MAPPING OF THE HONEY VALUE CHAIN AND ANALYSIS OF CHANGES IN GENDER ROLES AND FACTORS INFLUENCING WOMEN EMPOWERMENT AMONG BEEKEEPERS IN KITUI COUNTY, KENYA

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university

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DEDICATION

I dedicate this thesis to my dad Mr. Meshack Mburu Muchiri, my late mum Mrs. Beatrice Wanjiru, brother and sisters. Their world outlook has provided the much-needed inspiration in the course of my study.

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ABSTRACT

Beekeeping is an important activity that helps rural communities to raise additional income to improve their livelihoods. Often, among rural beekeeping households, it has been widely adopted as an income diversification strategy. In addition, it is a sustainable form of agriculture beneficial to the environment. An intervention conducted by the International Centre of Insect Physiology and Ecology (ICIPE), introduced modern hives such as the Langstroth and the stingless beehive through the Commercial Insect Programme (CIP) of the institute. Trainings given to the community were for the development of a value chain and hence the formation of farmer groups that aided in marketing of honey and other beekeeping products. Furthermore, the introduction of stingless beekeeping that is friendly was to encourage more women to participate in beekeeping. Owing to these interventions, beekeeping had now become an important income generating activity for both men and women in Kitui County. However, how beekeeping and commercialization of beekeeping products had influenced gender roles at the household level and factors influencing participation of households in CIP as well as women empowerment remain unknown. In this study, the gender analysis framework was used to identify gender roles, while beekeeping value chain analysis gave the study a structure and was useful in identifying actors along the value chain. Principal component analysis (PCA) was used to construct a composite index of Women empowerment. Indicators used to proxy women empowerment were drawn from five key areas; entrepreneurship or management of the apiary and other farm enterprises; labour use; acquisition and disposal of apiary; household and farm assets; children schooling decisions as well as acquisition and use of credit. A total sample of 498 household beekeepers comprising 251 CIP beneficiaries and 247 non-beneficiaries (NCIP) were interviewed during the study. Data were collected though the use of a semi-structured questionnaire and analysed using descriptive statistics and the Heckman sample selection model. The findings of the study indicated that among the CIP households, women performed significantly more beekeeping activities

for honey production compared to those in the NCIP households. Results also revealed that CIP women participated significantly more in making key decisions regarding beekeeping enterprise compared to NCIP women. This indicated that participation in beekeeping through the CIP led to a positive change in gender roles. Further, the study revealed that positive and significant factors influencing households' participation in CIP were dependency ratio, number of income sources, age of the household head, experience in beekeeping, quantity of honey harvested and access to credit by the household head. In addition, significant factors influencing women empowerment index (WEI) positively were gender of household head, number of income sources and beehive types used while dependency ratio was negatively associated with WEI. Finally, the difference in WEI was statistically significant when comparing CIP and non-CIP beneficiaries. The study concluded that, adoption of modern technologies among rural households such as modern hives contributed significantly to changes in gender roles, increased women participation and empowerment among beekeepers. The study provides evidence that income diversification and use of modern beehives are likely to improve women empowerment. In addition, championing of income diversification through introduction of modern technologies by governmental and non-governmental agencies and consideration of gender mainstreaming may contribute to income and food security among rural households.

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ACRONYMS AND ABBREVIATIONS

CBO	Community Based Organization
CIP	Commercial Insect Program
DR	Dependency Ratio
EPZ	Export Processing Zone
GOK	Government of Kenya
ICIPE	International Centre of Insect Physiology and Ecology
IFAD	International Fund for Agricultural Development
KEBS	Kenya Bureau of Standardization
KFS	Kenya Forestry Service
KOAN	Kenya Organic Agricultural Network
KMO	Kaiser-Meyer-Olkin
KTBH	Kenya Top Bee Hive
LHS	Left Hand Side
LR	Likelihood Ratio
NCIP	Non-Commercial insect Program
NGO	Non-Governmental Organizations
OLS	Ordinary Least Squares
PCA	Principal Component Analysis
RHS	Right Hand Side
WEI	Women Empowerment Index
UNDP	United Nations Development Program
UN	United Nations

CHAPTER 1: INTRODUCTION

This chapter is organised into five sub-sections that include; the background, which lays the foundation for the study, the problem statement, purpose of the study and the research question. The last section justifies the usefulness of the study findings and highlights potential users of the knowledge to be gathered.

1.1 Background

Beekeeping is an important activity that helps rural communities to raise additional income to improve their livelihoods. In addition, it is a sustainable form of agriculture beneficial to the environment. In Africa, traditional beekeeping is more common than modern beekeeping (Affognon et al., 2015). Countries such as Sudan, Uganda, Somali and Ethiopia largely use traditional beehives compared to countries such as Kenya, South Africa and Tunisia among others. In comparison to Europe, beekeeping in Africa is practiced as a supplemental income source to households (Dietemann et al., 2009; Carroll and Kinsella, 2013). In addition, it is often male dominated in most of the African countries such as is the case in Uganda and Zambia (Ogaba and Akongo, 2001; Chemurot, 2011; Shackleton, 2011). In Kenya, most of the agricultural work is done by women who play a major role in production and marketing of agricultural produce and yet receive a fraction of the income generated (Government of Kenya, 2005). In spite of this, they have had limited chances of owning, acquiring and controlling property. Even though beekeeping has often been documented as a male dominated enterprise, rural households in Kenya are increasingly adopting it as an income diversification strategy (Carroll and Kinsella, 2013). In addition, development initiatives do affect male and female beneficiaries differently, and intervention from development agencies could lead to a change in the perception that beekeeping is a male domain.

Beekeeping in Kenya dates as far back as the year 1950 during the British colonial period. Over time, it has been practised using traditional and modern beehives as documented by

Nightingale and Crane (1983). They also note that, the Government of Kenya, and other development agencies at the time, was involved in campaigns of promoting beekeeping as an income source for households in rural arid and semi arid areas, through the ministry of Agriculture. Estimated honey production in Kenya is about 100,000 tonnes of honey per year, which is far less than the country's demand, and the shortfall bridged through imports (Government of Kenya 2009). At the farm level, estimated honey yield is about 20% of the estimated productivity of a beehive at 3.7 kg per hive rather than 18.5kg per hive, hence indicating that Kenya has a high honey production potential (Carroll and Kinsella, 2013). Therefore, given the high market demand and low productivity, beekeeping is a potential income avenue for farmers in Kenya, and hence the need to evaluate challenges and constraints faced by gender in beekeeping.

A study done at the coast province by Pactkenya (2010) found transportation of hives, apiary cleaning and provision of water as the major roles of women in the beekeeping business. Men on the other hand were involved in harvesting, marketing of honey and offering security to the hives. In this scenario, women were less involved where revenue for honey was collected while more men were involved where financial gains were made. According to PactKenya, exclusion of women from handling financial gains was attributed to cultural reasons such as the man was the head of the household. Therefore, he had to make decisions concerning finances received from every household investment.

Ogaba and Akongo (2001) found that the bee enterprise in Uganda was mainly owned and managed by men. Women failed to participate in beekeeping due to cultural taboos such as those prohibiting them from climbing trees, and hence exclusion from honey harvesting operations (Chemurot, 2011). In addition, women strongly believed that they were supposed to keep off all man's activities, which include beekeeping. However, even where they showed the will to keep and manage bees as an income generating activity, they lacked the time and

resources for start-up. Often, honey harvesting was done at night or in the late evening for the aggressive bees reared in Uganda, yet women were expected to be at home attending to household chores.

A study carried out by International Fund for Agricultural Development (2009) showed that the beekeeping value chain was male-dominated in Rwanda. However, at the production stage, which involved management of bees at the farm, women played the greatest role as farm managers. That is, they provided bees with water and recommended to their husbands or hired someone to harvest honey. In Coastal Kenya, PactKenya (2010) showed that women played a limited role in beekeeping. They were more involved in the production stage compared to the processing and marketing stages of the value chain. Their roles involved watering of bees and transportation of new hives to the apiary while men refined the crude honey harvested to fine honey for sale.

In Kitui County, the International Centre of Insect Physiology and Ecology (ICIPE) had trained farmers on modern beekeeping practices through the Commercial Insect Program (CIP) that was operational between the year 2007 and 2013 (Affognon et al.,2015). It had introduced modern hives such as the Langstroth hive that yielded of up to 20 kilograms as compared to traditional hive that yielded only 5 to 8 kilograms per hive. In addition, through the CIP, ICIPE introduced beehives for stingless bees that were friendlier than the common aggressive African bee (*Apis Millifera*). Honey harnessed from the stingless bees was sweeter than that of the African aggressive bee, and because of this intervention, the number of women taking up beekeeping as an income generating activity in Mwingi had increased. The program promoted gender equity by ensuring that at least 50% of women attended trainings on modern apicultural practises (Raina et al., 2009). In addition, ICIPE initiated a process that certified farmers as organic honey producers leading to classification of farmers' products as organic. Consequently, the need for collective marketing by bee and silkworm farmers led to the establishment of the

"Mwingi Honey and Wild Silk Market Place". Better returns were received by farmers due to collective bargaining power achieved through consolidation of farmer produce (silk and honey) harvested (Kioko, 2010). However, honey value chain actors and roles performed by each gender at every stage remain unknown.

Traditionally, in most African communities, the norm has been that men reserved the right of making decisions at the household level (Chemurot, 2015). The decisions made concerned, allocation of labour, distribution of proceeds, ownership of property and access to resources as well as their use. Among the pastoral community, women had a limited say in decision making as well as a limited ability to influence use of resources (Gachimbi, 2002). Therefore, it was likely that cultural issues defined gender roles and responsibilities of Mwingi people who are agro-pastoralists. It is indisputable that the roles of men and women in a society are separate and intricately independent yet significantly contribute to the growth of society as an economy thrives.

1.2 Problem statement

Gender roles in a society are often determined by culture, politics, economics, religion and the environment in which people live. In most of the Kenyan communities, gender roles and responsibilities are linked to culture and religion (GoK, 2005). In the study area, the Akamba community who inhabits Mwingi West, Mwingi East and Mwingi North Sub-Counties found within Kitui County, have a culture that defines roles and responsibilities of each gender. However, participation in development projects often induces changes in roles and responsibilities esteemed by a society to belong to different gender. Further, roles performed by women are increasingly changing to resemble those performed by men as developing countries embrace gender equality (Presser and Sen, 2000).

Various governmental and non-governmental organizations have promoted beekeeping in Kitui County. Examples of such organizations include the Kenya Forest Service (KFS) and international organizations such as United Nations Development Program (UNDP), ICIPE through the Commercial Insect Program (CIP), among others (Affognon, 2015). Their main aim was to reduce food insecurity, unemployment and improve the people's social well being. Trainings given to the community had led to the establishment of a "market place" through the help of UNDP and ICIPE. In addition, the formation of farmer groups aided in pulling and marketing of honey (Kioko, 2010). Furthermore, with the introduction of Langstroth beehives and stingless bees that were friendly, more women were envisaged to participate in bee keeping. The major reason for such an expectation was that cultural practices on beehives could be carried out during the day alongside household chores (Raina et al., 2009). However, these changes have not been assessed.

Owing to these interventions, bee keeping has now become an important income generating activity in Kitui County that involves both men and women. This withstanding, how commercialization of beekeeping has influenced gender roles and responsibilities along the value chain remains unknown. In addition, factors influencing women empowerment and household participation in CIP have not been investigated.

1.3 Objectives of the study

1.3.1 Purpose

The purpose of this study is to map the honey value chain, analyse changes in gender roles and factors influencing women empowerment and household participation in the Commercial Insect Program in Kitui County.

1.3.2 Specific objectives

To achieve the study purpose, the general objective has been dissected to various components achievable through the following specific objectives that seek;

1. To map the honey value chain in Kitui County
2. To assess changes in gender roles along the honey value chain due to participation of beekeepers in CIP
3. To determine factors influencing beekeepers' participation in CIP
4. To determine factors influencing women empowerment among beekeepers in CIP

1.4 Research questions

The research questions in this study are:

1. What is the nature of the honey value chain in Kitui County?
2. Does participation in CIP lead to changes in gender roles along the honey value chain?
3. What are the factors determining participation of beekeepers in CIP?
4. What are the factors determining women empowerment among beekeepers in CIP?

1.5 Justification of the study

In a society, men and women perform different roles and have different responsibilities. Often, women have less ownership and control over assets, reduced decision-making capacity and fewer educational and economic opportunities than men (Malholtra and Schuler, 2005). Consequently, development initiatives do affect male and female beneficiaries in various ways due to gender differences and inequalities (Doss, 2015). In addition, women often encounter obstacles to participating in and benefiting from development projects such as CIP. Therefore, a deliberate consideration of gender dynamics for understanding how development initiatives lead

to changes in gender roles is required. As well, understanding gender roles is important in ensuring that men and women are equitably empowered by agricultural development initiatives.

ICIPE introduced modern hives such as the Langstroth hive and beehives for the stingless bees through the CIP. Trainings on beehive management were offered to the treatment group (CIP) while the control group (NCIP) comprised of beekeepers who were non-beneficiaries of the CIP. The NCIP group would be used to compare and contrast changes in gender roles at the household level in regards to managing of proceeds and the bee enterprise. In addition, comparison between the treatment and control group will help to unearth tasks performed by men and women in beekeeping. The findings will be vital in identifying the constraints that men and women face in beekeeping and how they can be addressed.

Estimating the determinants of women empowerment and household participation in CIP would unearth factors influencing women empowerment and household participation into the CIP. Therefore, findings on determinants of women empowerment will help to reveal what contributed greatly to empower women within the CIP. In addition, findings will be useful in determining if participation in CIP increased women empowerment. This will shed more light on the usefulness of development projects in empowering women. Consequently, accessing factors that influenced household's participation in the CIP will be vital in determining possible demographic factors that would influence a community to participate in development programmes.

Mapping the honey value chain in Kitui County will reveal the main actors, their gender, constraints experienced by each actor, forms of value addition and gross margins of the honey processors. Further, unveiling weak-points of the honey value chain will necessitate appropriate action plans that will lead to all stakeholders and actors benefiting amicably from honey trade. Establishment of the "Mwingi Honey and Wild Silk Market-place" was to facilitate bulking,

processing, branding and marketing of honey products. In addition, value addition created a sustainable income source for bee farmers through creation of market for their surplus crude honey (Affognon et al., 2015)

Assessment of gender roles at the household is vital in establishing what men and women do at the apiary, challenges encountered by men, women and possible remedies. Owing to the fact that, beekeeping has often been documented as a male dominated enterprise, the study will identify apiary activities not carried out by women and men. Therefore, gender mainstreaming in beekeeping can be better effected when strengths and weaknesses of modern and traditional beekeeping technologies are known even as women and men embrace the enterprise as an income generating activity. The findings will be informative to development project designers who desire men and women to participate and benefit from initiatives that are focussed on enhancing their well-being and that of a society. Further, challenges hindering men and women from participating in similar beekeeping initiatives will be identified.

Estimating determinants of women empowerment in beekeeping will unearth important factors that would hinder or lead to their empowerment. The finding will be useful to other development initiatives that seek to empower women and focus on enhancing women decision-making ability through issues such as access to, use and control of resources and benefits at the household. In addition, identification of factors leading to household participation in development initiatives such as beekeeping will help in designing of other initiatives that seek a higher enrolment if the target group has similar characteristics.

CHAPTER 2: LITERATURE REVIEW

This chapter contains six sections that review literature related to the four specific objectives. The chapter begins by description of mapping value chains, a general view of women involvement in beekeeping and roles performed by men and women at various stages of the value chain. It also reviews the role of development projects in empowering of households, determinants of women empowerment and household participation in development programmes.

2.1 Value chain mapping

A value chain refers to the full range of activities required to bring a product or service from conception through the different phases of production, delivery to consumers and disposal after use (Kaplinsky and Morris, 2001). Mapping a value chain provides a descriptive structure that is good for data generational and analysis (Kaplinsky, 2000). It often results in development of tree-like diagram showing the interconnectedness of various actors or their relation in an input output direction. It also involves market margin analysis which encompasses identifying of actors, product tranformation and estimated costs arising at every stage. Lowitt et al. (2015) states that value chains analysis has been used to understand how various actors interact with each other. However, such emphasize on aspects of production along value chains has been critiqued due to its limited nature on assessment of social aspects such as gender (Riisgarard et al., 2010). In addittion, Bair (2009) argued that most value chain analysis focusses on linkages between the buyer, supplier and consumers neglecting social, cultural and symbolic relations among actors. Even though this study is limited in some of these aspects, it is focussed on identifying actors, their gender and unearthing contraints that hinder participation of either men and women at various stages of the value chain. An input-output approach, also called the forward link, is suitable in mapping honey flow where it begins as a raw material untill it reaches the consumer as a finished product (Kaplinsky, 2000).

Value chain mapping can be complex due to some actors being involved at multiple levels (Roduner, 2004). A farmer can be a producer, consumer and a trader while at times they are involved in more than one chain hence leading to a value chain network. Moreover, mapping of a value chain leads to identification of the principal functions at each stage, agents carrying out these functions and principal products developed (Faße et al., 2009). Rudenko (2008) used this approach in his study on value chains for rural and regional development in cotton, wheat, fruits and vegetables in the lower Reaches of the Amu Darya River of Uzbekistan. Limitation of studies that have engender value chains leads to a combination of methods that this study proposes to use where the honey value chain structure is first mapped and a gender evaluation is later conducted with specific empahize on their involvement in production, input supply and processing.

2.2 Overview of women involvement in beekeeping

Beekeeping is often considered a male dominated enterprise (Ogaba and Akongo, 2001; Vlek et al., 2003; Shackleton, 2011) that involves management of bee colonies by humans through use of hives in an apiary (Qaiser et al., 2013). Even though it has benefits to a beekeeper, such as provision of honey, wax and pollination of crops, its adoption among female beekeepers is limited (Chemurot, 2015). Studies by IFAD (2009), Raina et al. (2009) and PactKenya (2010); show that women are increasingly taking up beekeeping as an income generating activity driven by the need for income diversification, food or income security. PactKenya (2010) found that formation of beekeeping groups, led to more women participating in the enterprise in Coastal Kenya. In Nepal, Bhusal and Thapa (2005) reported that, women involvement in beekeeping groups was limited by various constraints such as lack of time, awareness, and knowledge of tending to bees and the notion that beekeeping is a man's activity. Mwingi East, West and North Sub-county beekeepers were organised into groups that had a gender ratio of 1:1 at inception of the CIP in the year 2007 (Raina et al., 2009; Kioko, 2010).

Ogaba and Akongo (2001) revealed that, some of the reasons that deterred women from participating in beekeeping as lack of time, and the nature of bees kept in Uganda. The African bee, *Apis Millifera* was common and known to be aggressive even though the honeybee is highly productive as shown by Bhusal and Thapa (2005); in their comparative study on the adoption of improved beekeeping technologies in Nepal compared to other honeybees such as *Apis Cerena*. Cultural practises such as harvesting honey and colony transfer on beehives inhabited by the African aggressive bee were limited to nighttimes when women were busy with household chores. In addition, the traditional beehives commonly used in African (Dietemann et al., 2009) are hoisted on tall trees (Affognon, 2015) that women as compared to men find it a taboo to climb, hence their non-participation in activities such as honey hunting and harvesting. In addition, Chemurot (2015) found that traditional hives hung nearer the ground were less colonised by bees compared to those that hung on treetops far from the ground. Further, he noted that beehives managed by women in Uganda were more colonised than those managed by men. Therefore, introduction of modern hives, such as the Langstroth hives hoisted near the ground, and provision of bee suits among Mwingi beekeepers, and trainings conducted through CIP in Mwingi addressed these concern (Raina et al., 2009). This initiative benefited both men and women practising apiculture in Kitui County by ensuring easier and friendly bee management.

2.3 Roles of men and women along the beekeeping value chain

Women in Coastal Kenya participated in activities such as cleaning the apiary, an activity that often involves clearing of bushes near and around beehives to keep off predators such as honey badgers. They also watered bees by placing water-filled containers in the apiary or containers with sugar solutions, to reduce incidences of bees feeding on honey when water and food were in short supply in dry periods. In addition, women transported new and old hives repaired to the apiary for men to hoist. Men on the other hand offered security to keep off thieves who harvested honey at night, repaired broken and old hives destroyed by honey burgers and

eaten by termites. They also harvested and marketed honey in both processed and crude forms in Coastal Kenya. In Zambia, Shackleton (2011) indicated that women were more involved in value addition of harvested honey where they converted it to beer 'Mbote'. Men within beekeeping groups in Zambia participated in honey hunting that involved harvesting honey from bees in wild colonies found in forests, kept records and took of minutes during group meetings because they had more years of formal schooling compared to women. In Uganda, Chemurot (2015) reports that women were mostly involved in processing and marketing of honey compared to other apiary cultural practises. Nonetheless, the roles of each gender in beekeeping differed from community to community and country. Even though a few studies show roles done by men and women along the beekeeping value chain they do not assess whether participation in modern beekeeping induced changes in gender roles.

The need by women to improve their household's livelihood is attributable to modern technologies that make it easy for them to participate in apiary maintenance activities. However, the extent of their participation and activities they shy away from are unknown. In addition, it is important to unearth some of the constraints leading to non-participation in such activities if the enterprise is to be beneficial to men and women. Studies have shown that traditionally, men practised beekeeping unlike women who kept away due to taboos and bee sting phobia (IFAD, 2009; Qaiser et al., 2013). The extent to which erosion of such fears and taboos has occurred is accessible through evaluation of roles undertaken by participants with modern beekeeping technologies. Further, roles performed by women are increasingly changing to resemble those performed by men in the modern world where equality is sought (Presser and Sen 2000).

2.4 Empowerment of households in development programmes

Empowerment refers to the expansion of a people's ability to make strategic life choices (Kabeer, 2001). Training of individuals enhances their ability to adopt or make decisions after knowledge of a technology, idea or a new way of doing things is shared. Further, Marilee Karl

(1995) supports this definition by stating that empowerment is a process of awareness and capacity building that leads to increased participation, decision-making power, control and transformative action. Rowlands (1997) argued that empowerment is a process that often occurs over time, and it is highly influenced by culture, geographical environment and number of trainings. This study adopts the empowerment definition by Kabeer (2001) and extends it to acquisition, maintenance of the apiary, use and disposal of apiary products decisions at the household level.

Trainings among CIP beneficiaries conducted encouraged adoption of modern apicultural practises that would help overcome challenges such as taboos and bee sting phobia. Exposure to queen breeding, safe handling of bees using bee suits and smokers, colony multiplication, honey harvesting techniques, use of a special mesh-wire to separate honey storage compartment and bee colonies in beehives were some of the issues CIP beneficiaries learnt (Affognon, 2015). Therefore, decisive actions to undertake beekeeping in a modern aspect, are the sole purpose as to which this study seeks to stratify tasks done by men and women among beneficiaries and non-beneficiaries of the programme. Quantification of empowerment is difficult to achieve through evaluation of a single farm enterprise; it extends to other household farm enterprises and evaluates who made or makes decisions in regards to ownership of household assets such as livestock, and controlled benefits from crop production and livestock. Decisions evaluated extend to use of household resources in educating children, acquisition of assets and use of credit.

Critiques such as Adjei (2015) have a robust opinion on the components used to quantify empowerment in the African context. He argues that communities do not share the same social injustices that limit women decision-making ability on access, use and control of resources and benefits at the household. He argues that social injustices are often cultural or religious based and changing them can be achieved through rural development initiatives. Even though there are critiques that do not agree with quantification of empowerment, studies such as that of Garikapiti

(2008), assessed the impact of lending to women, and using empirical evidence, he showed that women were empowered when they received credit. He used indicators to determine who was empowered or not if a household score was above or below his determined threshold. This study, proposes to adopt principal component analysis (PCA) in the construction of a composite empowerment index as discussed in the construction of a social index by Antony and Rao (2007).

2.5 Determinants of women empowerment in development programmes

Kantor (2005) indicated that empowerment could be represented by control over enterprise earnings and could be influenced by human capital levels and demographic characteristics such as marital status. Further, he noted that empowerment can be observed through outcomes of decisions made by the empowered such as; alleviation of poverty through engagement in income generating activities hence contributing to the household financial pool. In addition, Kabeer (1999) noted that empowerment is measurable able through evaluation of one's choices or decisions. However, the researcher had the task of choosing questions that would show evidence of empowerment. As well, questions on control over resources were a more appropriate proxy for empowerment if one was able to determine who made the decision on how the resource would be used (Pahl, 1989).

Some of the questions used by Kantor (2005) relate to health, children schooling and purchase of items such as food, and assets that include property and household items. Further, indicators that comprise of questions that can be used to proxy women empowerment at the household, focussing more on access to and control of resources that include; labour, capital, and entrepreneurship (Presser and Sen, 2000; Pitt et al., 2006; Garikapiti, 2008). Some of the factors influencing different levels of empowerment include ethnic group, age and relative wealth (Mosedale, 2005). In addition, participation of a woman in professional activities due to her level of education may be considered empowering, however, other factors such as family systems, patriarchal social structures and customs may be considered disempowering if they do not allow

her to exercise her choices (Adjei, 2015). Nelson and Prilleltensy (2010) argue that, our choices in life are highly influenced by norms of conformity that we have set for ourselves, not because they are necessarily good for us, but because we are subjects of social influences at all times. Therefore, such psychological chains limit involvement of men and women in activities that would beneficially improve their living standards. In the study area, education level of participants, cultural influences such as taboos, age, and wealth could play a key role to the adoption of new beekeeping technologies.

2.6 Determinants of household participation in beekeeping

Participation in development projects is associated to personal gains perceived by a household head or the participant. Often, development projects target to fill a need within a community or a society such as creating awareness of opportunities available through initiatives that exploit or transform available resources (Dadvar-Khani and Choobchian, 2015). Some of the development initiatives lead to alleviation of the increasing burden of poverty, malnutrition, illiteracy of women, employment creation among others that demine a communities social and demographic well being (Kongolo and Bamgose, 2013). The affinity of a household to participate in such initiatives is driven by the need to meet some of their social and financial obligations (Carroll and Kinsella, 2013). Even then, there is an observable pattern of characteristics among individual participants in a particular programme.

Sub-Counties in Kitui are characterised by arid and semi-arid areas covered by shrubs and forage that support beekeeping. Reliance on conventional agriculture in such area for income is often not reliable due to periodic droughts hence the need for livelihood diversification in cushioning a farmer from unstable streams of income. Further, Carrol and Kinsella (2013) show that eighty percent of the honey produced in Kenya comes from the arid and semi arid area such as Kitui County among others. Affognon (2015) indicated that, most of the resource poor rural household are limited from exploiting natural resources such as forage, forests and ecosystems,

which bees can survive, by lack of financial capability. Therefore, development agencies initiatives are necessary for the development of rural communities because they help them tap the benefits of conserving an eco-system through integration of ideologies such as beekeeping and forests that are interlinked (Carroll and Kinsella, 2013). Further, rural household participation in beekeeping is often driven by the need to improve their livelihood, household nutrition, and tap the benefits of beekeeping such as pollination of crops. Commercialization of honey and its products arising from value addition pose a marketing challenge to technology adopters who desire to dispose off their excess at a favourable price. Therefore, formation of the "Mwingi Wild Silk and Honey Market Place" solved market challenges of dealing with intermediaries such as brokers (Raina et al., 2009). In addition, other factors influencing participation in development initiatives include peer pressure, benefits accrued such as trainings or access to extension services among others.

CHAPTER 3: METHODOLOGY

This chapter begins with the conceptual framework that summarizes the study using a diagram. Other sections discussed in detail are the theories upon which the study is anchored, analytical techniques used to achieve the objectives, the study area and research design adopted. Details on sampling of respondents, and identification of those interviewed, are found in the sampling and data collection sections, while tools used for data analysis are explained thereafter.

3.1 Conceptual framework

The honey value chain starts from the input suppliers and ends with consumption done by consumers. The left hand side (LHS) of Figure 3.1 shows various stages of the honey value chain while the right hand side (RHS) indicates the various interlinks within the value chain at each stage. The input stage comprises of the input suppliers who supply bee farmers with beehives, bee suits and smokers that are necessary for anyone practising beekeeping. Beehives are of various types such as the Kenya Top Beehive (KTBH), traditional hive, Langstroth and the beehive for stingless bees, while bees hived could be the aggressive or docile bees often found in the ground or tree crevices. A bee suit and a smoker are required during harvesting honey while floral vegetation is essential for nectar production. However, bees can search for nectar from other people's farms and hence the beekeeper does not need to have floral vegetation at his farm.

At the farm level, before inception of the CIP by the ICIPE, farmers practised apiculture as individuals. Thereafter, in the year 2007, the CIP led to organisation of farmers into groups for purposes of training, bulking and value addition of honey (Raina et al., 2009). Kioko (2010) showed that, there were 53 beekeeping groups formed in Mwingi sub-counties with a total membership of 1853 farmers that benefited from the CIP initiatives. However, within the same localities, bee farmers non-affiliated to any beekeeping group, and are referred to as the Non-CIP beneficiaries.

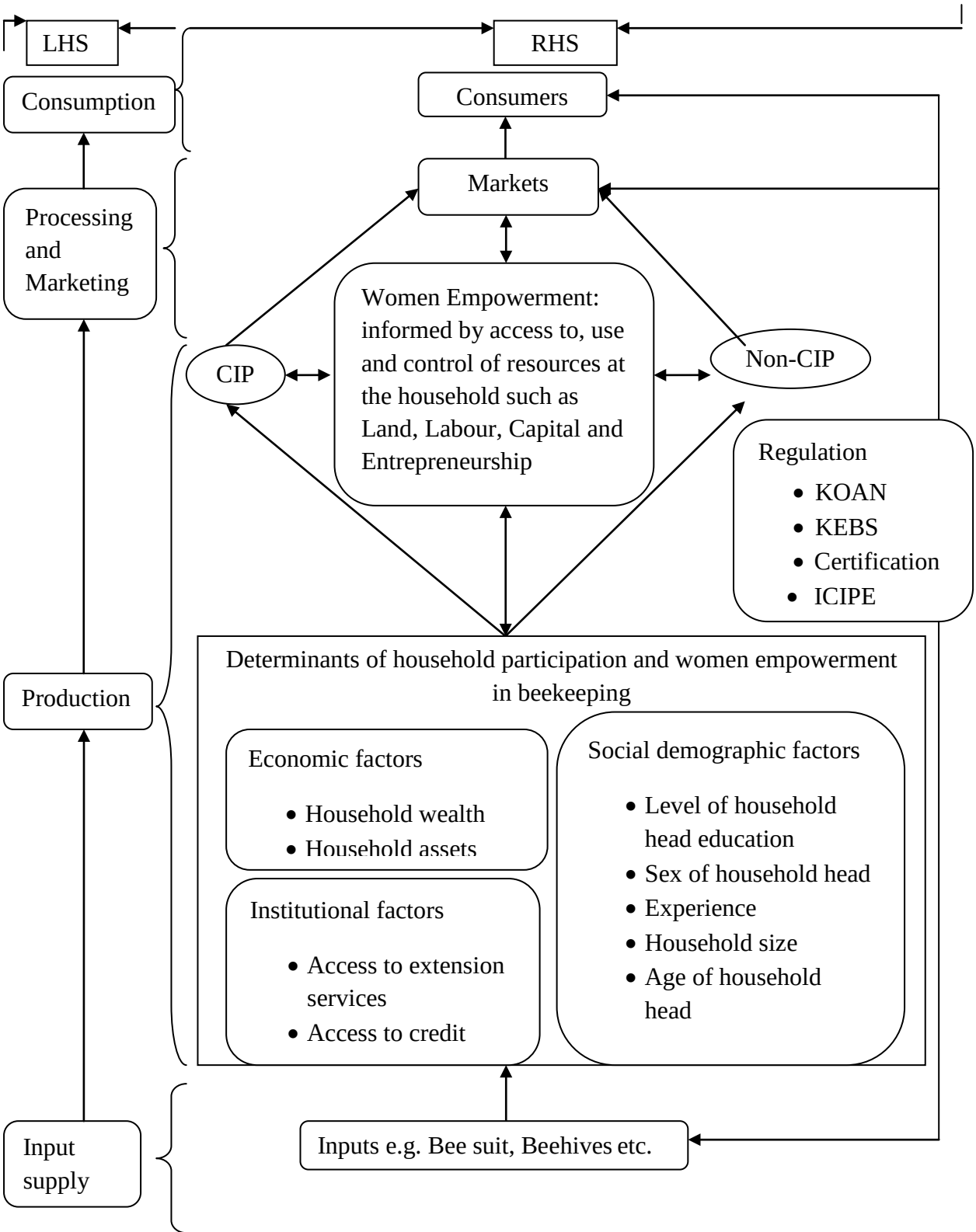


Figure 3.1: The concept framework shows various interlinks and actors of honey value chain

Source: Author, 2014

Participation of farmers in beekeeping as individuals or in groups is associated to various factors such as economic, institutional, farmer characteristic or social demography (Kongolo and

Bamgose, 2013). Factors influencing a household to participate in the CIP will be determined in the study. In addition, roles performed by gender among participants in the CIP and Non-CIP groups are perceived as different and therefore, changes in gender roles among beekeeping households will be evaluated through comparison of roles between the two groups. Roles carried out by gender refer to decisions made daily in regards to beekeeping such as hiring of labour, harvesting and marketing of honey. In addition, changes in gender roles perceived to contribute to women empowerment or occur because of women empowerment as well as factors leading to women empowerment will be determined.

The processing and marketing stage encompassed value addition done by farmers or other agents who owned processing plants. Farmers within CIP sold their honey to the "Mwingi honey and wild silk processing plant" which was a community based organisation (CBO) owned and run by farmers known as the "Mwingi wild silk and honey market place". Farmers in Non-CIP sold their honey to other processors such as individual processors and brokers. The processors sold value added honey to consumers directly or to other market intermediaries such as wholesalers and retailers. However, farmers also played a role as market agents where they sold their honey directly to consumers in processed or unprocessed form. Tasks carried out by gender at this stage were identified through interviewing managers, owners or workers at various processing plants.

Value chains often have various interlinks that are regulated by the government or other agencies such as quality assurance bodies among others (Gereffi et al., 2005). In Kenya, governmental and non-governmental regulatory intermediaries are the Kenya Bureau of Standardization (KEBS), Kenya Organic agricultural network (KOAN), and the International Centre of Insect Physiology and Ecology (ICIPE) effected regulation of the honey value chain. KOAN certified CIP farmers in production of organic honey while KEBS ensured that honey processed by the community-based organisation (CBO) was good for sale to consumers. ICIPE

played a great role in helping the CIP farmers set up a CBO. It also trained farmers benefiting from the CIP on good apicultural practices.

3.2 Theoretical framework

This study was guided by the principles of institutional theory that can be defined as the "rules of the game" or the humanly devised constraints that influence economic transactions (North, 1990). Determination of gender roles is highly inter-twined with societal values that influence who performed a task along a value chain and at the household level. Two concepts from the institutional theory are of importance to this study and they include autonomy and adaptability (Peters, 2000). Autonomy refers to an individual's ability to make his own decisions without the influence of another individual or institution while adaptability refers to the ability of an individual to change due to changes in the environment. A household unit was the focus of the study and within it, autonomy and adaptability determined who made decisions in regards to use and control of resources and benefits. This was the base upon which empowerment was measured among participants and non-participants in the CIP. Questions used to proxy empowerment revolve around farm enterprises, social and economic activities that farmers were commonly involved.

Other theories observed at the interface between farmers and brokers as well as between honey processors and producers are the bargaining and agency theories respectively. Value chains often have many theories that describe the behavior of actors and their interactions (Kaplinsky and Morris, 2001). Bargaining theory refers to the behavior of agents negotiating for a commodities best price with an aim of exchange (Muthoo, 1999). This behavior is observable between farmers and consumers, brokers and farmers among others such as input suppliers and farmers. However, this study is limited to assessing the source of inputs, prices at which consumers and brokers purchased honey from farmers and prices offered to consumers and farmers by CIP. Agency theory describes the nature of relationships among actors and is useful in

assessment of contracts binding behavior of various actors in any relationship (Ross, 1973). However, this study is limited to assessment of how the CIP beneficiaries and non-beneficiaries interact with processors.

A household's decision to participate in CIP is attributable to utility theory. The theory assumes maximization of utility by a rationale being. This implies that a household's choice to participate in CIP was driven by the need to improve their livelihood, increase honey production or take advantage of the emerging markets facilitated by ICIPE through encouragement of value addition. Therefore, assessment of factors influencing household participation in the CIP is anchored upon utility theory where farmers', social and demographic characteristics are evaluated to draw inferences on the pattern of predetermining participants.

3.3 Analytical techniques used to achieve objectives

3.3.1 Assessing changes in gender roles along the honey value chain

To understand the roles carried out by each gender in beekeeping, a gender analysis was required. An activity calendar was appropriate in identification of what men and women do on a day-to-day basis (Meyers, 2012). However, because agricultural practices are seasonal in nature and production occurs in cycles, an activity calendar could not conclusively capture division of labour. Therefore, apiary maintenance practices regarding the whole production aspect in beekeeping were identified, and respondents told the researcher who performed them at the household. Using the responses, the researcher would ultimately inference on roles performed by each gender. Statistical research tools such as the mode and mean analyzed the roles done by men and women in the beekeeping enterprise. The changes in gender roles performed by each gender would then be evaluated using t-statistics. A comparison for statistical significance of gender roles among households in CIP and NCIP and the difference between groups was tested.

Mapping of actors along the value chain was necessary to help in identification of roles carried out by gender at each stage. Actors along the value chain were mapped from the producer

whereas farmers were expected to help the researcher identify other actors in the forward and backward linkage of the value chain. Recalling was the basis of identifying actors in the forward and backward link. Processors and traders were in the forward link while input suppliers were in the backward link.

Mapping of the product flow began from the farmer where crude honey was the product of interest at the farm level. The end was finished products found in the market such as packaged honey, wax and candles. Farmers visited by interviewers helped to identify processors through referrals. To capture prices, interviewers asked farmers to recall prices at which various actors purchased honey from them. Open-ended questions were used to identify challenges experienced by both groups of farmers during honey production. In addition, farmers were asked to re-call the sources of their beekeeping inputs such as beehive types, smokers and bee suits The main challenge experienced in this approach was that a clear-cut line between producers, consumers and processors lacked. This was attributed to the fact that at times, producers were consumers and they processed crude honey into finished products in the case of individual farmers.

Gender analysis along the value chain involved evaluation of duties carried out by each gender at every stage. At the household level, ownership of beehives was sought. Questions used in determination of gender roles along the beekeeping value chain include who managed the apiary, watered the bees, transported hives to apiary, hired apiary labour, paid apiary labour, repaired beehives, harvested and sold honey. Other questions used to determine gender roles were who decided to set up the beekeeping enterprise, who decided the type of beehives to be used, and who sourced the smoker and bee suits. At the processing level, gender roles were identified through queries such as who packaged honey, who sourced crude honey from farmers, who transported it to the processing plant and who was involved in sales for the packaged honey. The results from this objective were both qualitative and quantitative. Descriptive statistics were used to show gender involvement at various levels or stages within the value chain as well as the

constraints encountered. T-test statistics were used to test if the difference in roles performed by CIP and NCIP groups were different.

3.3.2 Analysis of factors influencing household participation in CIP and WEI

Analysis of this objective followed Garikapiti (2008). He studied the impact of lending to women on household vulnerability and women empowerment in India. Garikapiti suggested that; indicators could be used to generate a dependent variable 'women empowerment'. This study adopted the use of indicators coupled with Principal Component Analysis (PCA) in the development of the women empowerment index. It is worth noting that with Garikapiti's approach, the researcher had to determine a cut off to show that a woman was empowered, while those below the cut off were deemed otherwise. This approach, led to a binary dependent variable that suggested the use of a logistic regression in determining what factors influenced or contributed to women empowerment in Kitui County. Owing to the challenge of deciding where the threshold or cut off for the empowered and non-empowered in the development of the binary dependent variable, this study adopted the use of a constructed index (women empowerment index) which was continuous in nature. One of the main advantages of using a continuous index was that it would allow all women to be included in the regression regardless of their empowerment score.

In the construction of a woman empowerment index using PCA, the selection of empowerment indicators followed De Brauw et al., (2014). Women empowerment categories subjected to PCA include the following; who established the farm enterprises? Who made the decision about when and where to sell the enterprise products? Who negotiated the pricing of the farm products during sale? Who owned the beekeeping assets? Who managed the farm enterprises outputs? Who kept money from the sale of farm products, credit access and children schooling decisions? Who managed the apiary activities? Who decided the beekeeping input sources? Who owned farmland and other household assets? Who hired apiary labour? Who paid

apiary labour hired? Who made decisions about income, asset acquisition, disposal and ownership of livestock assets? A summary of the 15 indicators and their subsequent questions used to determine if a woman was empowered are in Table 3.1.

Table 3.1: Empowerment indicators and their subsequent questions

	Indicator	Questions informing the indicator
1.	Who established each of the farm enterprises?	Crop production, cattle keeping, small ruminants, poultry, beekeeping, and milk production?
2.	Who decided when and where to sell each of the enterprise products?	Milk, bee products, poultry and its products, small ruminants, cattle and crop produce?
3.	Who negotiated the pricing or sale of each of the farm products?	Milk, bee products, poultry and its products, small ruminants, cattle keeping and crop produce?
4.	Who owned each of these bee assets?	Apicultural trees, harvesting gear (bee suit), smoker, stingless beehives, traditional beehives, mud hives, Langstroth hives, and the Kenya Top Bar Hive (KTBH)?
5.	Credit access	Have you taken a loan in the last 5 years? Do you seek approval from your husband before taking a loan? Do you inform your husband what to do with the loan?
6.	Who made the decisions on children schooling?	Women often pay for children school supplies. Women often pay school fees for children. Women contribute to purchasing of breakfast for children. Women never assist children with homework. Women often decide if a girl goes to school.
7.	Who kept revenue from the sale of each of these enterprises products?	Milk, honey and other bee products, poultry and its products, small ruminants, cattle and crop produce?

8. Who managed the beekeeping apiary activities?	The questions include who repaired the beehives, constructed new ones, watered the apiary, transported hives and managed the apiary in general?
9. Who managed output from each of the farm enterprises?	Milk production, beekeeping, poultry and its products, small ruminants, cattle and crop production.
10. Who decided where to source each of the beekeeping inputs?	Mud hives, traditional beehives, beehives for stingless bees, Langstroth hives, smokers, bee suit or protective gear.
11. Who owned each of the following household assets?	Land bought, inherited land, radio, bicycle, television, motorbike, car, mobile phone, fridge, gas cooker, microwave, digital video decoder, computer/laptop and internet modems.
12. Who hired apiary labour to do each of the following?	Apiary management, new beehive construction, beehive repair, watering apiary, hive transportation and cleaning the apiary.
13. Who paid for apiary labour to do each of the following?	Clean apiary, transport hives, water the apiary, construct new hives, apiary management and repairing hives.
14. Who owns each of the following livestock assets?	Adult cows, adult bulls, heifers, young bulls, male calves, female calves, goats, sheep, donkeys, chicken/poultry, rabbits and pigs.
15. Who made decisions regarding income, assets acquisition and disposal?	The husband always takes care of the wife's' income generating activities? The wife never takes care of the husbands' income generating activities. Women play a minor role in financial decisions on investment. The husband in the sale of assets never consulted the wife, Women usually keep money for emergency use, and women usually keep a share of the husband's wages?

Source: Author Survey, 2013

The 15 categories were essential in the analysis of women empowerment because they captured issues of use, access to and control of factors of production such as land, labour, capital and entrepreneurship that are essential in the agriculture.

3.3.3 Women empowerment Index

Principal component analysis (PCA) was used to generate a composite index called women empowerment index (WEI). In Canada, PCA was used in construction of a composite index for socio economic conditions using census data (Krishnan, 2010). In addition, Boelhouwer and Stoop (1999) used it to combine socioeconomic indicators into a single index in determination of a community's' well-being in the Netherlands. An application of PCA that is a data reduction method reduced the 15 indicators (Table 3.1) into a single index as a proxy for the women empowerment.

Selection of indicators to measure or proxy women empowerment involved identification of variables that could show changes in gender roles. Issues represented by the indicators cut across the four factors of production such as capital, land, labour and entrepreneurship. Therefore, questions leading to the development of the index were based on access to and control of these resources at the household.

PCA technique owed its earliest description to Pearson (1901) even though it has often been attributed to Hotelling 1933 (Krishnan, 2010). It computes principle components that can be referred to as a set of uncorrelated (orthogonal) factors. Each principle component is usually a linear weighted combination of the initial variables that are ordered so that the first component has the highest amount of variation arising from the original variables. The second and subsequent components are completely uncorrelated with the first component that often accounts for the maximum variation not accounted for in the first component or one before it and so on.

The weights of each principal component are the eigenvectors of the covariance or correlation matrix. Rotational strategies are used to obtain a clear pattern of high or low factor

loadings for the variables or indicators. Factor loading refers to correlations between variables and factors generated in PCA. It is worth noting that factor analysis includes both PCA and principal factor analysis where PCA approximates principal factor analysis if components are rotated. The distinguishing characteristic between principal factor and component analysis is that, in PCA, the assumption is that all data variability is used during construction of an index. However, the two methods yield similar results even though PCA is preferred for data reduction while principal factor analysis is used for detecting structure.

Use of PCA was adopted because it gives weights to the indicators. It is also easy to compute and shuns many problems associated with traditional methods such as aggregation, non-linear relationships of variables and standardization of variables (Vyas & Kumaranayake, 2006 and Saisana et al., 2005). Further, tests can be used to determine if the data is suitable for principal component analysis. Correlations between variables or indicators should be at least or greater than 0.3 for PCA (Tabachnick & Fedell, 2007). In addition, other measures of sampling adequacy such as the Kaiser-Meyer-Olkin (KMO) test can be used to test if the construction of a composite index is appropriate using PCA. In addition, sampling adequacy predicts if data can factor well based on correlations. KMO usually compares the magnitude of partial correlation coefficients to the observed correlation coefficients. It is important to note that if the data has common factors, the partial correlation coefficients will be small relative to the total correlation coefficients. The maximum value of KMO is 1.0, a value of 0.9 is considered ‘marvellous’, 0.8 ‘meritorious’, 0.7 ‘middling’, 0.6 ‘mediocre’, 0.5 ‘miserable (Antony & Rao, 2007). Further, Bartlett’s test of Sphericity can also be used to determine the strength of relationship among variables (Bartlett, 1954). It tests the null hypothesis that variables from the data correlation matrix are uncorrelated. The rule of thumb is that the probability should be less than 0.05 to reject the null hypothesis and conclude that the correlation matrix was not an identity matrix.

The 15 indicators were subjected to PCA for purposes of extracting principal components needed for construction of the non-standardized women empowerment index. Often, the researcher may determine the number of principal components he may desire to retain. However, one of the most reliable ways is Kaiser's criterion or the Eigen value rule, which stipulates that variables to be retained should have an Eigen value of one or more. Further, a scree-plot can be used to determine the number of principal components to retain. It is a graphical method known as the Cattell's (1966) scree-plot test, that plots the Eigen values of the principal components after PCA, and those above one on the y-axis are retained.

The proportions of the principal components are used as weights in calculation of the Non-standardized women empowerment index. The formula used is as follows:

$$WEI^{NSI} = \Sigma_{i=1,\dots n}\{\frac{proporion\ of\ principal\ component\ variation_{\ i}}{total\ variation\ of\ the\ five\ principal\ components} \times principal\ component_i\}$$

Where i represents the value of the principal component extracted from data and NSI represents the un-standardized index. WEI from this computation is un-standardized and has both negative and positive values. Standardization was done to make all values positive and easy to interpret. Standardization has been adopted in other studies such as that of Antony & Rao (2007), Hightower (1978) and Sekhar et al. (1991) and is achieved as follows:

$$WEI^{SI}_{i\dots.n} = \frac{(WEI^{NSI}_{i\dots.n} - Min\ WEI^{NSI})}{(MaxWEI^{NSI} - Min\ WEI^{NSI})}$$

Where $WEI^{SI}_{i\dots.n}$ are the standardized women empowerment index while $WEI^{NSI}_{i\dots.n}$ is the un-standardized women empowerment index for a household where i is a woman's empowerment index in household i of the *n* households interviewed.

3.3.4 The Asset Index

Asset indexing can be derived using monetary prices, unit values or weights obtained from software's such as the Principal Component analysis (PCA) or Multivariate correspondence

analysis (MCA). Unit values often equate or weigh equally all the assets regardless of their differences in cost of acquisition or capital. Monetary prices are used where the prices of the assets are known. However, price use is biased owing to factors such as when the asset was acquired, depreciation, and appreciation of assets hence not giving a true reflection of a household's wealth or asset index. Therefore, this study follows Filmer and Pritchett's' (2001) recommendation of using PCA that aggregates several binary asset ownership variables into a single dimension (Moser & Felton, 2007).

An asset index was constructed using the Principal Component Analysis (PCA) that provides weights that are more accurate. The underlying intuition of this method is that each asset has a latent (unobservable) variable C^i for each type of capital C^i which manifests itself for owning different types of asset $a^i....a^k$ in each household. For example, suppose a household X owns assets $a_{i,1}$ if $_i \sim$ C > w. It turns out that the maximum likelihood estimators of the w's (weights) are the Eigen vectors of the covariance matrix which are also known as the principal components of the data set (Moser & Felton, 2007). In PCA, the weights are the category loadings in the first principal component arising from the un-rotated factor analysis (Booysen et al., 2008).

The asset ownership index was built on the same principles as the women empowerment index. In the asset index construction, data subjected to PCA was of a binary nature where one represented that a household owned an asset while zero otherwise. The Eigen vectors generated by PCA were used as weights for assets owned by a household (Moser & Felton, 2007).The formulae adopted in construction and standardization of the asset index for each household was similar to that used in WEI in section 3.3.3.

3.3.5 Dependency ratio

This was a ratio of the net consumers to net producers or economic dependants to economically active person. It was calculated by summing up the number of children aged between (0-14) and person above the age of 65 divided by the economically active persons aged between (15-64) years of age (United Nations, 2005). The UN standard was adopted in computation of the dependency ratio (DR) used in this study. Therefore, an assumption was made that individuals between ages 15 to 64 were economically active or they had the potential to be economically active. The formula used to compute DR is as follows:

$$dependency\ ratio\ \ (DR) = 100 \times \frac{\{children(0-14)yrs + adults(\geq 65yrs)\}}{(15-64)yr\ old\ persons}$$

A high dependency ratio means that the economically active population and the overall economy faces a greater load of supporting and providing the social services needed by children and the older persons who are economically dependent (OECD, 2007). This implies that the burden often goes to the economically active persons who take care of children and the aged in society.

3.3.6 Heckman sample selection procedure

To assess whether participation in CIP had any effect on women empowerment, Heckman two-stage sample selection model was used. The rationale underlying its use was because it controls for self-selection or selection bias within the model. Selection bias often occurs due to estimating participation of individuals in a program. It arises from missing data, model specification errors, self-selectivity of the units being investigated or errors emanating from the data analyst (Heckman, 1979). In this study, the participation dependent variable was binary in nature with participants being equated to one and zero otherwise. The dependent variable for the second stage was women empowerment index (WEI) that was a continuous variable. Probit model within the Heckman estimated participation while the ordinary least squares (OLS) estimated women empowerment in the second stage.

The Heckman sample selection model is usually identified when the same independent variables in the selection equation (Probit) appear in the outcome equation (OLS). However, it is usually important to ensure that the selection variable appearing in the probit model does not appear in the OLS model (Wick, 1998). The sample selection model works under the assumption that ε_i and μ_i are distributed bivariate normal with mean zero where the assumptions is represented as follows (Wooldridge, 2002):

$$\varepsilon_i \sim N(0, \sigma^2)$$

$$\mu_i \sim N(0,1)$$

$$Corr(\mu_i, \varepsilon_i) = \rho$$

Normally, the sample selection estimates are efficient if μ_i and ε_i are jointly normally distributed (Wick, 1998).

The procedures used in the Heckman selection model are as follows. First, a Probit equation is estimated to obtain Y (outcome). Then for each observation in the selected sample, an inverse mills ratio is computed. It is useful in detecting and correcting any selection bias within the model. It is used in the second regression (OLS) as an independent variable and is denoted as follows:

$$\widehat{\lambda_i} = \emptyset(w_i\hat{\gamma}) \Big/ \Phi(w_i\hat{\gamma}).$$

From the model, we can compute delta by $\delta_i = \widehat{\lambda_i}(\widehat{\lambda_i} - w_i\hat{\lambda})$ where δ_i (inverse mills ratio) is useful in correcting the standard errors in the second equation. The reasons for correcting standard errors in the outcome equation can be attributed to heteroskedasticity if the $\beta_\lambda \neq 0$ implying presence of selection bias. Secondly, $\hat{\gamma}$ is the estimator of γ and $\hat{\lambda}$ estimate is the estimator of λ hence the need to correct the standard errors. At the second stage the Heckman

model estimates β and $\beta_\lambda = \rho\sigma_\varepsilon$ by OLS of Y (women empowerment) on X and $\hat{\lambda}$ (Greene, 2003).

The Heckman equations can be simplified and presented as described. Equation (1) represents the selection equation (Probit) while Equation (2) represents the outcome equation (OLS) of the model.

$$\text{Participation equation} \qquad Z_i^* = w_i\Upsilon + \mu_i \tag{1}$$

Where Z is observed, (Participation) is represented as $Z_i = \begin{cases} 1 \text{ if } z_i > 0 \\ 0 \text{ if } z_i \leq 0 \end{cases}$

Women empowerment is denoted as Y in the outcome equation

$$y_i = \begin{cases} x_i\beta + \varepsilon_i & \text{if } z_i^* > 0 \\ - & \text{if } z_i^* \leq 0 \end{cases} \tag{2}$$

The inverse mills ratio is derived from the conditional mean of the Probit regression that also makes an assumption that $\sigma_\mu = 1$ (Greene, 2003):

3.4 The study area

The study was conducted in Mwingi East, Mwingi North and Mwingi West sub-counties that are located in Kitui County found in the former Eastern Province of Kenya. The three Sub-counties are within the semi-arid zone V of Kenya (Gachimbi, 2002) and are part of the tropical and subtropical dry forests and woodlands. They have a heterogeneous type of vegetation which is a combination of dry-land vegetation, that is largely bush-land, grasslands and shrubs. The County has a warm climate through-out the year with temperature ranging between 24 and 30 degree Celsius, and an average annual rainfall of about 300 mm (Opiyo et al., 2011). These areas have a low potential for conventional agriculture and most of the population derives its livelihood from the forests. Beekeeping is, therefore, a vital source of income to the residents of this region. They have two significant forest reserves: Nuu and Imba forest reserve in the south and the larger Mumoni-Gaikuyu complex in the north. The Mumoni-Gaikuyu forest reserve has hilltop dry

forest patches at higher altitudes and dry woodland and river line forest lower down (Raina et al., 2009). Other livelihood activities in the County are agro-pastoralism and silkworm farming.

Mwingi North Sub-County has a population of 139, 967 persons who live in the five wards that include Ngomeni, Kyuso, Mumoni, Tseikuru and Tharaka. Mwingi East Sub-County had a population of 122,361 persons who live among its five wards namely; Kivou, Nguni, Nuu, Mui, and Waita. Mwingi West Sub-County has five wards that have a total population of 122,620 person found in Kyome, Nguutani, Migwani, Kiomo and Mwingi Central. In general, Kitui County has eight Sub-Counties that have a total population of 1,012,709 persons found in the 205,491 households that are disperse at 33 persons per square kilometre on average (Oparanya, 2009).

ICIPE, the Kenya Forestry Service among other governmental and non-governmental organizations played a key role in the promotion of the Participatory Forest Management project that was implemented in the year 2004 to 2008, in the former Mwingi District, but now the Mwingi North, Mwingi East and Mwingi West Sub-Counties. The project's overall aim was to strengthen the protection of the forest reserves and promote the utilization of forest resources in an efficient manner while ensuring the community also benefited as they conserved their biodiversity (Raina et al., 2009). The project promoted conservation of indigenous trees that largely comprised of shrubs and Acacia species such as *Acacis tortilis* that bees visit to collect nectar while silk worms depend on leaves for food. Further, in 2007 to 2013, ICIPE began the Commercial Insect Programme (CIP) to up-scale beekeeping as a revenue source for farmers who participated in the forestry conservation programme (Affognon et l., 2015).

During the project, ICIPE trained farmers on more efficient methods of utilizing their traditional beehives. It also played part in enabling farmers develop a value chain in order to access both national and international markets (Raina et al., 2009). According to Kioko (2010),

over 2000 individuals depended on bees and silk worms in Mwingi District. Farmers were organised into groups for collective marketing and trained on practical techniques of managing apiculture and sericulture technologies. These farmer groups were formed through an initiative by UNDP with the aim of helping them increase their bargaining power in selling finished products. Their silkworm and bee product were certified organically enabling them to access international markets. The objective of the CIP was to support nature-based enterprises among the rural poor communities through technical training, marketing and management assistance.. This was actualized through offering technical training in wild silk and bee farming to the rural households with a view of commercializing the enterprise.

Apiculture for a long time had been a preserve for men owing to the nature of bees kept and lack of time by women for carrying out cultural practises on the apiary. Due to the intervention of the CIP, changes in gender roles at the household were perceived to occur owing to an increased involvement by women in apiculture. Mwingi was therefore selected as a study site due to CIP intervention. Further, a control group was identified for comparison of gender roles with those in the treatment group.

3.5 Research Design

Salkind (2010) described a research design as a plan, structure or a strategy of investigation that was adopted by researchers to obtain answers to research questions. In addition, a study design is the plan of action a researcher adopts for answering research questions and it sets up the framework for the study or the blueprint of the researcher (Kerlinger and Lee, 1973). This study adopted a survey research design defined as a method of collecting information by interviewing or administering questionnaires to a sample of individuals (Orodho, 2003). The rationale of the survey research design was to describe characteristics of a large group of persons, objects or institutions, through use of questionnaires.

3.6 Sampling and data collection

Primary data was collected using semi-structured questionnaires that contained open-ended questions for identifying constraints faced by actors along the value chain, and remedies thought as appropriate. Respondents comprised of farmer in CIP and NCIP , traders and processors.CIP beneficiaries registered with farmer groups were 1815 out of which 251 farmers were selected for the study survey through use of an excel research randomizer. A similar number of beekeepers who were non-beneficiaries of CIP were identified through referrals within the study sites. Referral was preferred because a sampling frame of non-participants was not available. Therefore, respondents identified and interviewed for the control group were 247. They served as a proxy for the period before program inception for comparison of gender roles with those in the CIP. For the researcher to trace the processors and input suppliers, farmers were asked to recall those whom they sold comb honey to, or refer the interviewer to them for administration of questionnaires. The processing plants identified within Mwingi West, East and North sub-counties were 12 where the CBO was the most reliable compared to the rest that were owned by sole proprietors.

Determination of the sample size used in the treatment area followed the Cochran formula (1963). It denoted as follows:

$$n = {(Z^2pq)}/{e^2}$$

Where:

n = Sample size

Z = the standard normal deviate at the selected confidence level; the value is 1.96 for commonly used 95% confidence interval

P = Proportion in the target population estimated to have characteristics being measured.

q = 1 – p and e = the desired level of precision (5%)

In this case, p is determined as the proportion of household in the target area practicing beekeeping. This was determined during the reconnaissance survey where eight out of every 10 households interviewed practised beekeeping.

$n = 1.96^2 * 0.80 * 0.20/ (0.05)^2 = 245.8$, rounded to 250

3.7 Data analysis

Data entry was done on Excel while cleaning, coding, computation of descriptive statistics and data analysis were done on Stata software version 12 (Stata Corp, College Station, TX). Changes in gender roles were determined through t-test statistics that compared means of roles performed. Estimation of factors influencing women empowerment and household participation in CIP was estimated using the Heckman sample selection model (Puhani, 2000). The model has two equations that are the ordinary least squares and the probit model. The dependent variable chosen for the Ordinary least squares (OLS) was the Women Empowerment Index (WEI) that was computed. Principal component analysis was used for computation of the women empowerment index using Stata software. The dependent variable for the Probit model was participation in CIP.

The variables used in estimation of two equations include; number of income sources of a household referred to as income diversification (Table 3.2). The expected influence of this variable was positive on woman empowerment and participation in the CIP. This claim is founded on Dietemann et al. (2009) that, farmers in Africa often practised beekeeping as an income diversification strategy. The expected influence of dependency ratio (DR) on woman empowerment was negative. Women in households with more economic dependants often stayed at home taking care of the old and children, thus deprived off time to engage in other economically productive activities (Presser and Sen, 2000). In addition, women with control of their income tend to have fewer dependants, hence, the fewer dependants she had, the higher her empowerment index (Hess, 1998). However, a high DR would lead to a households' participation

in the CIP due to the need for extra income to feed the many dependants and achieve food and income security (Carroll and Kinsella, 2013).

Table 3.2 Expected sign of variables estimating participation in CIP and women empowerment

Variable description	Nature of variable	Expected sign on PCIP	Expected sign on WEI
Number of income sources	Continuous	+	+
Dependency ratio	Continuous	+	-
Credit access by household head	Yes=1, no=0	+	+/-
Number of hive types	Continuous	+	+
Kilograms of honey harvested	Continuous	+	+/-
Log Income from other sources	Continuous	-	+
Age of household head	Years	+	+/-
Gender of household head	Man=1, woman=0	+/-	+
Education level of the household head	Continuous	+	+
Tropical livestock units	Continuous	+	
Household asset index	Continuous	+	-
Number of years practised beekeeping	Continuous	+	+

Source: Author, 2013

Credit access by the household head is vital for the improvement of small holder agriculture as shown by Otieno et al. (2010). Therefore, the expected influence of credit on participation in the CIP was positive and negative on women empowerment if she did not have control of the funds. Use of modern hives was expected to influence participation and empowerment of women positively. This was because of trainings offered by the CIP and other development agents on modern hive management. In addition, Affognon et al. (2015) reports that most of the beehives used in Kenya are the traditional hives compared to modern hives. Therefore, use of modern hives alongside traditional hives was expected among the CIP participants. The expected influence on women empowerment was positive based on claims that

women were increasingly participating in beekeeping because modern technologies solved some of their cultural concerns such as taboos that hindered them from climbing trees (Adjei, 2015).

Training offered by the CIP and other development agencies were expected to increase the hive output of beehives due to better apiary management skills acquired by farmers. Affognon et al. (2015) indicates that farmers in CIP groups had a high revenue from honey compared to those in the treatment group and hence the positive influence of honey output on participation and empowerment based on the information that women who controlled their income would be more empowered (Hess, 1998).

Influence from other income sources on women empowerment and participation was expected to be positive. The higher the income from other sources, a farmers likelihood to participate in the CIP would be higher because they had the resources to invest or purchase the modern technology as shown by Carroll and Kinsella (2013) that, lack of resources limited household participation in development initiatives. Age of the household head was expected to have a positive or negative influence on women empowerment, and a positive influence on household participation in the CIP. Doss and Morris (2001) showed a positive relationship between participation or adoption of new technologies with age. They found that, older farmers adopted new technologies compared to younger ones in their assessment of maize technologies in Ghana.

Gender of the household head is a dummy variable with one representing male and zero female. If a woman headed a household, it is expected that she would have a higher empowerment index and likely to participate in the CIP to benefit from the extra income. If the gender of a household head was male, it was expected that a woman would not be in control of the household resources and hence a negative relationship with empowerment as indicated by Chemurot (2015) that, men in Africa made most of the household decisions regarding access, use

and control of household resources. In addition, variables such as Household asset index and Tropical Livestock Unit (TLU) were expected to have a negative influence on women empowerment if a woman in that household did not exercise control over the assets (Adjei, 2015). However, the education level of the household head and years of experience in beekeeping were expected to have a positive influence on household participation in the CIP. Carroll and Kinsella (2013) showed that a positive relationship existed between age, experience and household participation in beekeeping. Further, educated household heads were expected to understand the benefits of participating and have more access to information than those with a lower education level (Affognon et al., 2015).

CHAPTER 4: RESULTS AND DISCUSSION

This chapter is organised into sections and sub-sections. The main sections answer the four objectives in a logical flow manner while subsections give more details and findings within the main section. The chapter begins by mapping actors of the honey value chain and identifying support services within the chain. Roles performed by each gender at various stages of the value chain are discussed in the subsequent section while factors influencing beekeepers participation in the CIP and empowering women are discussed in the last two sections.

4.1 The bee keeping value chain in Kitui County

4.1.1 The honey flow chart

Farmers who either belonged to CIP or NCIP groups did harnessing of honey from bees. The CIP and NCIP farmers sold honey to consumers and to the CBO, individual processors, and brokers who added value to crude honey for sale. Value addition among brokers and individual processors involved little or no use of machinery in separation of honey and combs. Products sold by brokers and other processors were not certified, labelled or branded even though they packaged the processed honey into plastic bottles for sale. The CBO used a centrifuge machine to extract honey from honeycombs while wax and fibre were separated using hot water. The fibre extracted from wax was used to attract bees into new beehives or as chicken feed even though it lacked consumer demand and the CBO threw it away. Purified wax was moulded into candles, cakes or large wax blocks that would be sold based on weight. Processed honey from the CBO was packaged into bottles that were labelled and branded. The Kenya Bureau of Standardization (KEBS) and the Kenya Organic Agricultural Network (KOAN) certified products from the CBO. The most probable reason for non-certification and lack of branding for the small players could be due to low volumes of operation.

The CBO sold its value added products at Kenya shilling (Ksh) 450 per Kilogram of honey jar and Ksh 300 for every Kg of wax. Brokers and individual processors sold honey at Ksh

300 per kilogram and their involvement in separation of wax and fibre was limited due to little or no market demand. The price differential for the finished products could be attributed to the value addition process that involved the use of machinery, branding, certification and labelling among the CBO in comparison to other value addition actors.

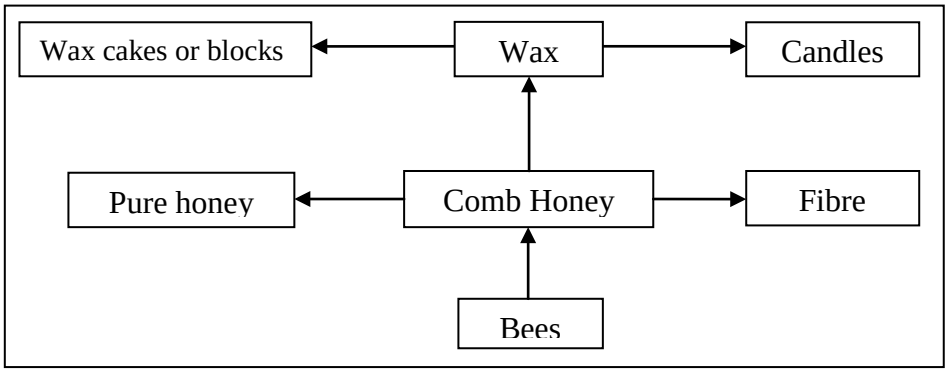


Figure 4.1: Transformation of crude honey from honey bees into finished products

Source: Author survey, 2013

4.1.2 Honey market share by various intermediaries

Farmers from the treatment and the control group sold comb honey to consumers and value addition actors who include brokers, individual processors and the CBO. At times, farmers' extracted honey from honeycombs at home for their own consumption or for sale. It was also noted that, value addition actors purchased honeycombs from farmers at various prices with the mean price offered by the CBO to the CIP and NCIP farmers as Ksh 200 and Ksh 190 (Table 4.1) respectively. The difference in mean prices was attributed to the fact that, the CBO strictly purchased honey from its members and the mark up was an incentive to encourage its members to produce more. Some of the reasons given for strictly purchasing from members were the issues of quality assurance and organic certification. The modal price offered by individual processors to farmers in the CIP and NCIP for a kilogram of honeycombs was Ksh 180. Brokers offered farmers a mean price of Ksh 136 and 151 to the CIP and NCIP farmers respectively. The difference in prices was attributable to the fact that the CBO bought quality honey from its members. Therefore, honeycombs that did not meet quality standards of the CBO were sold to

alternative market agents such as brokers, at a lower price by the CIP farmers. Consumers paid a modal price of Ksh 200 for a kilogram of honey from farmers who processed crude honey at home.

The market share or proportion of respondents who sold their honeycomb to various actors is as follows. Data collected revealed that 14% and 22% (Table 4.1) of CIP and NCIP farmers sold a proportion of their honey harvest directly to consumers. The difference in this proportion was significant at 5% implying that, a significant number of NCIP farmers sold honeycombs directly to consumers unlike those from the CIP. Since maximisation of returns is the objective of every farmer, NCIP farmers were motivated to sell to consumers because alternative market agents offered a lower modal price.

Table 4.1: Summary of modal and mean price, market share and gross margin of various actors who processed honey purchased from CIP and NCIP group.

Item	Group	Consumers	CBO	Individual processor	Brokers
Modal price (Ksh)	CIP	200	200	180	120
	NCIP	200		180	150
Mean price (Ksh)	CIP	175.4	200	185	136
	NCIP	188.1	190	180	151.1
Market share (%)	CIP	14	66	2	19
	NCIP	22	1	1	76
Z-value of market share		-2.32**	15.34***	0.92	-12.74***
Gross margin (Ksh) of	CIP		250	115	164
actors (processors)	NCIP		260	120	149

Source: Author survey; 2013

The proportion of respondents who sold honeycombs to the CBO among the CIP farmers was 66% compared to 1% among the NCIP. The difference was significant at 1% and was attributable to the by-laws governing the CBO, which stated that, the CBO was limited to purchasing honey from farmers registered in the CIP only. The by-law was meant to encourage non-members to be registered, trained and certified on organic honey production. In addition, the by-law ensured that CBO honey was of a high quality and could penetrate local and international markets.

Individual processors between the CIP and NCIP had a market share of 2% and 1% respectively. The difference among the two was statistically insignificant implying that these actors commanded a very small proportion of the market. Brokers had a market share of 19% and 76% between the CIP and NCIP respectively. The difference between the two groups was significant at 1% and was attributable to the fact that CIP farmers had a CBO they owned and hence sold much of their honey to it. NCIP farmers sold to brokers mainly because they had the capacity to buy bulk unlike consumers.

The gross margins of actors such as the CBO, individual processors and brokers were calculated using the mean prices offered to farmers during honey purchases and the average selling price of value added products. The gross margins included costs related to value addition, transport, labour, branding and profit. The CBO as a value addition actor had a gross margin of Ksh 250 if it purchased honey from the CIP farmers and Ksh 260 if from NCIP farmers though prohibited by the by-laws. Individual processors had a gross margin of Ksh 115 and Ksh 120 while for brokers it was Ksh 164 and Ksh 149 if they purchased honey from CIP and NCIP farmers respectively. The CBO had the highest gross margin compared to the other actors and the high values were attributable to the value addition process that involved branding, labelling and certification.

Based on the information gathered from the survey, it was concluded that there were three actors at the processing stage. Consumers were the ultimate recipients of the processed products. Farmers who were at the beginning point of the value chain were either affiliated to CIP or NCIP group. The flow of honey from farmers to consumers through the different actors can be diagrammatically represented as in Figure 4.2.

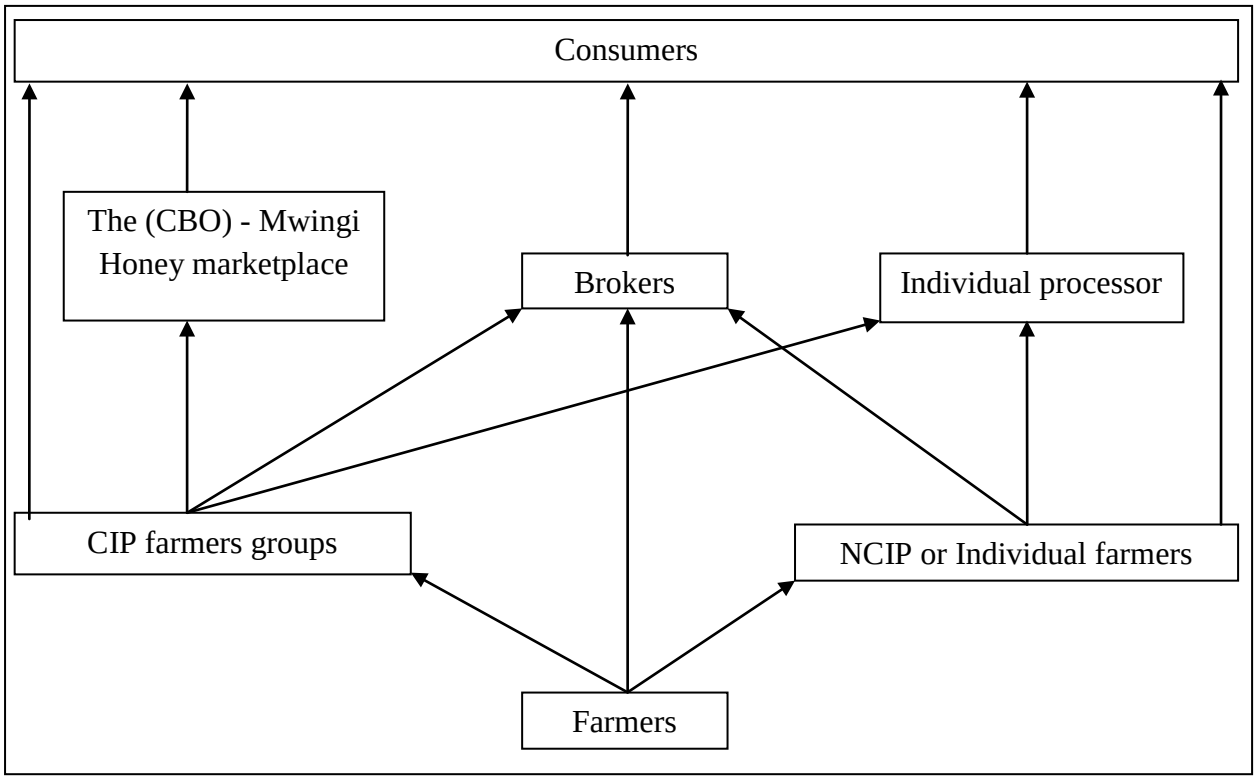


Figure 4.2: Honey value chain map showing honey flow from farmers to consumers through various actors

Source: Author, 2014

Between each, interlink in Figure 4.2 there were services offered by other agents such as KEBS, KOAN and the Export processing zone (EPZ) who regulated products from the CBO. However, products from brokers and individual processors seemed to be unregulated and did not have KEBS, KOAN or EPZ certifications. The roles of KOAN were to ensure that honey processed was organically produced and traceability was adhered to. ICIPE helped in setting up of the CBO processing plant and controlled the price at which honey was purchased from farmers. KEBS ensured that the honey packaged at the CBO was safe for human consumption.

The issue of regulation was a competitive advantage for the CBO products compared to those from other agents. It enabled the products to penetrate the local and international market at ease and perhaps contributed to the high gross margins at the CBO.

Agricultural extension services were provided to the CIP farmers by ICIPE, and the Ministry of Agriculture and Livestock, where they advised them on apicultural practices that suited their enterprise for an increased honey output. Some of the apicultural practises farmers were trained on included hive repair and construction, hanging of hives, apiary cleaning, bee and beehive management, honey harvesting and storage. The use of agricultural extension services by the NCIP was limited and could possibly contribute to the difference in the mean honey output among the control and treatment group.

A comparison of the inputs used farmers revealed that CIP beneficiaries had more bee keeping inputs than the control group (Table 4.2). CIP farmers owned more traditional hives than NCIP farmers who had an average of 30 hives compared to 20 hives respectively. The mean difference in traditional hives owned by the two groups was found to be significant at 1%. Use of Langstroth hives showed a difference among the groups with each CIP farmer owning at least four hives on average compared to zero hives among the NCIP. The mean difference in Langstroth hives owned by the two groups was found to be significant at 1%, and the difference in the number of traditional and Langstroth hives used, was attributable to the fact that CIP farmers had a marketing channel that purchased their surplus honey hence, motivating them to produce more honey and acquire more beehives. The use of stingless beehives, bee suits and apicultural supporting trees or foliage was common among CIP farmers and almost non-existent among the control group. The differences in the use of bee suits, stingless bee beehives and apicultural supporting trees among the CIP and NCIP farmers was significant at 1%. The differences revealed in ownership and use of more inputs by CIP farmers could have contributed to higher beehive output and income from bees. In general, the CIP farmers had more inputs that

characterised their seriousness in apiculture. They were more equipped compared to NCIP group, which justified the need to market honey harvested collectively through creation of a sustainable marketing channel. Data collected revealed that NCIP farmers minimally emulated technologies used by CIP farmers in honey production. Traditional hives were common among the control group while the use of commercial smokers was limited among them. Most of the NCIP and the CIP farmers used the traditional smokers during honey harvesting.

Table 4.2: Comparison of the average bee inputs owned and used by the CIP and NCIP farmers

	CIP (n= 251)			NCIP (n=247)			
Input	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Z-value**
Traditional Hives	0	300	30.0	0	100	20.3	-3.51***
Langstroth Hives	0	44	4.55	0	3	0.02	-6.66***
Stingless Beehives	0	25	0.31	0	0	0	-0.04**
Commercial Smoker	0	2	0.08	0	1	0.10	-3.88***
Bee Suit	0	2	0.10	0	0	0	-4.78***
Apicultural Trees	0	20	0.42	0	0	0	0.004***

Source: Author, 2013 survey

4.1.3 Access to support services among the CIP farmers

Access to support service providers such as extension agents from the Ministry of livestock and agricultural, was limited among NCIP farmers. ICIPE field officers assisted in formation of farmer groups among CIP farmers. They also helped the farmers in transforming their bee enterprises into agricultural businesses. ICIPE field officers played a key role in formation of the marketing or farmer groups at 41.25% (Table 4.3). The groups were meant to unite farmers with the aim of pooling harvested honey together. This would allow for processing, raise the farmers bargaining power and facilitate value addition. Through the groups, trainings on

better apicultural husbandry practises were offered. Other stakeholders that facilitated the formation of farmer groups were the farmers themselves at 28.33% and government extension officers from the ministry of livestock and agriculture at 18.75%. The involvement of ICIPE and government extension officers could explain the high honey yield from the CIP farmers.

Table 4.3: Sources of assistance with information on beekeeping among the CIP farmers

People who assisted in formation of the marketing groups	Frequency	Response %	Cum	Rank
ICIPE field officer	99	41.25	41.25	1
A group member (farmer)	68	28.33	69.58	2
Ministry of Livestock/Agriculture	45	18.75	88.33	3
Neighbour	17	7.08	95.41	4
Others e.g. friends, relatives etc	11	4.58	100.00	5

Source: Author survey; 2013

4.1.4 Challenges encountered at the farm level by CIP and NCIP farmers

At the farm level, individual farmers encountered challenges during honey production. The challenges encountered by CIP and NCIP farmers were similar, but the percentage responses to the same challenges differed. Pests such as sugar and black-ants were a concern to NCIP farmers at 41.67% (Table 4.4). Invasion of a beehive by sugar or blank ants made bees to migrate or abandon a beehive. CIP farmers had been trained on modern apicultural practises that included management of such pests. However, these pests bothered their bees at 22.70%. The difference in pest disturbance between CIP and NCIP was significant at 1% and this implied that, the treatment group had been adequately trained to protect their hives from the insect.

Drought was a challenge to CIP farmers at 27.60% compared to NCIP farmers at 15.67% (Table 4.4). The difference among the groups was significant at 1%, hence implying that drought was a major challenge for both groups due to its effect on natural resources where foliage that

bees depended on for nectar and water dried up. Without nectar and water, honey production was affected. In addition, during periods of drought, bees fed on honey in the beehive for survival and this had an adverse impact of honey yields. Consequently, this affected a farmer's income from honey harvests. Therefore, to keep bees from absconding a beehive, a farmer had to provide water that would be placed near the beehives or within the apiary in a jar.

Table 4.4: Challenges encountered at the apiary by CIP and NCIP farmers

Challenges encountered at the farm level by individual farmers in both categories	**% response CIP (n=251)**	**% response NCIP farmers (n=247)**	**Z- value**
Sugar and black ants	22.70	41.67	-4.53***
Drought (lack of foliage and water)	27.60	15.97	3.14***
Lack of harvesting gear	4.91	13.89	-3.44***
Theft of hives	17.79	11.11	2.12**
Honey burgers	19.02	8.33	3.47***
Absconding of bees from beehives	6.75	6.94	-0.08
Snakes	1.23	2.08	-0.74

Source: Author survey: 2013

Lack of harvesting gear was a concern to NCIP farmers at 13.89% compared to the CIP group at 4.91% and the difference among them was significant at 1% (Table 4.4). Harvesting gears or bee suits were crucial in the management of apiaries. The aggressive bees used for honey production required one to be properly dressed to avoid being stung. Bee suits were given to CIP farmers by ICIPE and hence the different ratings. However, the mean number of protective gears owned indicated that not all farmers within the CIP group owned a bee suit. Lack of harvesting gear could have limited farmers from harvesting and increasing the number of beehives owned.

Honey burgers were a common concern to both groups because they destroyed beehives in their quest for honey. This was a challenge among the CIP farmers at 19.02% compared to the NCIP farmers at 8.33%. The difference in rating was significant at 1% which was attributed to the high number of beehives they owned by CIP farmers. Destruction of beehives by honey burgers led to loss of incomes, honey yields and bee colonies.

Absconding of bees from beehives of farmers in the CIP and NCIP was a challenge caused by many reasons which include drought, use of insecticides on crops near the apiary and pests among others. Snakes were a minor challenge even though they bothered the beekeepers where apiaries were located far away from homesteads in bushy places, where they sheltered from the scorching sun. They were not a bother to many farmers and hence the low rating of 1.23% and 2.08% by CIP and NCIP farmers respectively. Even though absconding of bees and snakes were mentioned as a challenge at the farm level, comparison of the challenge between the CIP and NCIP groups did not show any statistical significance.

4.2 Gender roles and decision-making at each stage of the value chain

4.2.1 Gender roles and decision making at the input acquisition stage of the value chain

Inputs required for one to become a beekeeper include a beehive, a smoker and bee suit. However, from the average inputs, the survey indicated that traditional hives, smokers and Langstroth hives were common among CIP and NCIP farmers. Participation of women at the input acquisition stage was measured by determining who made decisions to acquire beekeeping inputs at the household level.

Women involvement on acquisition of smokers showed a statistically significant difference among CIP and NCIP farmers at 10% (Table 4.5). This implied that the NCIP women were more involved in acquisition of smokers for use in harvesting honey compared to those in CIP. The difference was attributable to the fact that CIP farmers had been issued with industrial

smokers by ICIPE at the onset of the program. In addition, NCIP farmers used local and homemade smokers.

The decision to acquire traditional hives showed a statistically significant difference among men and both spouses category when CIP and NCIP farmers were compared. Women participation in both spouses category between CIP and NCIP showed a significant difference at 1%. This indicated that women among the NCIP participated more than those in the CIP in acquisition of the traditional hive. In the men category, a difference was noted between CIP and NCIP during comparison. The difference was significant at 5% implying that, CIP men made the decision to acquire traditional hives compared to those in NCIP. In addition, harvesting honey from traditional hives required climbing of trees which women considered a taboo.

Table 4.5: Decision maker regarding acquisition of key inputs at the household in beekeeping

	% response (CIP)			% response NCIP			P-value		
Input	**Men**	**Both spouse**	**Women**	**Men**	**Both spouse**	**Women**	**Men**	**Both spouse**	**Women**
Smoker	90.3	3.4	5.1	87.6	6.9	5.0	0.96	-1.77*	0.05
traditional hives	55.6	18.4	25.6	44.7	33.3	22.0	2.43**	3.80***	0.94
Langstroth hives	28.0	28.0	44.0	0	0	0	8.97***	8.97***	11.82***

Source; Authors survey, 2013

Women made the acquisition decision of Langstroth hives more than men among CIP at 44.0%. The difference among men and women in CIP was significant at 1% and is attributed to the fact that, Langstroth hives were hoisted near the ground where climbing trees was not required hence the strong liking of the hive by women. This indicated that the taboo hindering women from climbing trees to tend to beehives was no longer in play for those using Langstroth hives.

4.2.2 Gender roles at the apiary or production stage of the value chain

At the farm level, apicultural practises involved cleaning of the apiary, transporting of hives to the apiary, construction and repair of beehives, watering of bees as well as managing the apiary. A general comparison conducted using averages of roles done by gender among the CIP and NCIP farmers revealed that, men in the CIP allowed their spouses to assist in apiary cultural activities. Men in the NCIP executed up to 82.0% (Table 4.6) of apiary tasks while those in the CIP carried out 68.1%. The difference of the average tasks done by men was significant at 1% implying that male dominance in executing apiary tasks among the CIP was lower compared to those in the NCIP. Literature reviewed indicated that beekeeping was male dominated (Ogaba and Akongo, 2001; Pactkenya, 2010 and Shackleton, 2011). However, the initiative by CIP had contributed significantly in reduction of the male dominance. Consequently, joint participation of men and women in executing apiary tasks showed a significant difference at 1% implying that, women in the CIP participated more in apiary tasks compared to those in the NCIP. This was attributable to training on beehive management practises (Kioko, 2010).

Cleaning the apiary involved clearing of bushes and trimming of tall grass around and within an apiary (where beehives were hived). It also involved reducing the number of braches on a tree where beehives were placed. A change in gender roles in performing the task is exhibited by a comparison of those who did it between the CIP and NCIP. A significant difference at 1% in the comparison of men, women and both spouses from CIP and NCIP farmers is observed. This implied that more women among the CIP in the both spouses and woman category helped to clean the apiary compared to those in NCIP. The difference can be attributed to trainings received by CIP farmers as well as the involvement of government and ICIPE extension officers. The importance of a clean apiary includes a higher productivity from bees and fewer disturbances of beehives by predators.

Men mostly transported hives and the difference among the CIP and NCIP farmers was significant at 1% in the joint or both spouses category respectively. This indicated an increased participation of women in the activity compared to those in NCIP. Consequently, the difference among men transporting hives to the apiary between CIP and NCIP was significant at 1% implying that more NCIP men transported hives to the apiaries compared to those in CIP. The difference was attributable to men in the CIP allowing women to take part in the activity.

Table 4.6: Comparison of roles done by men, women and joint effort at the apiary

	% response CIP (n=251)			**% response NCIP (n=247)**			**Comparison Z - Values**		
Apiary activity	**Men**	**Women**	**Both**	**Men**	**Women**	**Both**	**Men**	**Women**	**Both**
Clean apiary	69.8	9.7	20.6	86.3	2.2	11.5	-4.44***	3.53***	2.76***
Transporting of hives	69.1	4.0	26.9	78.8	5.3	15.9	-2.46***	-0.69***	2.99***
Watering of the apiary	44.8	16.9	38.3	71.7	6.2	22.1	-6.08***	3.73***	3.93***
Constructing of new hives	85.1	2.8	12.1	89.4	2.2	8.4	-1.44	0.43	1.36
Repairing of hives	87.2	3.6	12.1	88.9	2.2	8.9	-0.58	0.93	1.16
Management of apiary	52.4	6.5	42.0	77.0	2.7	20.4	-5.74***	2.02**	5.20***
Average	68.1	6.1	25.3	82.0	3.5	14.5	-3.58***	1.36	3.02**

Source: Author survey, 2013

Watering the apiary involved placing jars of water within the apiary or under a tree that beehives were hoisted. All categories of participants between CIP and NCIP showed a change that was significant at 1%. Data revealed that fewer men among CIP watered the apiary compared to those in NCIP. More women among the CIP participated in watering the apiary compared to those in NCIP while an increased participation in the joint or both spouses category was observed among CIP compared to NCIP. The difference in the significance was attributable to the importance of watering bees. Watering especially during the dry season inhibited bees from migration and moving over long distances in search of water.

Constructing and repairing of beehives involved curving of new beehives as well as repairing or doing maintenance on the old beehives. These activities were considered a man's domain because they required physical strength and skills. These tasks did not show a statistical significant difference among the treatment and control group that was attributable to the perception that construction was a man's' domain.

Management of the apiary involved, hiring of labour to carry out apiary activities and making of decisions on when to harvest honey. A comparison of men between CIP and NCIP in the management of the apiary showed a significant difference at 1% implying that, men among NCIP were more involved in management of the apiary compared to those in the CIP. Consequently, a statistical difference among women involved in apiary management was observed at 5%. The difference indicated that more women among CIP farmers were involved in apiary management compared to those in NCIP. Joint effort among CIP and NCIP farmers accounted for 42.0% and 20.4% respectively with a statistically significant difference at 1%. This showed that joint effort was common among the CIP compared to NCIP in apiary management and hence the conclusion that women in CIP preferred to work alongside men in apiary management.

Apiary activities not done by women at the apiary in the production stage include hanging of beehives, beehive construction and repair as well as harvesting of honey. Women at 49.6% and 70.0% (Table 4.7) among the CIP and NCIP farmers respectively never hoisted beehives. The difference was statistically significant at 1% implying that, more women among the CIP group got involved in citing places beehives would be hoisted compared to those in NCIP. The difference was attributed to assistance offered by government extension officers and ICIPE field officers. However, harvesting of honey was avoided at 19.2% and 2.4% by women among the CIP and NCIP farmers respectively. The difference was found to be statistically significant at 1% implying that more NCIP women got involved in honey harvesting compared to those in CIP. This was found contrary to the study expectation because, ICIPE had issued CIP farmers with bee suits that were meant to address bee sting phobia hence encouraging more women to participate in honey harvesting. However, the mean difference in number of hives owned and volume of honey output harvested by CIP farmers could have deterred women from harvesting honey hence leaving it to men. Hive construction and repair showed no significant difference among CIP and NCIP farmers

Table 4.7: Comparison of activities not done by women at the farm apiary

Apiary activities not done by women	% response (CIP) n=251	% response (NCIP) n=247	Comparison Z–value
Hanging of hives	49.6	70.0	-4.64***
Hive construction	30.8	27.2	0.89
Honey harvesting	19.2	2.5	5.97***
Repairing hives	0.4	0.4	0.00

Source: Author survey, 2013

Women from CIP and NCIP groups cited reasons as to why they refrained from performing some of the apiary activities. Some of the reasons given include lack of skills at

47.5% and 35.8% (Table 4.8) between CIP and NCIP farmers respectively. The difference was significant at 1% indicating that, in spite of the trainings offered by ICIPE, and the intervention by agricultural extension officers, CIP women felt that they lacked adequate skills. In addition, 31.3% and 23.0% of women between CIP and NCIP felt that climbing trees was a taboo that hindered them from hanging and harvesting honey. The most commonly used beehives were the traditional or log hives hoisted on tall trees. The difference was significant at 5% providing evidence that cultural believes were held on-to strongly by women in the control and treatment group. Fear of falling off a tree among the CIP and NCIP women farmers was at 19.6% and 41.2% respectively. The difference was statistically at 1% indicating that NCIP women refrained from climbing trees, due to fear, while the same reason was not a bother to the CIP women. Other reasons such as the fear of bee stings were statistically significant at 10%. Women from the CIP feared bee stings more than those in the NCIP. This was attributable to the fact that, they had more beehives and participated more in apiary management practices than those in the NCIP. This increased their contact with bees and hence a higher value for fear of bee stings.

Table 4.8: Reasons for women not undertaking apiary activities e.g honey harvesting

Reasons for not carrying out the activities	% response (CIP) N=251	% response (NCIP) N=247	Z-Value
They lacked the skills required	47.5	35.8	2.65***
Believed that culture prohibited tree climbing	31.3	23.0	2.08**
Feared falling from trees	19.6	41.2	-5.24***
Other reasons e.g. fear of bee sting	1.7	0.01	1.88*

Source; Author survey, 2013

The two types of bees found within the study area, domesticated by farmers are; the stingless bee and the African aggressive bee. However, preference for aggressive bees was dominant among CIP and NCIP farmers. Some of the reasons given for the preference were

adaptability to the environment and availability of the aggressive bees (Table 4.9). CIP and NCIP farmers respectively rated the preference at 50.2% and 71.3% (Table 4.9) and the difference in this proportion was significant at 1%. This preference was higher among NCIP farmers compared to those in the CIP, fewer NCIP farmers kept stingless bees compared to those in the CIP. In addition, aggressive bees were readily availability and all a farmer required to keep them was to buy a new beehive and hang it on a tree. The inner part of the new beehive would be rubbed with fibre from honey waste and once bees located it, it would be colonised. Another reason for the preference of aggressive bees was is that, they were regarded as a source of income at 43.1% compared to 26.4% by the CIP and NCIP farmers respectively. The percentage difference was statistically significant at 1%, depicting that, CIP farmers regarded beekeeping as a source of livelihood. Formation of a CBO was to help maximize returns from beekeeping. Another reason for the preference of aggressive bees was that it required little capital, and this preference was statistically significant at 5% level.

Table 4.9: Reasons for preference to rear aggressive bees among farmers

Reasons for the preference of keeping aggressive bees	**% response (CIP) n=251**	**% response (NCIP) n=247**	**Comparison P - values**
locally available and well suited to the environment	50.2	71.3	-4.82***
A source of income and produce quality honey	43.1	26.5	3.89***
Other reasons e.g. they require little capital to keep	6.7	2.3	2.36**

Source: Author survey 2013

Various types of beehives were used for beekeeping and they include traditional hives, Langstroth hives and beehives for stingless bees. However, results for the mean number of beehives owned indicated that traditional hives were the most commonly used by both CIP and NCIP farmers. Preference for use of traditional beehives over other types was associated to cheapness, availability and accessibility of traditional hives. The preference for this hives among

the CIP and NCIP was at 82.7% and 64.8% with the difference statistically significant at 1% (Table 4.10). This explained why the NCIP farmers used almost exclusively traditional beehives to rear bees. The CIP farmers observed that traditional hives had higher yields compared to other beehive types at 21.7% compared to 6.9% by NCIP farmers. The difference among them was statistically significant at 1% implying that the CIP farmers had not obtained optimal results from other types of beehives. Inheritance of beehives ranked highest among CIP farmers at 2.5% compared to 0% by NCIP and the difference was statistically significant at 5% hence implying that, a large number of traditional hives owned by the CIP farmers were probably inherited. Some of the reasons for preference of traditional beehives were ease of management, bees did not abscond easily, and modern hives were expensive and unavailable were statistically insignificant between CIP and NCIP.

Table 4.10: Factors that influenced preference for log hives over other hive types

Factors influencing preference for traditional hives over other types of beehives	% response (CIP) n=251	% response (NCIP) n=247	Comparison Z - Value
They are cheap, available and locally accessible	64.8	82.7	-4.54***
They have high honey yield	21.7	6.9	4.71***
They are easier to manage	8.6	9.6	-0.39
The beehives were inherited	2.5	0.0	2.50**
Modern hives are unavailable and expensive	1.6	0.9	0.70
The bees do not abscond easily	0.8	0.0	1.41

Source: Author survey, 2013

4.2.2.1 The role of women in on apiary management decisions

In order to determine the role of women in management decisions on beekeeping, the gender of the person who made decisions regarding honey production was sought. Decisions assessed include; who established beekeeping, negotiated honey sale price and who kept revenue from the sale. Involvement of women in establishment of beekeeping as an enterprise showed no

significant difference when a comparison among CIP and NCIP farmers was done at the spouses and women category (Table 4.11). However, a statistically significant difference is observed at 10% in negotiation of honey sale price indicating that, the NCIP women made decisions on honey sale negotiation compared to those in CIP. This is attributable to the fact that CIP farmers sold 65.6% of honey to the CBO that had a fixed price of Ksh 200 for a kilogram of comb honey. NCIP farmers had to negotiate a price for the honey harvested because their main buyers were brokers who purchased 76.1% of their honey harvest. Brokers offered a range of prices. Therefore, bargaining power and quantity probably determined the price at which brokers would purchase honey from them.

In regards to who kept revenue from honey sale, a statistically significant difference was observed at joint or both spouses and women category at 1% for CIP and NCIP respectively (Table 4.11). This implied that, more women among the NCIP kept revenue compared to those in the CIP. This was attributable to the fact that among the CIP, beekeeping was regarded as an income source and hence women and men participated jointly at the household level.

The decision on when and where to sell honey showed a statistical difference in all categories. Men between CIP and NCIP made this decision at 41.0% and 31.6%. The difference between them was significant at 5%, implying that men among CIP farmers made the decision more compared to those in NCIP. At the both spouse category, the difference was significant at 1%, implying that among the NCIP, the joint or both spouses category made the decision on where to sell honey more compared to those in CIP. However, data showed that women among the CIP were more involved in determining when and where honey could be sold compared to those in the NCIP. The difference in this category was statistically significant at 10%.

In general, overall participation in decision-making indicated that, the category of joint effort or both spouses had a significant difference at 10% implying that, participation of women in decision making at the production stage had increased among the CIP compared to those in

NCIP. However, independent decisions by women in regards to production of honey showed a significant difference at 1% where women among the CIP were fewer than those in the NCIP at 12.6% and 22.4% respectively. This was attributed to little or no involvement of men in making key decisions among NCIP farmers.

Table 4.11: Key decisions about apiary management among the CIP and NCIP farmers

	% response (CIP) n=251			% response (NCIP) n=247			Comparison Z-value		
Key decisions	**Men**	**Both spouse**	**Women**	**Men**	**Both spouse**	**Women**	**Men**	**Both spouse**	**Women**
Who established beekeeping	50.2	39.6	8.6	55.7	36.9	6.6	-1.23	0.62	0.84
Who negotiated honey sale price	37.6	53.9	6.9	32.1	61.7	5.4	1.29	-1.76*	0.70
Who keeps money from honey sale	9.8	63.7	26.5	11.1	15.6	73.4	-0.47	10.96***	-10.47***
When and where to sell honey	41.0	50.0	8.2	31.6	63.1	4.5	2.18**	-2.95***	1.69*
Overall	34.6	51.8	12.6	32.6	44.3	22.4	0.47	1.67*	-2.88***

Source; Author survey, 2013

4.2.3 Gender roles at the processing or value addition stage

Men and women performed different roles during value addition and a preference to work with men or women was sought. Many of the processors indicated that they preferred to work with women at 58.33% compared to those who did not at 16.67% whereas 25.00% did not mind working with either men or women. The roles of men during value addition were weighing of honey purchased by the processors and sourcing honey from farmers at 58.33% and 33.33% respectively. The roles of women at the value addition facilities were; packaging and processing of honey at 54.55% and 27.27% respectively.

4.2.4 Gender roles at the marketing honey value chain stage

The roles of men in marketing of honey were sales and transportation of honey to clients and to different retail outlets at 70.00% and 30.00% respectively. The roles of women in marketing were similar to those of men where they participated in the sales and in sought new markets at 80.00% and 20.00% respectively.

4.3 Socio-economic characteristics of the population sampled

This section begins with t-test analysis to determine differences in socio-economic characteristics among CIP (treatment) and NCIP (control) farmers. The results discussed have been summarized in Table 4.12. The mean difference for women empowerment index was significant at 5%. The CIP farmers had a higher mean at 58.77 units while that of NCIP was at 55.49 units. The finding tallies with that of Nel et al. (2004) that beekeeping can be an avenue for empowering women. Participation in CIP may have increased the labour burden of women due to their involvement in carrying out apiary activities. However, their involvement in beekeeping has a role in environmental conservation, increased food and income security. Traditionally, women had been culturally constrained by taboos from participating in beekeeping due to bee-sting phobia and the nature of beehives kept. In the advent of modern technology, women are increasingly taking part in the enterprise management, in addition to carrying out apiary practices they previously shunned. According to Kabeer (1999) empowerment was measurable through evaluation of one's own choices regarding economic and social activities. The composite index (WEI) includes choices made by women regarding acquisition, use of productive resources and benefits. Therefore, the composite index shows that, apart from participating in beekeeping, women are increasingly taking part in the management and use of productive resources at the household.

The CIP households had a higher number of economic dependants compared to NCIP households. The difference was statistically significant at 5% with the mean dependency ratio of CIP and NCIP households at 0.81 and 0.66 respectively. A high dependency ratio implied that such a household would require more income to cater for the needs of dependants. CIP offered a market for surplus honey and purchased comb honey from farmers at a constant price of Ksh 200 unlike other market actors who offered a lower price. This finding tallies with that of Vlek et al. (2003) who found that, farmers who sold their honey through a group got more money than those who sold as individuals. This boosted their income to cater for the needs of their households.

The average age of household heads and that of their spouses was statistically different at 1%. The CIP had older household heads and spouses who had a mean of 55yrs and 48yrs compared to those in NCIP that had an average age of 48yrs and 43yrs respectively. However, NCIP households had more educated household heads and spouses. The mean difference in years of formal education among the CIP and NCIP household heads and spouses was at 10% and 5% levels of significance respectively. In addition, CIP households had more years of experience in beekeeping compared to those in NCIP. The difference in years of beekeeping experience was statistically significant at 1%. The difference in the years of experience could have contributed to CIP farmers forming a CBO to aid in marketing of honey harnessed. Marketing challenges could have been a motivating factor for readily accepting benefits of a CBO. It is argued that, farmers with more experience and age can predict future outcomes of the enterprise based on past encounters (Affognon et al., 2015). Consequently, CIP farmers were older and exhibited more years of experience on average compared to those in the NCIP. In addition, Chirwa (2005) found that age was positively related to adoption of new technologies in Malawi.

Table 4.12: Demographic and farm characteristic differences

Characteristic	Mean CIP	Mean NCIP	t-value
Dependent variables			
Women empowerment index	58.77	55.49	-2.35**
Participation in CIP			
Household characteristics			
Dependency ratio (%)	80.51	66.16	-2.01**
Household size	5.57	5.86	1.49
Household asset index	16.67	17.55	1.00
Tropical livestock Units	5.43	5.96	1.21
Farmer characteristics			
Age of household head	55.46	48.55	-5.93***
Age of spouse	48.38	43.04	-4.84***
Education of household head(Yrs)	5.74	6.42	1.71*
Education of spouse (Yrs)	4.28	5.15	2.24**
Education level of household head	1.58	1.60	2.51
Credit access by the household head	0.10	0.04	-2.81***
Accessed credit in the last 5yrs (man)	0.08	0.02	-2.64***
Accessed credit in the last 5yrs (woman)	0.05	0.02	-1.70*
Gender or Sex of household head	0.90	0.91	5.48
Experience in beekeeping	20.84	15.55	-5.52***
Farm characteristics			
Number of hive types	1.58	1.00	-15.72***
Number of income sources	3.85	3.42	-3.66***
Beekeeping income(annual)	14882.37	6665.47	-3.99***
Income from other sources(annual)	78437.37	65322.71	-2.19**
Quantity of honey harvested (Kg)	81.60	46.10	-3.93***
Quantity of honey consumed (Kg)	7.21	6.34	-1.60

*NB: the asterisk denotes significance level; * at 10%, ** at 5% and *** at 1%.*

Source: Author survey, 2013

The CIP household heads were found to have more access to credit than those among NCIP. The difference in access to credit between the groups was significant at 1%. Accessibility to credit is assumed to have been driven by assured income or higher incomes. The CIP households had a higher income from other income sources compared to those in NCIP and the difference between them was significant at 5%. In addition, beekeeping income among CIP

farmers showed a significant difference when compared with that of NCIP. The difference was statistically significant at 1% imply that income levels could have been a determining factor in credit worthiness of CIP farmers hence leading to a high eligibility for credit. In addition, access to credit among beekeepers is important for the improvement of smallholder agriculture (Otieno et al., 2010).

Types of hive used in beekeeping by both groups are the traditional hives, Langstroth hives and the stingless beehive for stingless bees. However, the most commonly used beehive was the traditional hive. Other types of hives were considered modern, expensive and unavailable. A difference was noted between the CIP and NCIP on hive types used. The average number of hive types used by the CIP and NCIP farmers was 1.58 and 1.0 respectively. The difference was statistically significant at 1% and was attributable to the fact that the CIP farmers were easily assembled into groups for dissemination of new technologies and training. Those in the NCIP practised beekeeping as individuals and did not have any unifying factor.

CIP farmers had a greater number of income sources compared to those in the NCIP group. The number of income sources included beekeeping and the difference among them was significant at 1%. A higher number of income sources implied the need for income diversification embraced by the CIP farmers compared to those in the NCIP. In addition, the CIP farmers had more dependants than those in NCIP and therefore, it was prudent for them to increase their income base to cater for needs expressed by their household members.

The CIP farmers harvested more honey compared to NCIP farmers. The mean number of honey kilograms harvested per year by the CIP and NCIP farmers was 81.6 and 46.1 Kilograms respectively. The difference was statistically significant at 1% and attributable to the assurance of a market for honey. This may have encouraged CIP farmers into increasing honey production,

and doubling it as depicted by results. In addition, their increased output could have been due to better beehive husbandry practises among the CIP compared to NCIP.

4.3.1 Factors influencing participation in CIP program

The post estimation diagnostics used to assess the suitability of the Heckman model include the likelihood ratio test for independent equation that was significant at 1% implying that selection bias was present and hence the model was appropriate in estimating the participation. Participation in CIP was estimated in Heckman model through a probit regression. Factors influencing participation of households in CIP from the Heckman model are summarized in Table 4.13. Factors that were found to significantly influence positively or negatively beekeepers participation in CIP include; dependency ratio, number of income sources, age of household head, experience in beekeeping, kilograms of honey harvested annually and credit access by the household head.

Dependency ratio is a ratio of economic active person to those who are economically inactive. It had a positively and significant influence on beekeepers participation in the CIP. Households with a higher dependency ratio were more likely to participate in the CIP compared to those who had a lower dependency ratio. The variable had a coefficient of 0.001 that was significant at 1%. This implied that a unit increase in dependency ratio would lead to an increased likelihood of participation by 0.1 percentage points. This finding concurs with that of Hess (1999) who argued that households with more economic dependants had to seek for ways and means to cater for the needs of their members. The CIP provided a market and offered a constant price for the honey harvested by CIP farmers.

The variable number of income sources included beekeeping. It was positive and statistically significant at 5% with a coefficient of 0.111. This implied that the more income sources you had, the more likely you were to participate in CIP. A unit increase in number of

income sources would have led to an increase in participation in CIP by 11 percentage points. This finding tallies with of that of Dietemann et al. (2009) that beekeeping is often a supplemental income source to most of the African households. The motivation to join CIP could have been driven by the need to diversify income sources for purposes of meeting their livelihood needs

Table 4.13: Factors influencing participation in the CIP and WEI obtained from Heckman sample selection model

Variables	Co-efficient of Probit in CIP Participation equation	Co-efficient of OLS in the WEI equation
Gender of household head	-0.207	-6.933**
Dependency ratio	0.001***	-0.025**
Number of income sources	0.111**	2.596***
Log Income from other sources	-0.005	
Number of Hive types		5.298***
Age of household head	0.017***	
Experience in beekeeping	0.018***	
Asset index	-0.004	0.135
TLU	-0.008	0.250
Kilograms of honey harvested	0.002**	
Level of household head education	0.051	
Credit access by household head	0.387*	

*NB: the level of significance is represented by the star ***at 1%, **at 5% and * at 10%.*
Source; Author survey, 2013

Age of the household head had a positive coefficient that was significant at 1%. The variable indicated that older household heads were more likely to join the CIP than households

headed by younger persons. This finding tallies with that of Doss and Morris (2001) that age has a positive relationship with adoption of new technologies. In addition, the years of farming experience had a positive coefficient of 0.018, which was significant at 1%. This implied that households heads with more years of experience in beekeeping had a higher likelihood of participating in CIP compared to the less experienced. The finding tallies with that of Affognon et al. (2015) who found that, farmers with more experience and age were likely to predict future outcomes of an enterprise based on past encounters. A unit increase in a households experience in beekeeping increased the likelihood to a household to participate in the CIP by 1.8 percentage points.

The number of kilograms of honey harvested by a farmer had a positive coefficient significant at 5%. This implied that farmers with a high beehive output were more likely to participate in the CIP unlike those with little output. This finding concurs with of Raina et al. (2009) that development of a value chain was necessary to create a sustainable source of income for the farmers. The CIP offered a ready market for the surplus honey harvested by farmers and the CBO purchased it at a better price compared to other agents. A unit increase in honey production increased a farmer's likelihood to participate in the CIP by 2 percentage points.

Credit access by household heads had a positive coefficient with a coefficient of 0.387 and was statistically significant at 10%. This implied that increased access to credit by a household head increased chances of such a household participating in the CIP. Otieno et al. (2010) showed that access to credit was important for the improvement of smallholder agriculture. Even though the relationship between income levels and credit worthiness have not been determined in this study, it is most likely that, a farmer's high income from beekeeping led an increase in eligibility for credit.

4.4 Factors influencing women empowerment among the CIP households

Appropriateness of the woman empowerment index constructed was determined by the Kaiser-Meyer-Olkin (KMO) test, which had a value of 0.7557 ($\chi^2 = 3639.6$; df $= 105$; P $=$ 0.000) implying that data were good for PCA and sufficient for construction of a composite index. In addition, Bartlett's test of sphericity had a p-value of 0.000 indicating that, the index was acceptable, since the threshold for rejecting then index, is any p-value value greater than 0.005. The OLS results from Heckman sample selection model discussed here are in Table 4.13. Factors that influenced significantly women empowerment positively among beekeeping households were gender of the household head, dependency ratio, number of income sources and number of hive types used in beekeeping.

Gender of the household head was significant at 5% with a coefficient of -6.93. This implied that if a woman headed a household she was empowered. This was attributed to the fact that a woman who was a household head made decisions regarding use and allocation of household resources at her disposal. Further, previous studies indicated that married women at times had less-decision-making ability over use of resources unlike divorced, unmarried or widowed women and hence this reduced their empowerment scores (Kantor, 2005). In addition, participation of a woman in professional activities due to their level of education may be considered empowering, however, other factors such as family systems, patriarchal social structures and customs may be considered disempowering if they do not allow her to exercise her choices (Adjei, 2015). Even though this study does evaluate concerns by Adjei, it is evident that such constraints would be an influential factor on women empowerment.

Dependency ratio that is a measure of the economically active versus inactive persons was significant at 5% with a negative coefficient of -0.025. This implied that an increase in the dependency ratio at the household reduced women empowerment. A calculation of marginal effects showed that a unit increase in dependency ratio reduced women empowerment by 2.5

percentage points. This tallies with claims of Hess (1999) that a high dependency ratio was likely to reduce women empowerment because she would have to stay at home and take care of the young ones and the very elderly (i.e. dependants above the age of 65 and children below the age of 15). Therefore, valuable was time used in taking care of the young and old in society rather than elsewhere for economic gain hence, negatively contributing to a woman's empowerment. In addition, a high dependency ratio has a positive relationship with high fertility rates and therefore results of this study concur with findings from previous studies that women who control their income tend to have fewer children and hence lower dependency ratio (Hess, 1998). Further, Presser and Sen (2000) demonstrate that a high number of dependants affected a woman's empowerment negatively.

The number of income sources that excluded beekeeping was positive and significant at 1% with a coefficient of 2.59. The variable indicated that an increase in household income sources increased a woman's empowerment index. Results from marginal effects indicated that a unit increase in income sources increased a woman empowerment index by 259 percentage points. The rationale behind such a high increase in empowerment index was attributable to an increased level in decision-making, use and management of the extra income. In addition, an increase in income sources is associated with income diversification that would help to even out income shocks. Further, Kongolo and Bamgose (2013) show that involvement in a development project such as the CIP reduced illiteracy of women, created employment, reduced malnutrition and improved a communities social and demographic well being and hence the exponential increase of empowerment of women caused by the variable.

The number of hive types used in production of honey involved use of other beehive types such as the Langstroth hive, the beehive for the stingless bees in addition to traditional hives and mud hives. The variable was positive and significant at 1% indicating that, diversification and use of more than one beehive type led to an increase in women empowerment.

In addition, the CIP introduced the Langstroth hive and beehive for stingless bees to attract more women into beekeeping. Use of other beehive types, other than the traditional bee hive, that was most common as documented by Affognon et al. (2015), implied that beehive diversification encouraged more women into beekeeping and hence their empowerment. This finding tallies with that of Nell et al. (2004) that beekeeping was a good avenue for empowering women in rural communities.

CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The purpose of this study was to map the honey value chain, examine changes in gender roles among beekeepers and factors leading to women empowerment and beekeepers' participation in the commercial insect programme in Kitui County. The purpose was achieved through four specific objectives that sought to map the honey value chain where actors and their roles were identified, assess changes in gender roles along the honey value chain, determine factors influencing beekeepers' participation the CIP, and women empowerment. The study used a Heckman sample selection model to estimate factors influencing beekeepers participation in CIP, and women empowerment while gender roles at every stage of the value chain were identified after mapping of honey flow in Kitui County. The study was conducted in the former Mwingi district, that is currently divided into three sub-counties namely; Mwingi East, Mwingi North and Mwingi West which and are part of Kitui County. This study site was chosen because beekeeping is one of the major supplemental income sources for the arid and semi-arid area. Further, the study adopted a research survey design that involved administration of pre-tested semi-structured questionnaires to 251 participants in the CIP and 247 non-Participants in CIP.

The study found that, the honey value chain had various actors who processed honey and include; the CBO "the Mwingi Honey and Silk worm Market Place", brokers and individual processors as the key actors in value addition and sales. Further, farmers who were honey producers hived bees in the Langstroth hives, traditional hives and the stingless bee beehive. The main products of the value chain were honey and wax while fibre from honey lacked a market demand. The CBO was the main market for honey produced by farmers in the CIP while those in NCIP sold most of their surplus harvest to brokers.

This study also found a positive relationship between participation of beekeepers in the CIP and changes in gender roles at the value chain. Empirical evidence showed that, women

among the CIP participated in more apiary activities compared to those in the NCIP. In addition, male dominance in apiary cultural activities showed a significant reduction among the CIP beneficiaries compared to those in the NCIP. Further, more women participated in acquisition of modern hives and in management decisions such as deciding when the beehives would be harvested and where they would be hoisted among others such as watering and transporting hives to the apiary.

Factors with a positive and significant influence on beekeepers participation in the CIP were dependency ratio, number of income sources, age of the household head, years of experience in beekeeping, access to credit by the household head and the quantity of kilograms of honey harvested. These factors depicted that, a household with more dependants was more likely to participate in the CIP due to benefits accrued such as income diversification in return for a better livelihood due to income earned from the enterprise. Participation of older household heads and years of beekeeping experience indicated that such persons were able to predict future outcomes owing to previous experiences garnered over the years, and hence embraced initiatives that solved some of the previously encountered challenges such as low market prices for their surplus.

Factors influencing women significantly and positively were; diversification of income sources (number of income sources), and the number of hive types (diversification of beehive types). Income diversification was a boost to their empowerment due to their participation in decisions regarding the use and control of resources gained from such an enterprise. Further, diversification to use of different beehive types was an indication of a shift from the common tradition hive that limited women in performing some of the cultural practises such as harvesting honey due to taboos hindering them from climbing trees. Hence, introduction of hives that were hoisted near the ground solved some of their limitations, hence exposing them to an income source, better nutrition and participation in rural development initiative, thus being empowered.

Those that limited their empowerment negatively and significantly were dependency ratio, showing that, a high number of dependants limited their involvement in activities that empowered them due to time competition between taking care of the old and young to participating in economically productive activities.

5.2 Conclusion

The study concluded that, participation of beekeepers in the CIP led contributed to changes in gender roles at the household. It increased women participation in apiary activities that they previously avoided, due to cultural constraints founded on taboos such as prohibition from tree climbing to harvest and hoist hives. In addition, empirical evidence is provided that household participation in development programmes can be highly influenced by the need to diversify income sources, increase an enterprise output as well as age and experience of the participant. Further, evidence showed that women empowerment can be influence positively by income diversification initiatives and adoption of new technologies that are friendly to them. However, a high dependency ratio influenced women empowerment negatively.

5.3 Recommendations

The study recommends that promotion of modern technologies friendly to women can lead to erosion of male dominance in income activities that they shy away, due to cultural barriers founded on taboos. Therefore, creation of a favourable environment by policy makers through formulation of policies that allows development agencies to target the rural poor will be vital in enabling them to achieve income and food security. In addition, an assessment of challenges hindering women participation in beekeeping revealed that lack of skills and knowledge as some of the limitations to effective management and realisation of the technologies potential among women. Therefore, training conducted by development agencies and the government through the Ministry of Agriculture, would lead to an increased productivity for the

beekeeping enterprise, boost local honey production output and thus reduce the quantity imported to meet local demand.

Promotion of income diversification initiatives among rural farmers is necessary for improving their well-being and employment creation. Often, such initiatives lead to exploitation of natural resources in a sustainable manner such as a conservation of trees while benefiting from beekeeping due to their coexistence. Therefore, policy makers can offer incentives to development agencies that seek to improve the living standards of the rural resource poor farmers through, tax exemptions of imported technologies that can transform available natural resources into useful products for economic gain such as, value addition machinery of honey or other farm products. Empirical evidence shows that income diversification improves empowerment of rural women and offers an alternative livelihood to rural households.

REFERENCES

Adjei, S. B. (2015). Assessing Women Empowerment in Africa A Critical Review of the Challenges of the Gender Empowerment Measure of the UNDP. Psychology & Developing Societies,27(1), 58-80

Affognon, H. D., Kingori, W. S., Omondi, A. I., Diiro, M. G., Muriithi, B. W., Makau, S., & Raina, S. K. (2015). Adoption of modern beekeeping and its impact on honey production in the former Mwingi District of Kenya: assessment using theory-based impact evaluation approach. *International Journal of Tropical Insect Science*, *35*(02), 96-102.

Antony, G. M., & Rao, K. V. (2007). A composite index to explain variations in poverty, health, nutritional status and standard of living: Use of multivariate statistical methods. Public Health, 121(8), 578-587.

Bartlett, M. S. (1954). A note on the multiplying factors for various chi square approximations. Journal of the Royal Statistical Society, 16 (Series B), 296-8

Bhusal, S. J., & Thapa, R. B. (2005). Comparative study on the adoption of improved beekeeping technology for poverty alleviation. Journal of the Institute of Agriculture and Animal Science,26, 117-125.

Boelhouwer, J., & Stoop, I. (1999). Measuring well-being in the Netherlands: The SCP index from 1974 to 1997. Social indicators research, 48(1), 51-75.

Booysen, F., Van Der Berg, S., Burger, R., Von Maltitz, M., & Du Rand, G. (2008). Using an asset index to assess trends in poverty in seven Sub-Saharan African countries. World Development,36(6), 1113-1130.

Carroll, T., & Kinsella, J. (2013). Livelihood improvement and smallholder beekeeping in Kenya: the unrealised potential. *Development in Practice*,*23*(3), 332-345.

Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate behavioral research*, *1*(2), 245-276.

Chemurot, M. (2011). Beekeeping in Adjumani District, Uganda. *Bee World*, *88*(3), 58-61.

Chirwa, E. W. (2005). Adoption of fertiliser and hybrid seeds by smallholder maize farmers in Southern Malawi. *Development Southern Africa*, *22*(1), 1-12.

Cochran, W. (1963). Sampling techniques. New York: John Wiley and Sons, Inc.

Dadvar-Khani, F., & Choobchian, S. (2015). Women and Rural Development in Iran: Analysis of the effect of Socio-Economic changes on women' work in agriculture. Ciencia & Natura, 37(3), 36-50.

De Brauw, A., Gilligan, D. O., Hoddinott, J., & Roy, S. (2014). The impact of Bolsa Família on women's decision-making power. World Development, 59, 487-504.

Dietemann, V., Pirk, C. W. W., & Crewe, R. (2009). Is there a need for conservation of honeybees in Africa? Apidologie, 40(3), 285-295.

Doss, C. R. (2015). Women and Agricultural Productivity: What Does the Evidence Tell Us? *Yale University Economic Growth Center Discussion Paper*, (1051).

Faße, A., Grote, U., & Winter, E. (2009). Value chain analysis methodologies in the context of environment and trade research (No. 429). Discussion papers//School of Economics and Management of the Hanover Leibniz University.

Gachimbi, L. (2002). Participatory diagnosis of soil nutrient depletion in semi-arid areas of Kenya. Managing African soils no.26 .

Garikapiti, S. (2008). The impact of lending to women on household vulnerability and women's empowerment: evidence from India. World Development, 36(12), 2620-2642.

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. Review of international political economy, 12(1), 78-104.

Government of Kenya (2005). ASAL Gender Policy Guidelines. Printer; Government Press Nairobi

Government of Kenya. 2009. National beekeeping policy [proposed]. Nairobi: Ministry of Livestock, Government of the Republic of Kenya

Greene, W. (2003). Limited dependent variable and duration models. In W. Greene, Econometric analysis (p. 782). London, England: Pearson Education limited .

Heckman, J. J. (1979). Sample selection bias as a specification error. Econometrica , 153-161.

Hess, P. (1998). Population growth and socio-Economic progress in less developed countries: determinants of fertility transition. New York: Praeger.

Hightower, W. L. (1978). Development of an index of health utilizing factor analysis. Medical care, 16(3): 245-255.

Kabeer, N. (1999). Resources, agency, achievements: Reflections on the measurement of women's empowerment. Development and change, 30(3): 435-464.

Kantor, P. (2005). Determinants of women's microenterprise success in Ahmedabad, India: Empowerment and economics. Feminist Economics, 11(3): 63-83.

Kaplinsky, R. (2000). Globalisation and un-equalisation: What can be learned from value chain analysis?. Journal of development studies,37(2): 117-146.

Kaplinsky, R., & Morris, M. (2001). A handbook for value chain research (Vol. 113). Ottawa: IDRC.

Karl, M. (1995). Women and empowerment: participation and decision making (Vol. 10). London: Zed Books.

Kerlinger, F. N., & Lee, H. B. (1973). Foundations of behavioural research.

Kioko, E. (2010, April). Agfax: Reporting Science in Africa. Retrieved from Agfax: http://www.agfax.net 30th January 2013

Kongolo, M., & Bamgose, O. O. (2013). Participation of rural women in development: a case study of Tsheseng, Thintwa, and Makhalaneng Villages, South Africa. Journal of International Women's Studies,4(1), 79-92.

Krishnan, V. (2010). Constructing an area-based socioeconomic index: A principal components analysis approach. Edmonton, Alberta: Early Child Development Mapping Project

Lowitt, K., Hickey, G. M., Ganpat, W., & Phillip, L. (2015). Linking communities of practice with value chain development in smallholder farming systems. World Development,74, 363-373.

Magambo, R. (2010, March). A Guide For Mainstreaming Gender In the Agricultural Sector (NALEP). Nairobi, Kenya.

Malhotra, A., & Schuler, S. R. (2005). Women's empowerment as a variable in international development. Measuring empowerment: Cross-disciplinary perspectives, 71-88.

Meyers, L. (2012, August). Gender Analysis, Assessment and Audit Manual and Toolkit. ACDI VOCA . ACDI/VOCA.

Morris, R. (2000). Why is Value chain analysis Important? In A Handbook for Value Chain Research (pp. 9-13). IDRC.

Mosedale, S. (2005). Assessing women's empowerment: towards a conceptual framework. Journal of International Development, 17(2): 243-257

Moser, C., & Felton, A. (2007, July). The construction of the asset index measuring asset accumulation in Ecuador. Global economy and development: The Brookings Institution . Massachusets, Wachington D.C, U.S.A: Chronic Poverty Research Centre.

Muthoo, A. (1999). Bargaining theory with applications. Cambridge University Press.

Nel, E., & Illgner, P. (2004). The contribution of bees to livelihoods in southern Africa. *Rights, Resources and Rural Development: Community-based Natural Resource Management in Southern Africa*, 127-134.

Nelson, G., & Prilleltensky, I. (Eds.). (2010).Community psychology: In pursuit of liberation and well-being. Palgrave Macmillan.

Nightingale, J., & Crane, E. (1983). *lifetime's recollections of Kenya tribal beekeeping*. International Bee Research Association.

North, D. C. (1990). Institutions, institutional change and economic performance. Cambridge university press.

OECD. (2007). Age dependency ratios. society at a glance; OECD social indicators, 2006 edition.

Ogaba, M. R., & Akongo, T. (2001). Gender issues in Beekeeping–The Uganda case. In APIMONDIA Congress. Durban, South Africa.

Oparanya, W. A. (2009). Population and housing census results. *Kenya Census*.

Orodho, A. J. (2003). Essentials of educational and social science research methods. Nairobi: Mazola Publishers.

Otieno, P. S., Nyikal, R. A., & Mugivane, F. I. (2010). Non-credit services of group-based financial institutions: Implications for smallholder women's honey income in arid and semi arid lands of Kenya.

Pactkenya. (2010, February). Scoping study and value chain analysis for bee keeping and honey products,draft copy. Retrieved from www.pactkenya .org.

Pahl, J., & Pahl, J. M. (1989). Money and marriage (p. 67). London: Macmillan.

Pearson, K. (1901). On lines and planes of closest fit to systems of points in space. Philosophical Magazine, 2(6): 559-572.

Peters, B. G. (2000). Institutional theory: Problems and prospects.

Pitt, M. M., Khandker, S. R., & Cartwright, J. (2006). Empowering women with micro finance: Evidence from Bangladesh. Economic Development and Cultural Change, 54(4) : 791-831.

Presser, H., & Sen, G. (2000). Women's empowerment and demographic processes: Moving beyond Cairo. Oxford University Press.

Puhani, P. (2000). The Heckman correction for sample selection and its critique. Journal of Economic Surveys, 14(1) : 53-68.

Qaiser, T., Ali, M., Taj, S., & Akmal, N. (2013). Impact assessment of beekeeping in sustainable rural livelihood. Journal of Social Sciences (COES&RJ-JSS) Vol, 2.

Raina, S. K., Kioko, E. N., Gordon, I., & Nyandiga, C. (2009). Improving Forest Conservation and Community Livelihoods through Income Generation from Commercial Insects in Three Kenyan Forests.

Riisgaard, L., Bolwig, S., Ponte, S., du Toit, A., Halberg, N., & Matose, F. (2010). Integrating poverty and environmental concerns into value-chain analysis: A strategic framework and practical guide. Development Policy Review, 28(2), 195–216.

Roduner, D. (2004). Report on Value Chains: Analysis of existing theories, methodologies and discussions of value chain approaches within the development cooperation sector, prepared for SDC by Daniel Roduner. LBL,2004.

Ross, S. A. (1973). The economic theory of agency: The principal's problem.The American Economic Review, 134-139.

Rowlands, J. (1997). Questioning empowerment: Working with women in Honduras. Oxfam.

Rudenko, I. (2008). Value Chains for Rural and Regional Development: the case of cotton, wheat, fruits and vegetables value chains in the Lower Reaches of the Amu Darya River, Uzbekistan, pp. 18-27.

Saisana, M. A. S., & Tarantola, S. (2005). Composite indicators—the controversy and the way forward. Statistics. In Knowledge and Policy, OECD World Forum on Key Indicators. 1 (1): 2-4.

Salkind, N. J. (Ed.). (2010). Encyclopedia of research design (Vol. 1). Sage.

Sekhar, C. C., Indrayan, A., & Gupta, S. M. (1991). Development of an index of need for health resources for Indian states using factor analysis. International Journal of Epidemiology, 20(1): 246-250.

Shackleton S, (2011). Opportunities for enhancing poor women’s socio-economic empowerment in the value chains of three African Non-Timber Forest Products (NTFP). International forestry , 136-142.

Tabachnick, B. G., & Fedell, L. S. (2007). Using Multivariate Statistics (Fifth edition). Boston: Pearson Education.

United Nations, U. (2005). World population policies. Sale No.E.06.XIII.5,2006.

Vlek, P. L., Denich, M., Martius, C., van de Giesen, N., & Gichora, M. Ecology and Development Series No. 6, 2003.

Vyas, S., & Kumaranayake, L. (2006). Constructing socio-economic status indices: how to use principal components analysis. Health Policy and Planning, 21(6): 459-468.

Wick, M. (1998). Selection models. Cambridge Massachusetts: Express.

Wooldridge, J. (2002). Sample selection,Attrition, Stratified sampling. In J. M. Wooldridge, Econometric analysis of cross section and panel data (p. 566). London, England: The MIT press.

APPENDIX:

1.0 QUESTIONNARRE

SECTION A: HOUSEHOLD DEMOGRAPHY

I. Background information

Questionnaire number _____ _____

Enumerator's Name_____

Division_____ location_____

Village: _____ GPS Reading _____

Respondent's name_____

Respondent's mobile number _____

A1. What is the relationship of respondent to household head? Spouse =1/____/ son =2/___/ daughter=3/___/ relative=4/___/ other (specify) =5/___/
A2. Is the Household Head an ICIPE-CIP beneficiary? Yes=1/____/ No=2/____/

SECTION B: BEEKEEPING

B1. Is the household head a member of any bee marketing group? Yes=1/___/ No=2/____/

B2. If yes; Name of the bee marketing group the farmer belongs to _____

B3. Which year did the household head join the bee marketing group? _____
B4. Indicate the gender of the management committee of your honey marketing group

Committee	**Gender**	
Chairman		
Secretary		
Treasurer		
Member 1		
Member 2		
Member 3		
Store keeper		

B5. Which year did you start keeping bees as an economic activity? _____
B6. What motivated you to keep bees as an economic activity?
_____
_____
_____

B7. Who assisted you when you started keeping bees as an economic activity?
_____
_____
_____
B8. In what way(s) were you assisted?
_____
_____
B9. What motivated you to join the honey marketing group?
_____
_____
B10. Who helped you to come up with the honey marketing group?
_____
_____
B11. In what ways were you helped?

C: SOURCE OF INPUTS

C1. Please fill in the table below regarding where you get the inputs for your commercial bee keeping enterprise.

Input	Cost per unit (Ksh)	Who decided on where to source the input? (code)
Queen bees		
Bee colonies		
Clothing gear(as a set)		
Smoker		
Beehives:		
Langstroth		
Kenya top bar hive		
Log hives		
Stingless bee hives		
Traditional hives		
Mud hives		
Input decision: 1=HH head, 2=Spouse, 3=Son, 4=Daughter, 5=Relative, 6= Other		

C2. Children's schooling (the codes are as shown in the table below, fill the gaps appropriately)

1=Strongly agree	2=Agree	3=Neutral	4=Disagree	5=Strongly disagree

1) In your household, women often pay their children's school supplies such as stationery /_____/
2) In your household, women often pay their children's school fees/____/
3) In your household, women never contribute to the children breakfast /_____/
4) In your household, women never assist their children with homework at home /____/
5) In your household, men always assist their children with homework at home/____/
6) In your household, both spouses never decide whether a boy goes to school /___/
7) In your household, women often decide whether a girl goes to school/___/

SECTION D: INCOME AND CREDIT

D1. As a household head, is beekeeping your only source of income? Yes=1/___/ no=2/___/

D2. If no, fill the table below the farmer's income sources starting with the most important.

Rank	Income source	Earnings per month/season
1		
2		
3		

D3. Credit: fill in the table below

QUESTION	Household head,	Spouse
Have you taken a loan in the last 5 years (1=YES; 2=NO)		
If Yes, how much did u borrow?	Ksh	Ksh
What was the loan repayment period?		
Did you need collateral? 1=YES; 2=NO		
What type of collateral?		
Were you able to repay the loan on time?1=YES: 2=NO		
If NO, why not?		

D4. Financial decisions (use the code in the bracket to answer the questions below)

1=Strongly agree	2=Agree	3=Neutral	4=Disagree	5=Strongly disagree

1) In your household, women always seek permission from their husbands before taking a loan/___/
2) In your household, women never inform their husband what they intend to do with the loan/___/
3) In your household women play a minor role in financial decisions regarding family investments /_____/
4) In your household women are never consulted by their husbands during sale of family assets like land and livestock/____/
5) In your household women usually keep money for emergency use /____/
6) In your household women often keep a share of the husband's wages/income /____/

SECTION E: HOUSEHOLD ASSETS

Land Tenure

E1. Please provide information on land tenure and use in the table below:

Land tenure	**Size** (Acres)	**Land ownership [PUT THE CODES HERE]**
Owned land		
Rented land		
Borrowed land		
Family land		
Communal land		
Government land		

E2. Do you own the household's house? Yes=1/___/ No=2/___/. Who owns it? HH head=1/____/ spouse=2/____/ HH head parents=3/____/ Other (specify) =4/_____/

Livestock assets

E3. Livestock owned

Livestock species/Type	**Total**	**Owned by HH head**	**Owned by spouse**	**Jointly owned**
Adult cows				
Adult bulls				
Heifers				
Young bulls				
Male calves				
Female calves				
Goats				
Sheep				
Donkeys				
Chicken/poultry				
Rabbits				
Pigs				
Other (Specify)				

E4. Ownership of other assets

Asset	**Total**	**Owned by HH head**	**Owned by spouse**	**Jointly owned**	**Owned by other HH members***
Kenya top bar hive(KTBH)					
Langstroth hives					
Log hives/traditional hives					
Mud hives					
Stingless bees Beehives					
Smoker					
Harvesting protective Clothing gear					
Apicultural supporting trees					
Radio					
Bicycle					
TV					
Motorbike					
Car					
Mobile phone					
Fridge					
Gas Cooker					
Microwave					
Video/DVD					
Computer/laptops					
Internet connection (modems)					

***Code**: Son = 1; daughter=2, relative=3, other=4 (specify)

SECTION F: ENTERPRISE AND LABOUR USE

F1. Enterprise establishment and management

Enterprise	Who manages the enterprises? (code)	What was the source of start up capital for the enterprise? (Code)	What support services do you receive for the enterprises? (code)	Do you hire labour to assist in any of the enterprises (code)
Crop production				
Cattle keeping				
Small ruminants				
Poultry				
Beekeeping				
Milk production				

Management code: household head=1, spouse=2, son=3, daughter=4, hired labour=5, other=6
Enterprise establishment code: savings=1, loan/credit=2, inherited=3, other=4
Support services code: government extension service=1, private extension service=2, other=3

F2. Decision criterion

Enterprise	Who established the Enterprise? (code)	Who manages the produce/products from the enterprise (code)	Who decides when and where to sell the products (code)	Who negotiates the pricing/selling price (code)	Who keeps the money from the sale of produce (code)
Crop production					
Cattle keeping					
Small ruminants					
Poultry					
Beekeeping					
Milk production					

Decision criterion code: household head=1, spouse=2, son=3, daughter=4, other=5

F3. Household responsibilities (use the codes below to fill the gaps appropriately)

1=Strongly agree	2=Agree	3=Neutral	4=Disagree	5=Strongly disagree

1. In your household women always share household chores such as washing clothes and utensils equally with men /____/
2. In your household women share cooking duties equally with men /___/
3. In your household women never share tasks such as fetching water and firewood equally with men/____/
4. In your household the husband often take care of his wives' income generating activities /____/
5. In your household the wife never take care of her husbands' income generating activities /_____/

BEE ENTERPRISE

F4. What influenced you to keep the type of bees you have on the farm currently?

F5. What influenced you to use the type of beehives you have on the farm?

F6. Cultural practises on apiary

Activities	Who performs this task at the household? (code)	Do you hire labour to help in any of these activities? (code)	Who hires the labour needed to assist (code)	Who pays for the labour hired? (code)	Has CIP training helped in running any of these tasks (code)
Cleaning the apiary					
Transporting hives to apiary					
Watering the apiary					
Construction of new hives					
Repairing hives					
Management of apiary					
Colony transfer					
Queen breeding					

Task performance at household code: household head=1, spouse=2, son=3, daughter=4, 5=Other (Specify)
Do you hire labour code; yes=1 no=2 **CIP trainings code:** yes=1, no=2
Who hires labour code: household head=1, spouse=2, son=3, daughter=4, other=5
Who pays for the labour code: HH head=1, spouse=2, son=3, daughter=4, other=5

F7 Cultural issues (fill the table below)

Which apiary activities are not done by women?	Why don't women do these activities?

F8. Household consumption and marketing

Item	Quantity harvested in the 12 months	Quantity consumed by household	Quantity sold to consumers		Quantity sold to marketing groups		Quantity sold to individual processor		Quantity sold to brokers	
			Kg	Price	Kg's	Price /Kg	Kgs	Price/Kg	Kg	Price/kg
Stingless bee honey	Kg	Kg								
Stinging bee honey	Kg	Kg								

SECTION G: MARKETING AND VALUE ADDITION

G1. As a farmer, do you add any value to your harvested honey before sale? 1=yes/___/ 2=No/___/

G2. If yes, which of the value addition activities are you involved in? (Tick where appropriate)

Value addition activity	Tick	Value addition activity	Tick
Extract honey from the honey comb		Extract wax from the combs	
Package in bottles/cans		Mould candles from the wax	
Brand or Label the honey for sale		Label or brand the candles for sale	
Other(specify		Other(specify	

G3. How many products do you extract from your crude honey? /_____/

G4. What price do you sell the extracted product per kg?

Product	**Price/Kg**
Honey	
Wax	
Royal jerry	
Pollen	
Other(specify)	

G5. How long does it take you to market your finished products /_____/?
G6. Do you add value/process your own honey only? 1=yes/___/ 2=No/___/
G7. If no, what are your other sources of honey and price you purchase it (fill the table below)

Source	**Quantity purchased(Kgs)**	**Price/kg**
Individual farmers		
Organised farmer groups		
Brokers		

Product certification
G8. Are your products certified? 1=YES/____/ 2=NO/____/
G9. IF Yes, by which organization?

_____

G10. Do you pay for certification? 1=yes/___/ 2=no/____/
G11. If yes, how much for each certification?

_____

Branding
G12. Are your products branded? Yes=1/___/ No=2/___/
G13. Which of these products have you branded?

1. honey yes=1/___/ no=2/___/
2. wax yes=1/___/ no=2/___/
3. royal jerry yes=1/___/ no=2/___/
4. pollen yes=1/___/ no=2/___/
5. other(specify)_____

Product acceptance
G14 Have your products had any challenge in penetrating the market? 1=yes/___/ 2=No/___/
G15. What challenges are these hindering product market penetration?

_____
_____
_____

G16. What challenges have you faced in? (Fill the table below)

Honey production	Honey processing	Honey marketing

New opportunities
G17. Are there new opportunities for developing new products? yes=1___ no=2___
G18. If yes what are these opportunities?

Markets
G19. Which markets do your products go to?

_____

G20. What challenges do you encountered as an individual/processing plant?

Challenge	**Tick**
Inaccessibility to credit for expansion purposes.	
Lack of labour expertise	
Lack of sufficient honey to keep the plant running throughout the year	
Challenge	**Tick**
Expensive machinery to ease the processing	
Inaccessibility to the national power glid to run machinery	
Low demand for the products by the market.	
Stiff competition from other types of honey	

G21.How long does it take to market your finished products after processing/_____/
What support services have been used by this business?
G22. Credit/loans for start up or expansion? Yes=1____ No=2___
G23. Government regulation? Yes=1/___/ No=2/___/ E.g.(business license)
G24. Financing from donors? Yes=1/___/ No=2/___/
Personnel/labour required at the processing plant
G25. At the processing level do you prefer to work with women more than men? Yes=1___ no=2___
G26. What roles do men and women play in the processing plant?

Men	**Women**

G27. What role do men and women play in the marketing of the honey products?

Men	**Women**

G28.What challenge does the marketing group face?

_____
_____

Processing

G29. What level of processing are you operating at? Private/individual processor=1/___/ Private/organised market group processor=2/___/
G30. How long does it take to market honey processed from the farmers who are in groups/_____/
G31. Is there time the processing plant stays idle without function owing to insufficient honey supply? 1=yes/___/ 2=No/___/
G32. If yes, how long throughout the year is the plant idle?

_____
_____

G33. Does the plant incur losses due to:

1) spillage.1=yes/____/ 2=No/____/
2) spoilage.1=yes/___/ 2=No/____/

G34.What are the estimated operational costs emanating from processing such as:

1) labour use/_____/
2) certification/_____/
3) Transportation/_____/

F. Household demographics information

Please fill the table below NB: A household member is one who eats from the same pot and /depends on the household resources.

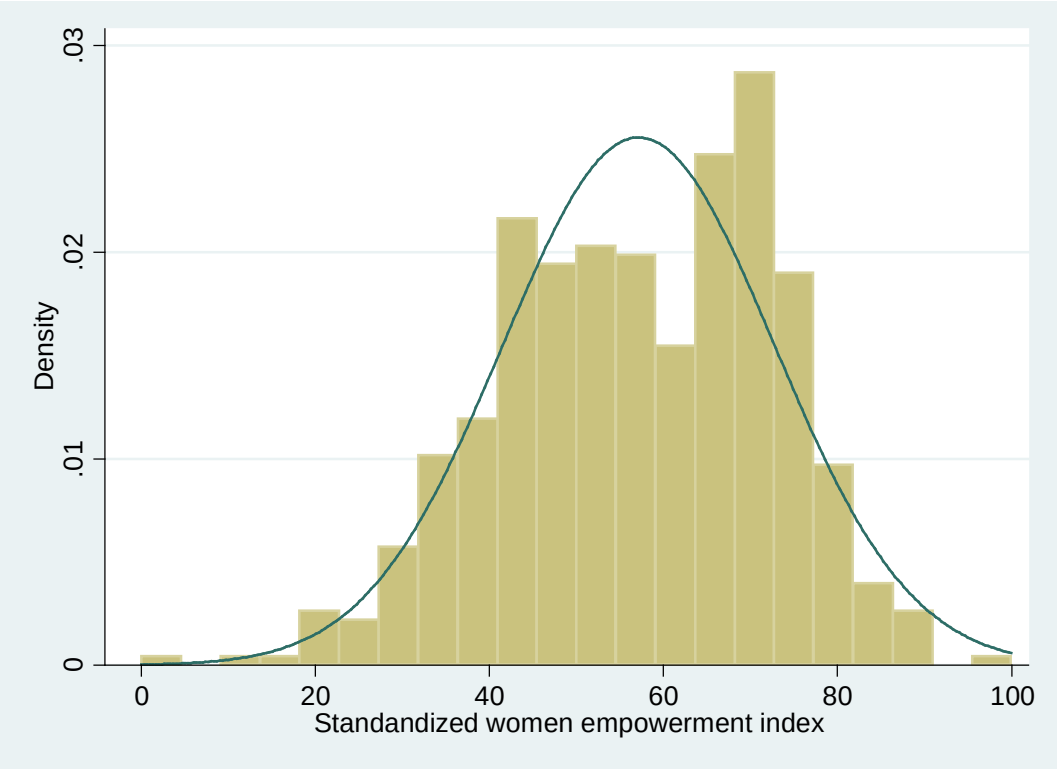
	Name for the household member *(Full name of the household head, first name for the others, start with household head)*	Relation- ship with household head (***codes below table)***	In which **year** was this person born?	What is the **sex** of this person? ***1=male 2=female***	What is the **highest** level of education completed in years?
1					
2					
3					
4					
5					
Codes for relationship with household head: 1=head 2=spouse; 3=own child; 4=step child; 5=parent; 6=brother/sister; 7=nephew/niece; 8=son/daughter-in-law; 9=grandchild; 10=other relative (specify) ; 11=unrelated; 12=brother/sister-in-law; 13=parent in law: 14=worker					

1.2 Results generated from Stata version 12 by Author.

1.2.1 Heckman regression results

```
Iteration 0:   log likelihood = -1311.1791
Iteration 1:   log likelihood = -1310.2889
Iteration 2:   log likelihood = -1309.5014
Iteration 3:   log likelihood = -1309.4953
Iteration 4:   log likelihood = -1309.4953
Heckman selection model                         Number of obs      =       492
(Regression model with sample selection)        Censored obs       =       245
                                                Uncensored obs     =       247
                                                Wald chi2 (6)       =     37.22
Log likelihood = -1309.495                      Prob > chi2        =    0.0000
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
WEI          |
   GENDER_HHH |    -6.9333   3.400117    -2.04   0.041    -13.59741   -.2691943
           DR |  -.0255953   .0123869    -2.07   0.039    -.0498732   -.0013174
  NUM_INC_SCR |   2.596319   .8332264     3.12   0.002     .9632251    4.229412
    HIVETYPES |   5.298396   1.683612     3.15   0.002     1.998577    8.598215
  ASSET_INDEX |    .135332    .109517     1.24   0.217    -.0793174    .3499814
          TLU |   .2507042   .2327728     1.08   0.281     -.205522    .7069305
        _cons |    54.7374   5.850007     9.36   0.000     43.27159     66.2032
-------------+----------------------------------------------------------------
P_CIP        |
   GENDER_HHH |  -.2079045   .1991553    -1.04   0.297    -.5982416    .1824327
           DR |    .001988    .000755     2.63   0.008     .0005083    .0034677
  NUM_INC_SCR |   .1112455   .0470634     2.36   0.018     .0190029    .2034881
  logIN_O_SRC |  -.0052302   .0280527    -0.19   0.852    -.0602124    .0497521
         AOHHH |   .0172442   .0047166     3.66   0.000     .0079999    .0264885
EXPERIENCE_BK |    .018051   .0056967     3.17   0.002     .0068857    .0292163
  ASSET_INDEX |  -.0043672    .006262    -0.70   0.486    -.0166404     .007906
          TLU |  -.0080523   .0122722    -0.66   0.512    -.0321053    .0160007
         KGHH |   .0025596   .0010023     2.55   0.011      .000595    .0045242
  EDUCHHH_LVL |   .0512192   .0757192     0.68   0.499    -.0971878    .1996261
CREDTACCSSHHH |   .3871916   .2305416     1.68   0.093    -.0646616    .8390449
        _cons |  -1.647306   .4962466    -3.32   0.001    -2.619931   -.6746801
-------------+----------------------------------------------------------------
      /athrho |  -1.033758     .25855    -4.00   0.000    -1.540506   -.5270088
     /lnsigma |   2.864293   .0842169    34.01   0.000     2.699231    3.029355
-------------+----------------------------------------------------------------
         rho |   -.775411   .1030937                     -.9122054   -.4830913
       sigma |   17.53664   1.476881                      14.86829    20.68388
      lambda |   -13.5981   2.839278                     -19.16299   -8.033223
------------------------------------------------------------------------------
LR test of indep. eqns. (rho = 0):   chi2 (1) =     9.61   Prob > chi2 = 0.0019
```

1.2.2 Tests for normality of WEI, distribution of WEI



1.2.3 Pair wise correlation matrix of variables in the model

	WEI	GENDER~H	DR	NUM_IN~R	HIVETY~S	ASSET_~X	TLU
WEI	1.0000						
GENDER_HHH	-0.0689	1.0000					
DR	-0.1078	0.0540	1.0000				
NUM_INC_SCR	0.3769	0.0457	-0.0476	1.0000			
HIVETYPES	0.2340	-0.0264	0.0506	0.2622	1.0000		
ASSET_INDEX	-0.0030	0.0538	0.0324	-0.0527	-0.0784	1.0000	
TLU	-0.0186	0.0339	-0.0288	-0.0269	-0.0655	0.1850	1.0000
P_CIP	0.1050	-0.0246	0.0900	0.1629	0.5766	-0.0451	-0.0543
logIN_O_SRC	-0.0354	0.0241	0.0410	0.1390	-0.0185	0.0245	0.0758
IN_O_SRC	0.0017	0.0663	0.0336	0.1272	0.0221	0.0180	0.0285
AOHHH	0.1730	0.0115	0.0045	0.1316	0.1573	-0.0683	-0.0142
EXPERIENCE~K	0.1822	0.0151	-0.0530	0.0906	0.1646	-0.0636	-0.0309
ASSET_INDEX	-0.0030	0.0538	0.0324	-0.0527	-0.0784	1.0000	0.1850
TLU	-0.0186	0.0339	-0.0288	-0.0269	-0.0655	0.1850	1.0000
KGHH	0.0730	0.0779	-0.0229	0.1478	0.1620	-0.0134	-0.0719
EDUCHHH_LVL	-0.1155	0.0628	0.0070	-0.0281	0.0177	0.1351	-0.0172
CREDTACCSS~H	0.0905	0.0075	0.0252	0.1772	0.1766	0.1298	-0.0081

```
             |    P_CIP logIN_~C IN_O_SRC    AOHHH EXPERI~K ASSET_~X      TLU
-------------+------------------------------------------------------------------
       P_CIP |   1.0000
 logIN_O_SRC |   0.0611   1.0000
    IN_O_SRC |   0.0981   0.5463   1.0000
       AOHHH |   0.2575   0.0418   0.0567   1.0000
EXPERIENCE~K |   0.2407   0.0108  -0.0119   0.3333   1.0000
 ASSET_INDEX |  -0.0451   0.0245   0.0180  -0.0683  -0.0636   1.0000
         TLU |  -0.0543   0.0758   0.0285  -0.0142  -0.0309   0.1850   1.0000
        KGHH |   0.1738   0.1404   0.2616   0.0831   0.1385  -0.0134  -0.0719
 EDUCHHH_LVL |  -0.0113   0.0691   0.1633  -0.3634  -0.0799   0.1351  -0.0172
CREDTACCSS~H |   0.1252   0.0690   0.1378   0.0106   0.0462   0.1298  -0.0081

             |     KGHH EDUCHH~L CREDTA~H
-------------+---------------------------
        KGHH |   1.0000
 EDUCHHH_LVL |   0.0516   1.0000
CREDTACCSS~H |   0.1037   0.1034   1.0000
```

1.2.4 Marginal effects after Heckman

```
      y  = Linear prediction (predict)
         =  66.627347
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
GENDER~H*|    -6.9333     3.40012   -2.04   0.041  -13.5974 -.269194   .904472
      DR |  -.0255953      .01239   -2.07   0.039  -.049873 -.001317   72.8634
NUM_IN~R |   2.596319      .83323    3.12   0.002   .963226  4.22941   3.63415
HIVETY~S |   5.298396     1.68361    3.15   0.002   1.99858  8.59821   1.29065
ASSET_~X |    .135332      .10952    1.24   0.217  -.079317  .349981   17.1513
     TLU |   .2507042      .23277    1.08   0.281  -.205522  .706931   5.70787
logIN_~C |          0           0       .       .         0        0   10.6257
   AOHHH |          0           0       .       .         0        0   51.9878
EXPERI~K |          0           0       .       .         0        0   18.2033
    KGHH |          0           0       .       .         0        0   63.9959
EDUCHH~L |          0           0       .       .         0        0    1.5874
CREDTA~H*|          0           0       .       .         0        0   .069106
------------------------------------------------------------------------------
```

(*) dy/dx is for discrete change of dummy variable from 0 to 1