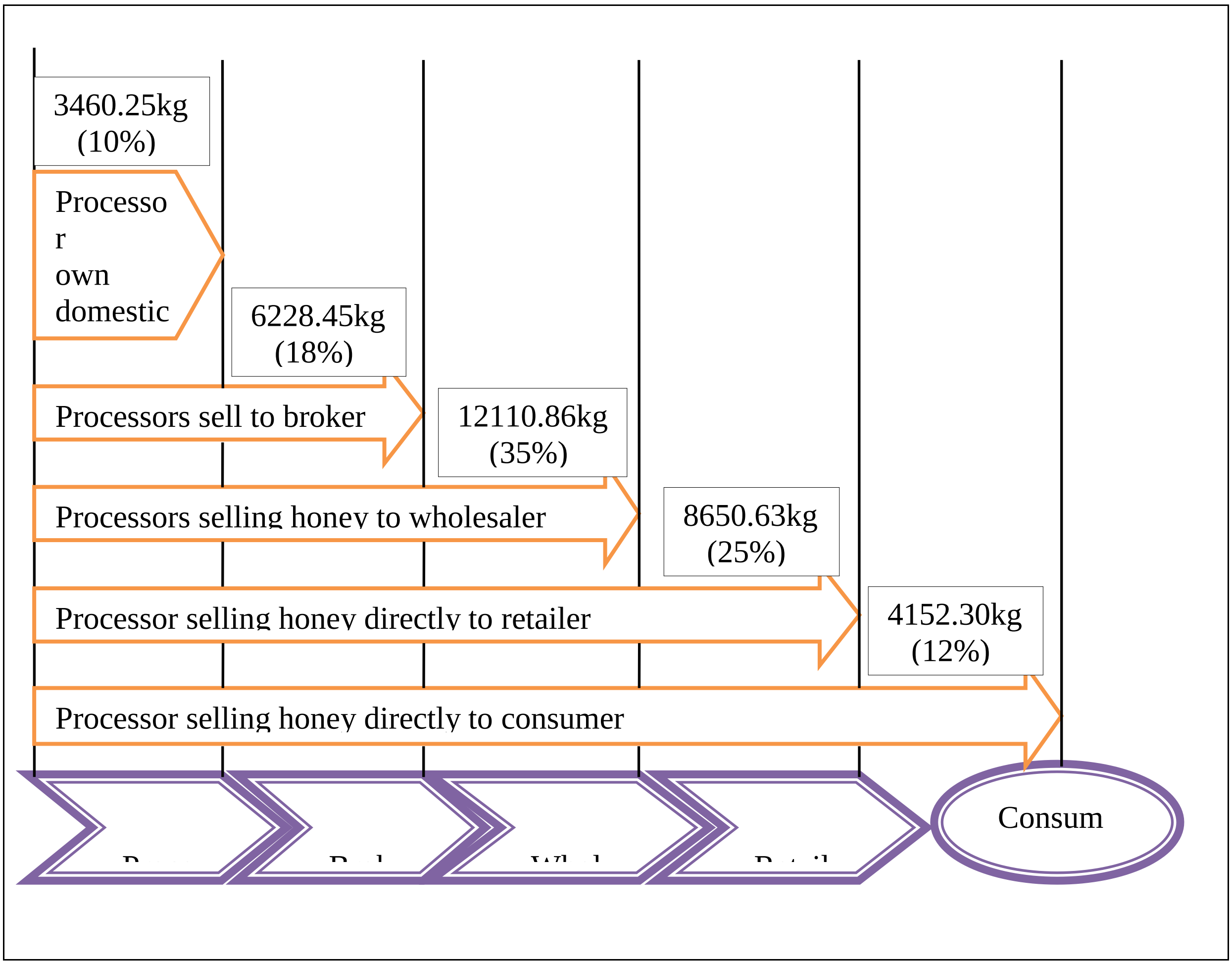

Figure 4.3: Marketing channels of bee products

Source: Survey data, 2012.

4.4.4 Harvesting, Processing and Packaging of Honey

The harvesting tools in beekeeping were smoker, harvesting knife, cutlass, boots, gloves, bee veil and suit. The two ways of harvesting honey comb in the study area were harvesting with a smoker and harvesting without a smoker. From table 4.3 about 90% of the beekeepers used all the tools in harvesting honey combs including the smoker. Those beekeepers that did not use smokers during harvesting did so to prevent microscopic soot incorporated in honey as a form of value addition. According to the beekeepers that practiced such technology, consumers pay a premium price for honey harvested without a smoker. This is in tandem with Krell (1996) who reported that honey absorbs odour of all kinds apart from its hygroscopic nature hence, honey could take the scent of smoke if the smokers were used in harvesting honey combs.

Table 4.3: Value-adding activities in the honey value chain

Activities	Frequency (n = 200)	Percentage (%)
Harvesting methods		
with smoker	180	90.0
without smoker	20	10.0
Processing methods		
Filtration by gravity	85	42.5
Hand pressing	60	30.0
Machine pressing	40	20.0
Centrifugal extraction	15	7.5
Container for packing	**n=350**	
New plastic containers	266	24.0
Recycled plastic cont.	84	76.0
Labeling containers		
With label	98	28.0
Without label	252	72.0

Source: Survey Data, 2012

Beekeepers used both traditional and modern methods in processing honey and other bee products. Filtration by gravity and hand pressing methods of processing honey are classified under the traditional methods whilst machine pressing and centrifugal extractor are the modern methods. The centrifugal extractor is cited in literature as the best method of processing honey but only 7.5% of the beekeepers processed honey by this method. Akangaamkum et al. (2010) also reported that centrifugal extractors were limited in honey processing in Ghana compared to other methods like squeezing, solar and cold extractions. Majority of the beekeepers (42.5%) processed their honey using the traditional method of filtration by gravity. Since most of the producers could not get access to improved methods of processing honey, there is higher possibility that the quality of honey was affected. In the study area, the previously used cooking oil or alcoholic and plastic mineral water containers (recycled containers) were used for packaging honey by about 76% of the actors. This was in contrast to a report by Krell (1996) that previously used containers for oils or any petroleum product should never be used for storing any bee product. Akangaamkum et al. (2010) also reported that about 80% of processors in the Volta Region relied on recycled containers for packaging their honey for sale. Therefore, it was more likely that such honey was adulterated since honey absorbs odour of all kinds (Krell, 1996). Over 72% of the actors had no labels on their packaging materials which attracted lower prices as compared to imported honey products which were well packaged and labelled. It was discovered during a personal observation in some markets that the price of a well labelled imported honey of 500g was GH₵10.00 compared to GH₵5.00 of the same quantity of locally produced honey.

4.4.5 Beekeeping Technology in the Value Chain

The technology used in beekeeping refers to the various types of beehives owned (traditional and modern hives) which were used mainly for honey production and the management practices adopted by chain actors to improve yield, product quality and income. From table 4.4, three distinct types of beehives were identified and used by the sampled beekeepers in the study area. They include Langstroth hive, KTBH and clay pot hive but the common technology (beehive type) used in the study area was the KTBH representing 84.5% of the beekeepers and mostly found in NSD (119) than NND (50). Similarly, Akangaamkum et al. (2010) also found that in all the regions they studied in Ghana including Volta Region, the KTBH was the common type of beehive used by beekeepers. This meant that beekeeping was mostly practiced in Nkwanta South District (NSD) than Nkwanta North District (NND). This was because, with the establishment of the Kyabobo National Park in NSD, people whose farmlands were captured were given beehives to practice beekeeping as alternative livelihood so as to protect the Park from encroachment for farming activities. Langstroth and clay pot hive users were only found in NSD but the KTBHs were used in both districts. The clay-pot hives fall under the traditional or local hives, KTBH under the intermediate or transitional hives and Langstroth hives under the improved or modern beehive type according to the classification by Tessega (2009).

Table 4.4: Technology used in beekeeping activities

Type of Technology	NND	NSD	Total Frequency	Total Per.(%)
		Beekeeping technology		
Type of beehives			**n = 200**	
Langstroth hive	10	20	30	15.0
KTBH	50	119	169	84.5
Clay pot hive	0	1	1	0.5
		Management technology		
Transitional KTBH			**n = 169**	
Single-chamber KTBH	50	100	150	88.8
Double-chamber KTBH	10	9	19	11.2
Modern Langstroth hive			**n = 30**	
Single-chamber Langstroth hive	0	10	10	33.3
Multy-chamber Langstroth hive	0	20	20	66.7
Migratory beekeeping			**n = 199**	
Yes	55	120	175	87.9
No	5	19	24	12.1
Testing for moisture content			**n = 199**	
Using hydrometer	5	10	15	7.5
Traditional knowledge	15	55	70	35.2
No testing at all	40	114	121	57.3

Source: Survey data, 2012.

With the management technology, two main types of transitional beehives (KTBH) were identified in the study area thus Single-chamber and Double-chamber KTBHs. The results showed that single-chamber KTBHs (88.8%) were mostly used by beekeepers in the area especially those in NSD. The practice of double-chamber KTBHs was a new technology under observation by producers for its effectiveness. The name ‘Modern hive’ or Movable Frame Hive (MFH) refers to Langstroth hive as it is a modular type of hive consisting of super-imposed chambers with frames to hold the combs. The multy-chamber Langstroth was the common type of modern Langstroth hive used by about 66.7% of the beekeepers. The advantage of Langstroth hive over KTBH and clay-pot hive is that at the same apiary (place where beehives are kept close together) two or more beehives could be placed on one another. Also, honey could be extracted mechanically from the comb using centrifugal extractor and the empty comb returned to the bees for refilling. Therefore, the energy required for making foundation combs by bees is used for collecting additional nectar. Hence, Langstroth hives have the potential to produce much greater yields than any other hive type. However, production of beeswax is often low as compared to the other beehive types since the honey combs are returned into the beehives for honey production rather than for processing of wax. Also, the advantage of top-bar or movable comb hive over clay-pot hive is that it allows the beekeeper to remove the combs attached to the top bars without any breakage for inspection to be carried out. Majority of the beekeepers (87.9%) practiced migratory beekeeping in search of better forage for honey production and protection of colonies from pests such as ants and lizards from killing bees. Most of the processors (57.3%) did not test their honey before sale to buyers but some processors (35.2%) employed traditional methods such as immersing match stick in a little quantity of honey to observe its wetness. The honey quality was therefore questionable with only about (7.5%) of the processors testing their honey with the standard instrument called hydrometer.

4.5.1 Economic Analysis in the Value Chain

The economic analysis was based on assessment of the honey value chain performance in terms of its economic efficiency. This was done by quantifying the yield and overall value added generated by the chain actors, the cost of production, marketing, profitability and returns on investment made by the technology used and value chain actors.

4.5.2 Honey Production from Beehive Types

Maximum returns from beekeeping depend on the type and number of beehives colonized by bees and the yield obtained from each beehive. There was only one season of honey production during the research work in the study year thus major season which was within the period of January–May, 2012. From table 4.5, the total number of Langstroth hives found in the study area was 299 compared to 2,366 KTBHs and 3 clay pot hives resulting to a total of 2,668 beehives.

Table 4.5:Average annual yield of beehive types

Variable	Annual total yield from beehive types			Total
	Langstroth	KTBH	Claypot	
Total No of hives colonised	299	2366	3	**2668**
Total quantity of honey (kg)	5591	28983.50	28	**34602.5**
Total honey revenue (GH₵)	40702	309046.92	244	**349992.92**
Total quantity of wax (kg)	358.80	2933.84	3.75	**3296.39**
Total wax revenue (GH₵)	981.00	7807.80	10.00	**8798.80**
	Average annual yield/beehive			**Total Avg**
Avg. No of hives /beekeeper	10	14	3	**9**
Avg. qty of honey (kg)/beekeeper	186.37	171.50	28.00	**128.62**
Avg. honey rev (GH₵)/beekeeper	1356.73	1828.68	244.00	**1143.43**
Avg. qty of wax (kg)/beekeeper	11.96	17.36	3.75	**11.02**
Avg. wax rev (GH₵)/beekeeper	32.70	46.20	10.00	**29.63**

Source: Survey data, 2013.

The total annual honey yield and revenue obtained from Langstroth hive was 5591kg and GH₵40,702.00 respectively compared to a total annual honey yield of 28,983.50kg and annual revenue of GH₵309,046.92 from KTBH. From 358.80kg of beeswax, about GH₵981.00 was obtained from Langstroth hive whilst GH₵7,807.80 revenue was also obtained from 2933.84kg beeswax of KTBH per annum. The average number of beehives colonized by bees per beekeeper for Langstroth, KTBH and Clay pot hive were 10, 14 and 3 respectively. However, the total average of 9 beehives per beekeeper was consistent with studies by Akangaamkum et al. (2010) of 9.3 beehives per beekeeper in the Volta Region. Average annual quantities of 186.37kg, 171.50kg and 28kg were obtained from Langstroth, KTBH and clay pot hives respectively per beekeeper. The corresponding revenues from these hives were GH₵1,356.73 for Langstroth, GH₵1828.68 for KTBH and GH₵244.00 for clay pot hive. However, the total average revenue of GH₵1143.43 obtained from the three hives in the area was relatively higher than findings by Akangaamkum et al. (2010) of GH₵1139.60 revenue per beekeeper per annum in Ghana.

4.5.3 Revenue Analysis of Modern and Transitional Beehives

The average revenue generated per beehive type in the study area was calculated by multiplying their respective yields (honey and beeswax in kg) by the unit price per kilogram in Ghana cedi. From table 4.6 an estimated quantity of 18.70kg of honey was obtained per Langstroth hive and at a unit price of GH₵6.39 per kg, about GH₵119.49 revenue was generated compared to honey yield of 12.25kg and revenue of GH₵78.28 per KTBH.

Table 4.6: Average yield, price and revenue per beehive

Type of Beehive	Average Honey Yield/Annum		Revenue Per Beehive (GH₵)
	Avg. Qty (kg)	Unit price (GH₵)	
KTBH (transitional)	18.70	6.39	119.49
Langstroth (modern)	12.25	6.39	78.28
	Average Beeswax Yield/Annum		
KTBH (transitional)	1.24	2.50	3.10
Langstroth (modern)	1.20	2.50	3.00

Source: Survey data, 2012.

Honey yields from Langstroth (18.70kg) and KTBH (12.25kg) hives were lower than estimated production capacity figures of 35kg for Langstroth and 21kg for KTBH in the transitional zone of Ghana as reported by Akangaamkum et al. (2010) and Ahmed (2014). Similarly, beeswax yield of 1.20kg (Langstroth) and 1.24kg (KTBH) were also lower than estimated beeswax production capacity of 2.93kg/hive/annum in Ghana (Akangaamkum et al., 2010) and 1.80kg wax/annum in Kenya (Paterson, 2006). Though factors that accounted for low yields includes poor hive management, inability to bait bees and recycle the honey combs for rapid colonisation, their production performance could be improved through proper colony management practices since most of the beekeepers were within 1-5years of honey production. Higher yield from Langstroth hive (modern hive) in the study area confirms the reason why modern hives were reportedly used for large-scale commercial beekeeping throughout the world (Assefa, 2009). This was an indication that in future, the study area has the potential to produce honey of commercial quantity to supply both local and international markets. Clay pot hive was not considered here because the only beekeeper who inherited the 3 beehives from the father had hinted on abandoning them and opting for either the KTBH or Langstroth hive due to constant lost of hives through breakage of the clay pots.

4.5.4 Costs and Return Analysis of Beehive Types

The analysis of cost and return on beekeepers' capital investment was based on Langstroth and KTBH with products such as honey and beeswax. Table 4.7 shows that Langstroth hive generates revenue of GH₵122.59 per hive compared to ₵81.28 from KTBH per/hive/season. Labour cost accounted for about 21.36% and 15.39% of TVC for Langstroth hive and KTBH respectively. Depreciation on beehives used for beekeeping accounted for about 25.24% for Langstroth hive and 21.65% for KTBH.

Table 4.7: Average costs and returns on investment per beehive per season

Transaction	Langstroth Hive		KTBH	
	Amount	**% Cost**	**Amount**	**% Cost**
Revenue Items				
Honey	119.49		78.28	
Beeswax	3.10		3.00	
Total Revenue	**122.59**		**81.28**	
A. Variable Cost				
Labour	3.40	21.36	2.13	15.39
Bait material	2.23	14.01	2.12	15.32
Maintenance	1.85	11.62	1.50	10.84
Smoking mat.	1.48	9.30	1.45	10.48
Extracting honey	2.45	15.39	2.35	16.98
Wax processing	2.15	13.50	2.22	16.04
Transportation	2.36	14.82	2.07	14.96
TVC	**15.92**	**100.00**	**13.84**	**100.00**
B. Depreciation				
Beehive	2.67	25.24	2.15	21.65
Bee suit	1.02	9.64	1.00	10.07
Smoker	1.33	12.57	1.30	13.09
Sieve	1.65	15.60	1.50	15.11
Wax extractor	2.58	24.39	2.68	26.99
Cutlass	1.33	12.57	1.30	13.09
Sub-total Dep.	**10.58**	**100.00**	**9.93**	**100.00**
TC (A+B)	26.50		23.77	
Net Profit	96.09		57.51	
ROI	3.62		2.42	

Source: Survey data, 2012.

Langstroth hive generated the highest Net Profit of GH₵96.09 compared to GH₵57.51 from KTBH per annum. The results showed that Langstrhoth hive was more profitable with return on investment of 362% compared to 242% of KTBH. This implies that on the average a beekeeper made a net profit of GH₵3.62 for every Ghana cedi invested in Langstroth hive compared to GH₵2.42 from KTBH. Therefore, this study agrees with reports by Oluwatusin (2008) that it was more profitable to product honey from Langstroth hive than KTBH. The higher yield and ROI from Langstroth hive was due to the use of centrifugal extractors in processing honey combs from Langstroth hive more than from KTBH as more empty combs were returned for bees to refill instead of making new foundation combs.

4.5.5 Producers Costs and Return Analysis in the Honey Value Chain

The major actors in the honey value chain perform different value-adding activities hence, the cost items, pricing strategies, revenues and profits obtained also differ from one actor to another. This study employed the traditional method of return on investment (ROI) to arrive at the value-added generated by a particular actor in the honey value chain. From table 4.8, the net return to the total investment (ROI) of the producers (beekeepers) was 128%.This indicated that the beekeepers gained additional money apart from the capital invested thus the producers made more than 100% profit from the business. Ahmed (2014) in his study on the return on investment in apiculture for honey and beeswax production reported a higher ROI of 281% in Mampong Municipality in Ghana even though both study areas lies within the same transitional vegetation zones. The return on investment (128%) was higher than the minimum interest rate (15%) in the area which indicates economic efficiency (Scarborough and Kydd, 1992) and price efficiency (Crawford, 1997; Smith, 1981). Further implication was that the capital was optimally allocated to the resources so that wastage and inefficiency were minimised to maximise profits. On the average a profit of GH₵1.28 was realised on every Ghana cedi invested in honey production.

Table 4.8: Producers average returns on capital investment/annum

Transaction	Qty (kg)	Price /kg (GH₵)	Total Value (GH₵)	% of Total Cost (GH₵)
Total Revenue				
Honey comb	178.94	6.39	1143.43	
Cost of production				
Input payment			165.74	33.10
Bait material			56.40	11.26
Maintenance			45.88	9.16
Rent of equipt			51.90	10.36
Labour (har)			85.36	17.05
Transportation			70.39	14.06
Annual Dep.			25.09	5.01
Total Cost			**500.76**	**100**
Value-added (NP)			642.67	
ROI (NP/TC)			**128%**	
Value-adding efficiency (NP/labour cost +Dep.)			5.82	

Source: Survey data, 2012.
*The quantity of honey and beeswax was based on averages of Langstroth and KTBH.

The costs of investment analysis revealed that averagely, the cost of payment for the inputs given in kind constituted about 33.10% followed by labour cost of 17.05%.This disagrees with the fact that labour is found as the most expensive farm input in beekeeping business as reported by Oluwatusin (2008) where labour accounted for about 64% to 70% of the total cost of honey production. Analysis of the value-adding efficiency to measure productivity of value-added per labour generated a GH₵5.82 returns per unit of labour employed in value addition. This shows that labour was efficiently used during the process of value addition.

4.5.6 Processors Costs and Return on Investment in the Value Chain

The processors (who double as collectors or assemblers) in the honey value chain obtain raw materials from the beekeepers in the form of honey combs and extract honey from the combs and the by-products as beeswax. From table 4.9, the processors ROI was about 53% from honey and beeswax processing business.

Table 4.9: Processors average returns on capital investment/annum

Transaction	Qty (kg)	Price /kg (GH₵)	Total Value (GH₵)	% of Total Cost (GH₵)
Revenue item				
Processed honey	178.94	10.78	1928.97	
Beeswax	14.66	2.50	36.65	
TR			**1965.62**	
Cost of processing				
Raw mat. (honey comb)	178.94	6.39	1143.14	88.80
Labour (Sorting)			20.50	1.59
Labour (Extraction)			35.70	2.77
Market toll			25.68	1.99
Transportation			40.40	3.14
Annual Dep.			21.86	1.71
Total Cost			**1287.28**	
Value-added (NP)			678.34	
ROI (NP/TC)			**53%**	
Value-adding efficiency (NP/labour cost +Dep.)			8.69	

Source: Survey data, 2012.

This means that more than half (53%) of the total capital invested in processing honey and beeswax was gained. Averagely, a profit of GH₵0.53 was realised on every Ghana cedi invested in processing. The cost of raw materials (honey comb) was the highest (88.8%) and accounted for the total cost of processing. Therefore, the honey processing business was profitable and worth investing in since the Return of Net Profit to Total Cost was higher than the minimum interest rate (15%) of the credits accessible to the processors in the study area as reported by Malaa et al. (2004). Besides, the processors were also economic (Scarborough and Kydd, 1992) and price (Crawford, 1997; Smith, 1981) efficient in the allocation of capital to resources. Measuring productivity using value-adding efficiency showed GH₵8.67 returns per every unit of labour employed in value addition which implies efficient use of labour during the value addition process.

4.5.7 Wholesalers Costs and Return on Investment in the Value Chain

The wholesalers work closely with the brokers who help in locating honey buying centers. Wholesalers buy crude honey in semi-processed form and further strain or refine and package for sale. Averagely the return on investment (ROI) of wholesalers was 24% (see table 4.10).

Table 4.10: Wholesalers average returns on capital investment/annum

Transaction	Qty (kg)	Price /kg (GH₵)	Total Value (GH₵)	% of Total Cost (GH₵)
Revenue item				
Pure honey	178.94	14.25	2549.90	
Beeswax	14.66	5.37	78.72	
TR			**2628.62**	
Cost of processing				
Semi-processed honey	178.94	10.78	1965.62	92.41
Beeswax	14.66	2.50	36.65	1.72
Straining/refining			33.52	1.58
Market toll			26.18	1.94
Transportation			41.25	1.23
Annual Dep.			23.79	1.12
Total Cost			**2127.01**	
Value-added (NP)			501.61	
ROI (NP/TC)			**24%**	
Value-adding efficiency (NP/labour cost +Dep.)			8.75	

Source: Survey data, 2012.

This figure implies that about 24% of the total capital invested in processing crude honey and beeswax was gained from refining honey. On average a profit of GH₵0.24 was realised on every Ghana cedi invested in the trade. The cost of raw materials (crude honey) representing 92.41% accounted for the total cost of straining or refining honey. Comparing the Return of Net Profit to Total Cost (24%) to the minimum interest rate (15%) of the credits accessible to wholesalers shows a higher ROI which was an indication of a profitable and economic efficient business (Malaa et al., 2004). Analysis of the value-adding efficiency to measure productivity of value-added per labour resulted in GH₵8.75 returns per unit of labour employed in value addition. This shows that labour was efficiently used during the process of value addition.

4.5.8 Retailers Costs and Return on Investment in the Value Chain

The retailers in the honey value chain buy the refined pure honey from the wholesalers and package them into smaller containers for sale to consumers. From table 4.11, the return on investment (ROI) of about 26% was obtained from retail trade. This means that retailers obtained a little above one-quarter (26%) of the total capital invested in packaging refined honey and beeswax. Averagely, a profit of GH₵0.26 was realised on every Ghana cedi invested in retailing.

Table 4.11: Retailers average returns on capital investment/annum

Transaction	Qty (kg)	Price /kg (GH₵)	Total Value (GH₵)	% of Total Cost (GH₵)
Revenue item				
Packaged honey	178.94	18.75	3355.13	
Beeswax	14.66	8.98	131.65	
TR			**3486.78**	
Cost of processing				
Refined pure honey	178.94	14.25	2549.90	92.48
Beeswax	14.66	5.37	78.72	2.86
Packaging			37.28	1.35
Market toll			29.80	1.08
Transportation			38.50	1.40
Annual Dep.			22.77	0.83
Total Cost			**2756.97**	
Value-added (NP)			729.81	
ROI (NP/TC)			**26%**	
Value-adding efficiency (NP/labour cost +Dep.)			12.15	

Source: Survey data, 2012.

The cost of refined pure honey (92.48) accounted for the total cost of packaging honey into smaller units for sale. Therefore, it was profitable to engage in retail trade since the Return of Net Profit to Total Cost (26%) was higher than the minimum interest rate (15%) of the credits that was accessible to the retailers in the study area (Malaa et al., 2004). This implies that the retailers where economically efficient in pricing their products so as to maximise profits (Crawford, 1997; Smith, 1981). This higher return on capital investment (26%) in the retail business compared to the minimum interest rate of 15% was considered normal net profit (Tomek and Robinson, 1990). Labour productivity using value-adding efficiency estimated

GH₵8.67 returns per every unit of labour employed in value addition which indicates efficient use of labour during the process of value addition.

4.5.9 Comparison of Mean Difference

The independent sample t-test was used to compare the means of outputs (honey yield) of beehive types (Langstroth and KTBH) and actors Return on Investment (ROI). The results from table 4.12 showed a significant difference between the mean honey yield of Langtroth hive and KTBH at 1% significant level (t=24.996, P = 0.000< 0.001).

Table 4.12: Mean difference in yield and Return on Investment

	Mean yield difference between beehive types			
Variable	**Mean for Langstroth**	**Mean for KTBH**	**t-statistic**	**P-value (sig. 2-tailed)**
Mean honey yield (kg)	18.70	12.25	24.996	0.000***
Mean wax yield (kg)	1.20	1.24	-0.967	0.335
Total revenue (GH₵)	122.59	81.28	6.958	0.000***
Labour cost (GH₵)	3.40	2.13	3.239	0.000***
TVC (GH₵)	15.92	13.84	-0.756	0.450
Depreciation (GH₵)	10.58	9.93	0.023	0.981
TC (GH₵)	26.50	23.77	0.329	0.743
NP (GH₵)	96.09	57.51	9.755	0.000***
ROI (GH₵)	3.62	2.42	3.565	0.000***
	Mean difference of ROI			
	Producer	Processor		
Mean ROI (GH₵)	1.28	0.53	6.808	0.000***
	Producer	wholesaler		
Mean ROI (GH₵)	1.28	0.24	7.427	0.000***
	Producer	Retailer		
Mean ROI (GH₵)	1.28	0.26	7.369	0.000***

Source: Survey data, 2013.
Note: *** means significant at 1%

This implies that the mean honey yield of Langstroth hive (18.70kg) was significantly higher than KTBH (12.25kg). There was no significant difference between the mean beeswax yield of Langstroth hive (1.20kg) and KTBH (1.24kg) because few processors used centrifugal extractors for processing honey produced from Langstroth hives. Records showed that processors who used centrifugal honey extractors were able to obtain the empty honey combs to be returned into the beehives as foundation combs for honey production (Marieke et al., 2005b). With the limited usage of centrifugal honey extractors meant that more honey combs from Langstroth hives similar to KTBH was available for processing into beeswax. Therefore, the null hypothesis that ‘there were no honey yield differences among the beehive types’ was rejected for honey yield but not for beeswax yield. This implies that the types of beehives used by beekeepers contributed to the honey yield difference but not wax yield difference.

There was significant difference between the mean TR, NP and ROI of Langtroth hive and KTBH thus ($t = 6.958$, $P = 0.000 < 0.001$), ($t = 9.755$, $P = 0.000<0.001$) and ($t = 3.565$, $P = 0.000<0.001$) at 1% significant levels respectively. This indicates that the TR (GH₵122.59), NP (GH₵96.09) and ROI (GH₵3.62) of Langstroth hive higher than TR (₵81.28) NP (GH₵57.51) and ROI (GH₵2.42) of KTBH shows that Langstroth hive was more profitable than KTBH. This agreed with Oluwatusin (2008) and hypothesis 1 of this study that it was more profitable to produce with Langstroth hive than Top-Bar hive. Also, the mean difference between producers and processors ROI ($t = 6.808$, P-value $= 0.000<0.001$), producers and wholesalers ROI ($t = 7.427$, $P = 0.000<0.001$) and producers and retailers ROI ($t = 7.369$, $P = 0.000<0.001$) all showed a strong significant difference at 1% levels. This showed that the mean profit of producers (GH₵1.28) was significantly higher than the mean profits of processors (GH₵0.53), the wholesalers (GH₵0.24) and the retailers (GH₵0.26). This result confirmed Malaa et al. (2004) and hypothesis 2 of this study that profitability in honey production was higher when the raw material was comb honey than when the raw material was partially drained or processed honey. Hence, the type of raw material used by various actors in processing honey contributed to the net profit difference among actors.

4.6 Governance in the Value Chain

Governance in the honey value chain was observed using the type of information that flows from the buyers to the suppliers. This reflects the authority that value addition participants had in relation to product flow and information flow in the opposite direction to improve product quality. From table 4.13, majority of the actors representing 63% received information on buyer requirements.

Table 4.13: The governance system in the honey value chain

Governance by Information	Frequency (n = 350)	Percentage (%)
Type of Information		
Buyer requirement	221	63
Technical assistance	87	25
Conformity to standards	42	12
Buyer requirement	**n = 221**	
Codified information	85	38
Non-codified information	136	62
Source of information	**n = 350**	
Extension agents	51	14.6
Textbooks/journals	35	10.0
Honey buyers	107	30.5
Beekeepers association	71	20.3
Fellow beekeepers	86	24.6

Source: Survey data, 2013

This implies that the backward suppliers were forced to comply with the demands of buyers. The type of information transferred was either codified or non-codified forms. In the honey value chain, about 62% of the actors received information in non-codified form. This means that the buyers gave the requirements of bee products to suppliers but did not share the cost of the value added either through training or advice. It was expected that the buyers who better understood the demands of the market should provide technical and financial assistance to enhance the capacity of their suppliers after communicating the requirements. Unfortunately, about 25% of the suppliers received technical assistance from buyers. Besides, only 12% of the suppliers were able to measure their product quality against the requirements set by the buyers in conformity to standards. This explains the inclusion or exclusion of some products or actors from the value chain based on the ability or inability to fulfill the basic requirements. Also, those who received information in codified form representing 38% where those suppliers who were able to monitor their products in compliance with the requirements set by buyers. Finally, the major source of information on modern beekeeping practices and quality products was from honey buyers (30.5%). Information from buyers mostly results to high transaction cost since buyers did not contribute to the improvement of the product.

4.7.1 Honey Production Constraints in the Value Chain

Even though honey production is highly promoted in the study area through interventions by various organizations, the sub-sector has not been fully exploited to its potential due to several constraints. Based on the non-parametric statistical tool called Kendall test employed to assess the magnitude and rank of the major constraints faced by beekeepers in the value chain, lack of finance for expansion and procurement of modern tools and equipment (21.5%) emerged as the first and most pressing constraint(see table 4.14).

Table 4.14: Major constraints faced by beekeepers in the honey value chain

Constraints	**Frequency (n = 200)**	**% Ranking**
Lack of finance for expansion	43	21.5
Lack of technical assistance	30	15.0
Inadequate infrastructure and modern technology	25	12.5
Weak producer groups	22	11.0
Aggressiveness, absconding & swarming tendency	20	10.0
Bad state of feeder roads	17	8.5
Pests and predators	14	7.0
No proper documentation on production	12	6.0
Indiscriminate bush burning	10	5.0
Theft cases	7	3.5
Kendall's W[a]	0.68	
Chi-Square (χ^2)	85.122	
Degree of Freedom (df)	9	
Asymptotic Significance	0.000***	

Source: Survey data, 2012.
a = Kendall’s Coefficient of Concordance (KCC)
***means significant at 1% level

This was followed by lack of technical assistance to improve the capacity of beekeepers in honey production with 15% ranking. This was in line with a baseline study by Subbey (2009) in Ghana where the major constraint identified in honey production was lack of access to financial resources whilst Ahmed (2014) reported lack of technical assistance as the second constraint factor in Apiculture in Mampong Municipality of Ashanti Region. It also confirms similar reports by Oluwatusin (2008) that lack of capital and technical assistance were the most constrained factors facing producers in the development of the honey industry in Nigeria.This study also agrees with Kimbi et al. (1999) that some beehives such as modern hives (Langstroth) were found to be appropriate for beekeeping, but most beekeepers could not afford to buy due to lack of capital. This is also related to a study by Dowswell (1993) that financial institutions are reluctant to make credits in cash accessible to producers for purchasing modern processing equipment due to the general risk involved in agriculture.

Indiscriminate bush burning and theft case were ranked least on the table as 5% and 3.5% respectively. This meant that they were not major problems in the area due to the establishment of Kyabobo National Park which discourages bush burning and the belief in punishment by lesser gods on theft cases in most of the beekeeping communities like Shiare. Finally, the results based on ranking by Kendall's Coefficient of Concordance (W) of 0.68 which is less than 1 indicates that there was about 68% agreement among the respondents in the ranking system. Hence, Kendall’s ‘W’ testing the null hypothesis that there was no agreement among beekeepers in ranking the problems affecting honey production was rejected at 1% significant level.

4.7.2 Honey Marketing Constraints in the Value Chain

The marketing constraints in the honey value chain were those challenges facing the middlemen such as the brokers, wholesalers and retailers who were engaged in bee products trade. Based on the results of Kendall's Coefficient of Concordance employed in the ranking of the major constraints faced by middlemen in the value chain, competition from imported honey and lack of proper records on marketing of bee products with 20% and 16.7% emerged as the first and second most constrained factors in the honey trade respectively (see table 4.15). This ranking was consistent with findings by Aidoo (2005) that though tonnes of honey were being produced every year in Ghana, its place in the local market was being taken by imported honey.

Table 4.15: Major marketing constraints faced by middlemen in the honey value chain

Constraints	**Frequency (n = 150)**	**% Ranking**
Competition from imported honey	30	20.0
Lack of proper records on marketing of bee products	25	16.6
Limited access to credit facilities	21	14.0
Bad state of feeder roads	18	12.0
High transportation costs	16	10.7
lack of detailed market information	15	10.0
Inaccessibility to marketing centers	10	6.7
Low turnover rate	7	4.7
Lack of standardized and quality management	5	3.3
Lack of enabling regulatory and policy framework	3	2.0
Kendall's W[a]	0.56	
Chi-Square (χ^2)	70.145	
Degree of Freedom (df)	9	
Asymptotic Significance	0.000***	

Source: Survey data, 2013.
a = Kendall's Coefficient of Concordance
***means significant at 1% level

The second ranked constraint also confirmed results of Akangaamkum et al. (2010) that lack of proper recording of production, sales and export of honey from 2004 to 2008 accounted for their inability to document production trend of the honey sector in the Volta Region of Ghana. The results based on ranking by Kendall's Coefficient of Concordance (W) of 0.56 which is less than 1 indicated about 56% agreement among the respondents in the ranking system. Hence, Kendall's 'W' testing the null hypothesis that there was no agreement among beekeepers in ranking the problems affecting honey production was rejected at 1% significant level.

4.7.3 Upgrading of the Honey Value Chain

In upgrading the honey value chain, all efforts at improving the bee products along every step of production, harvesting, processing and distribution was focused on interventions that could enhance the capacity of chain participants. The strategies for upgrading the honey value chain were based on the technologies identified in this study and the processes involved in improving the product at every stage of the chain (see table 4.16).

Table 4.16: Upgrading of the honey value chain based on the study results

Fields of Action	Technology used	Value chain upgrading strategy	Particular action to improve performance
Improving production	1. Modern beekeeping with KTBH and Langstroth hives	Improving production volume of products	Training on use of multi-chamber KTBH and Langstroth hives including feeding of colonies outside the bloom period.
Improving business linkages and partnership associations	Contract farming	Formation of producer & trade associations	Stakeholder support in conducting regular training and meetings. Encouraging payment of dues for use by members. Improving terms of contracts and encouraging collaborative marketing.
Strengthening service supply and demand	1. Modern processing method	Processing innovation for diversification of bee products	Training participants in processing other marketable bee products for sale such as propolis, chunk honey, royal jelly, venom bee brood and bread apart from honey and wax.
Introducing standards and improving policies in the business and marketing	Use of hydrometers or refractometers	Quality improvement by introducing standards.	Introducing testing of moisture content of honey and grading system so that bee products are priced according to the quality of product.

Source: Survey data, 2012.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter involves the summary of the key findings to the research work, the conclusions drawn and recommendations for further studies and suggestions for policy makers to implement for development of the honey industry.

5.2 Summary

The principle of value chain analysis was applied on beekeeping in Nkwanta North and South Districts of the Volta Region. The results of socio-economic characteristics of beekeepers showed that the average age of respondents was 40.7 years which was within the productive ages of 40-49 years (27.1%). The study also showed that about 76% of the beekeepers were married with majority of about 70.6% male beekeepers and 75.4% Christian population. Majority of the respondents (61.1%) had formal education with a mean of 6.66 years in schooling. The respondents had an average household size of about 6 people with 5.79 years mean experience in beekeeping activities. Most beekeepers (64.3%) were members of beekeeping association and about 60% started beekeeping through training with most actors (23.1%) receiving inputs from an NGO called WADEP. The major source of capital for activities in the value chain was through actor's personal savings (50.9%) with a loan averaging GH₵750.00 at 25% average interest rate. The credit accessible in the area was mostly in-king (54.3%) with about 80% renting equipment using 44.3% hired labour.

The major actors in the honey value chain were producers, processors (who double as assemblers or collectors), brokers, wholesalers and retailers. The total honey and beeswax yields realized from both Nkwanta North and South Districts were 34602.50kg and

3296.39kg respectively. Honey was distributed through four channels with herbal industry receiving the highest quantity of honey (13148.95kg) representing 38%. Beeswax was also distributed through two main channels with more than half of the total quantity (1780.05kg) thus 54% being used as bait materials. The study identified five marketing channels of bee products, but processors mostly sold honey to wholesalers (35%). The common harvesting method employed in harvesting honey combs was through the use of smokers (90%) whilst filtration by gravity (42.5%) was mostly used for processing honey combs. The common containers used for packaging processed honey was recycled plastic containers (76%) and about 72% of this packaged materials were not properly labeled.

The technology employed in beekeeping activities was based on the types of beehives used and the management practices. The study identified three types of beehives; clay-pot, KTBH and Langstroth hives but the KTBH was commonly used by about 84.5% of the beekeepers with which about 88.8% was constructed as single-chamber KTBHs. With the Langstroth hive, about 66.7% were constructed as multy-chamber Langstroth hives. Almost all the beekeepers in the study area (87.9%) practiced migratory beekeeping during baiting of colonies. Unfortunately, about 57.3% of the total quantity of honey produced in the area was not tested for moisture content level before it was sold to buyers. The total number of beehives owned and colonized by bees was 2668 beehives with an average of 9 beehives per beekeeper. The average quantities of honey and beeswax obtained per beekeeper was 128.62kg and 11.02kg respectively. The average honey revenue generated per beekeeper was GH₵1143.43 whilst beeswax revenue was also GH₵29.63. The mean annual honey yield of the various beehive types were 9.33kg (clay-pot hive), 12.25kg (KTBH) and 18.64kg (Langstroth hive). The average honey revenue realized per beehive was GH₵119.49 for Langstroth hive and 78.28 for KTBH with average beeswax revenue per beehive of GH₵3.10 and GH₵3.00 respectively. The NP of Langstroth hive and KTBH were GH₵96.09

and GH57.51 whilst the ROI for Langstroth and KTBH were also GH₵3.62 and GH₵2.42 respectively. The TR, NP and ROI of Langstroth hive were significantly different from that of KTBH at 1% significant levels.

The return on investment obtained from honey trade along the value chain was highest for producers (128%) followed by processors (53%), the retailers (26%) and wholesalers (24%). The retailers were more efficient in value addition with GH₵12.15 whilst producers were less efficient with GH₵5.82 per every unit of labour employed in the process of value addition. This was because producers employed the highest labour force of about 17.05% compared to 1.35% labour employed by retailers hence retailers obtained the highest Net Profit of GH₵729.81 in the honey value chain. Comparison of the mean difference between honey yield of Langstroth hive and KTBH showed a 1% significant level but there was no significant difference in wax yield between the two beehives. Comparing the mean difference between the producers and other actors (processors, wholesalers and retailers) all showed 1% significant levels. Governance based on information received was 63% buyer requirement which was in non-codified form (62%) and about 30.5% of producers' source of information was from their buyers. The most encountered constraint in honey production using Kendall's Coefficient of Concordance was lack of finance for expansion (21.5%) followed by lack of technical assistance (15%) with 68% agreement which was significant at 1% level. Finally, competition from imported honey (20%) followed by lack of proper records on marketing of bee products (16.6%) were the major marketing constraints faced by the middlemen with 56% agreement at 1% significant level.

5.3 Conclusion

The results from the positive returns on investment on Langstroth and KTBH and all the major actors (producers, processors, wholesalers and retailers) indicated profitability and value-adding efficiency in the value chain. It also demonstrated economic and price efficiency in the honey trade since all the returns on investment of all the beehive types and actors in the honey value chain were higher than the minimum interest rate of 15% of the study year in the area. From this key findings and lessons learnt in best practices and experience suggests that beekeeping was an economically viable activity that could strengthen people's livelihoods, especially in developing countries like Ghana. Therefore, if attention is given to the processing of other bee products such as Propolis, royal jelly, bee larvae, bee brood and bread apart from honey and beeswax it would not only increase the net profits of participants but also create jobs for the people. Hence, the honey sub-sector has the potential of giving people opportunities for reliable alternative incomes through job creation to unemployed youth at every step of the honey value chain. The sector could also provide major inputs for the development of allied industries like the brewery and pharmaceutical industries and improve environmental conservation. There are prospects for the sector to complement other efforts to enhance people’s standard of living. When effectively supported, beekeeping could be one of the pillars for reducing poverty and economic vulnerability of low-income communities in Ghana.

5.4 Recommendations

Value chain analysis is highly advisable for those chains that exhibit strong interdependencies of the actors throughout the chain. The study therefore recommends that financial institutions should consider beekeepers as farmers when loans are granted for acquisition of modern equipment such as centrifugal extractors for processing honey. Input suppliers should be encouraged to increase the supply and use of Langstroth hives for honey production and centrifugal extractors in processing the honey combs. With the use of centrifugal honey extractors, the empty honey combs could be returned into the beehives for honey production. So the energy worker bees require in making foundation combs could be used in collecting flower nectar so that honey would be produced twice in a year (both major and minor seasons) instead of the single season production. This would enhance yield and profit levels of chain actors and also improve the vegetation of the area through pollination by the honeybees during nectar collection. Beekeepers especially females should be trained on honey comb harvesting to reduce the labour cost in harvesting honey or consider the introduction of stingless honeybees for more female participation in beekeeping. The buyers should also share the cost of information given to suppliers through advice and training to improve their capacity in processing bee products according to standards.

Further research should be carried out on beekeeping for poverty reduction in Ghana and the contribution of beekeeping sector to household income and the economy of Ghana. This research concentrated on internal governance based on information flow. A further study should be carried out on external honey value chain governance to determine the executive, judiciary and legislative functions and how domestic honey value chain could be integrated into the global value chain for global market accessibility. There should be a comparative analysis of beekeeping sector to crop production so that policy makers could recommend beekeeping as a poverty reduction strategy in poverty endemic areas since beekeeping does not compete with crops for resources and require less land for production.

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APPENDIX

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
COLLEGE OF AGRICULTURE AND NATURAL RESOURCES
DEPARTMENT OF AGRICULTURAL ECONOMICS,
AGRIBUSINESS AND EXTENTION

QUESTIONNAIRE USED IN THE RESEARCH WORK

SELF-ADMINISTERED QUESTIONNARE

Dear respondent,

My name is Jakpa Mamebi Moses; a student of Kwame Nkrumah University of Science and Technology. I am conducting a research on the topic: Value chain and profitability analysis of honey production in Nkwanta North and south Districts of the Volta Region, Ghana. The information required from you is for academic research purposes. Therefore, the answers you give will be treated as confidential and anonymous to enhance the research work only. I would be grateful if you could spare some of your time to respond to the interview questions that follows. I count on your kind cooperation. Thank you.

Serial number ....District.........................Date........................Time.........................

NAME OF ORGANIZATION:...

DATE OF INTERVIEW:..

TIME OF INTERVIEW:..

REGION:...

DISTRICT:..

COMMUNITY:...

INTERVIEW QUESTIONS

1. When was your organisation established?...

2. What was the purpose of establishment?

....

....

3. Why did you choose to support beekeeping activities?

i)..

ii)..

iii)..

4. What services does your organisation provide for beekeepers?

....

....

5. How do you fund the beekeeping activities?

....

....

6. How do you ensure that beekeeping activities in the area is sustainable?

....

....

7. What challenges do you face with the beekeepers?

i)..

ii)..

PERSONAL INTERVIEW QUESTIONNAIRE

Name of respondent..Community...

Serial number ....District........................Date........................Time.........................

Table 6.1: Socio-economic characteristics of respondents

Gender	**Age**	**Marital status**	**Household size**	**Religion**
1.Male 2.Female ☐	1. 20 – 29 2. 30 – 39 3. 40 – 49 4. 50 – 59 5. 60+ ☐	1.Single 2.Married 3.Divorced 4.Separated 5.widowed ☐	No of people 1. 1 – 5 2. 6 – 10 3. 11 – 15 4. 16 – 20 ☐	1.christian 2.Muslim 3.Traditional ☐ Others............
Experience	**Education**	**Credits**	**Training**	**Activity**
Number of years in beekeeping 1. 1 – 5 (little ex) 2. 6 – 10 (avg) 3. 11 – 15 (exp) 4. 16 – 20 (more) ☐ Year started ……………	No of years …………… Level of educ. 1. no educ. 2. basic educ. 3. secondary 4.tertiary ☐	Do you obtain any credits for production? 1. Yes 2. No ☐ If yes in which way? 1. in cash 2. in kind ☐	Are you trained in beekeeping? 1. yes 2. no ☐ If yes, how many times in a year? ………………	What activity do you do? 1. production 2. assembling 3. processing 4. advertising 5. wholesale 6. retailing 7. hawking ☐
Capital	**Labour**	**Equipment**	**Starting of beekeeping**	**Association**
Source of capital 1. own savings 2. relatives ☐ 3. banks 4. credit union 5. susu collectors	What type of labour do you use? 1. hired 2. family 3. both ☐	How do you acquire equipment? 1. renting 2. own source ☐	1.by training 2.inheritance 3.own initiat-ive ☐ Others …………...	Do you belong to beekeeping association? 1.yes 2.no ☐ If yes, name the association……

Table 6.2: Honey production process

Starting of beekeeping	**Type of beehive used**	**Harvesting methods**	**Supply of inputs**	**Migratory beekeeping**
1.by training 2.inheritance 3.own initiative ☐ Others …………...	1.Langstroth 2.KTBH ☐ 3. Claypot **Construction** 1.single-chamber 2.double-chamber ☐	Do you use smokers in harvest honey comb? 1. yes 2.No ☐ Month of harvest……….	1. MoFA 2. wildlife 3. WADEP 4. WVI 5. Heifer ☐ 6. Assiciations 7. own initiative	Do you practice migratory beekeeping? 1. yes 2. no ☐
Packaging material	**Processing methods**	**Major Buyers**	**Information governance**	**Source of information**
1.new plastic 2. recycled ☐ **Labeling** 1. with label 2.without Label ☐	1. filtration by gravity 2.hand pressing 3.machine press 4.centrifugal extractor ☐	Who are your major buyers 1. processors 2. brokers 3. wholesalers 4. retailers ☐	1. Buyer req. 2. Tech. assit. 3. Conformity **Buyer req't** 1. codified 2. non-codified ☐	1. extension agents 2. textbooks 3. buyers 4. association 5. fellow beekeepers ☐

Table 6.3: Distribution of bee products

Honey distribution	Wax distribution	Domestic use of honey	Testing of honey
1. brewery 2. medicine 3. consumption 4. export ☐	1. bait material 2. cosmetic ind. ☐	1. food 2. medicine 3. beverage 4. ceremony 5. gifts ☐	How do you test honey? 1. using hydrometer 2. traditional testing 3. no testing ☐

Table 6.4: Honey yield from hive types

Type of Beehive used	Number of beehives		Annual quantity of honey combs harvested (kg)	Annual qty of processed honey (kg)	Price per kg
	Owned	Colonized by bees			
Langstroth					
KTBH					
Clay pot					

Note: KTBH=Kenyan Top-Bar Hive

Table 6.5: Wax yield from hive types

Type of Beehive used	Number of beehives		Annual quantity of honey combs harvested (kg)	Annual qty of processed honey (kg)	Price per kg
	Owned	Colonized by bees			
Langstroth					
KTBH					
Clay pot					

Note: KTBH=Kenyan Top-Bar Hive

Table 6.6: Rank the following constraints encountered in beekeeping by indicating 1-10 against each problem (1=most encountered problem up to 10 = the least encountered problem).

Constraints of beekeepers	Rank
Indiscriminate bush burning	
Bad state of feeder roads for transporting honey to marketing centers	
Theft (stealing of honey and honey combs from beehives)	
No proper documentation on beekeeping activities	
Pests and predators (ants, termites, hive beetles, wax moths, birds and lizards)	
Weak producer groups	
Lack of technical assistance	
Lack of finance for expansion	
Bees unpleasant behaviour (aggressiveness, absconding & swarming tendencies)	
Inadequate infrastructure and modern technology	

Table 6.7: Rank the following constraints encountered in marketing by indicating 1-10 against each problem (1= most encountered problem up to 10 = the least encountered).

Constraints of middlemen	Rank
Lack of standardized and quality management	
Bad state of feeder roads for transporting honey to marketing centers	
High transportation costs	
Lack of enabling regulatory and policy framework	
Lack of proper records on marketing of bee products	
Limited access to credit facilities	
Competition from imported honey	
Lack of detailed market information	
Low turnover rate	
Inaccessibility to marketing centers	

Table 6.8 Revenue and expenditure account in the honey production year - 2012

Revenue & exp. account for **Producers** Revenue & exp. account for **Processors**

Revenue Items	**Qty**	**Unit Price (GH¢)**		**Rev Items**	**Qty**	**Unit Price (GH¢)**
Honey comb (kg)				Honey comb (kg)		
Wax (kg)				Wax (kg)		
Variable Costs Items	**Qty**	**Unit Price (GH¢)**		**Variable CostItems**	**Qty**	**Unit Price (GH¢)**
Maintenance				Maintenance		
Bait materials				Sorting		
Payment of inputs				Extraction honey		
Labour (harvest)				Processing wax		
Rent of equipt.				Market toll		
Transportation				Transportation		

Table 6.9:Account for **Wholesalers** Account for **Retailers**

Revenue Items	**Qty**	**Unit Price (GH¢)**		**Revenue Items**	**Qty**	**Unit Price (GH¢)**
Proc. honey (kg)				Proc. honey (kg)		
Wax (kg)				Wax (kg)		
Variable Costs Items	**Qty**	**Unit Price (GH¢)**		**Variable Cost Items**	**Qty**	**Unit Price (GH¢)**
Maintenance				Maintenance		
Cost of honey				Cost of honey		
Refining/straining				Packaging		
transportation				transportation		

Table 6.10:Depreciation on equipment

Name of item	**Useful life**	**Residual value**	**Cost of item**	**Depreciation**
beehive				
bee suit				
smokers				
extractors				