ASSESSMENT OF BEEKEEPERS' PERCEPTION ON ADOPTION OF MODERN TECHNOLOGIES IN BEEKEEPING IN IRINGA REGION

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT FOR THE REQUIREMENTS OF THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION OF THE OPEN UNIVERSITY OF TANZANIA

2019

CERTIFICATION

The undersigned certifies that, he has read and hereby recommends for acceptance by the Open University of Tanzania a dissertation titled: ñAssessment of Beekeepersô Perception on Adoption of Modern Technologies in Beekeeping in Iringa Region.ò in partial fulfilment of the requirements for the Degree of Master of Business Administration (MBA) of the Open University of Tanzania.

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Supervisor

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Date

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DECLARATION

I, Amina Said, do hereby declare that this dissertation is my own original work and that it has not been presented and will not be presented to any other university for a similar or any other degree award.

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Signature

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Date

DEDICATION

This work is dedicated to my mother Mwajuma and my brother Ibrahim.

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Dissertation writing has not been an easy task. There are some people who helped me in one way or another so as to accomplish this work. First I would like to extend my sincere gratitude to my supervisor Dr. Saganga for his tireless assistance in terms of ideas and comments for this study from proposal development to dissertation writing. I would also like to thank the department of trade in Iringa Municipal council for providing me with necessary information.

I am also grateful for being given permission to conduct my study in the Township. I would also like to extend my sincere gratitude to the beekeepers in IringaTownship for their willingness and prompt cooperation to this study. Last but not list I would like to extend my sincere gratitude to mymother for bearing with me during my study period, I am sure she missed an important moment with her mother.Lastly I would like to thank my brother, my uncle and my sibling for their support during my study.

ABSTRACT

Adoption of modern beekeeping technologies in Iringa region. The study comprises three objectives namely, factors affecting ease of use of beekeeping modern technologies, level of usefulness of the technologies, and the effect of perceived ease of use and perceived usefulness on adoption of modern beekeeping technology. Cross-sectional study design was adopted employing a sample size of 100 beekeepers. The study employed quantitative approach in data collection and analysis. Analysis of the findings revealed that, factors affecting ease of use of modern beekeeping technologies was categorised into three aspects namely demographic, socio-economic, and institutional factors. The results show that local technology (i.e. grass hive, gourd hive, log hive, barrel hive, and clay-pot hive) is more useful compared to modern technology (top-bar hive) due to its usage level. However, there are indices of increase rate in usefulness of modern technology with regards to analysis of the usage trend within past three years among beekeepers whereas usage of local technology tends to decline substantially. Findings affirm that, perceived usefulness, perceived ease of use among beekeepers have positive significant association with adoption of modern beekeeping technologies such that, perception of beekeepers explained 92.6% of the modern technology. Study recommends government and other stakeholders to initiate training programs aiming at raising awareness and highlights the potentials of adopting modern beekeeping technologies.

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LIST OF ABBREVIATION

ANOVA	Analysis of Variance
GDP	Gross Domestic Product
SPSS	Statistical Package for Social Science
URT	United Republic of Tanzania
USA	United States of America

CHAPTER ONE

INTRODUCTION

1.1 Overview

The main purpose of this chapter is to enlighten briefly the nature of the problem under investigation. It covers background of the study, statement of the problem, research questions, objectives of the study, significance of the study and the chapter ends with the delimitation of the study.

1.2 Background to the Study

Recently, beekeeping has been receiving adequate attention and promoted as a significant contributor of rural development globally (Keiyoro et al., 2016). For instance, USA spent approximately $15 billion for honeybeesô pollination in the last decade (Al-Ghamdi et al., 2016). Honey bees plays crucial role in pants pollination since more than 90 crops pollination relies on honey bees (Gupta et al., 2014). Moreover, practices of beekeeping enhance individual health and financial status by providing source of nutritional ingredients as well as financial products such as beeswax, honey, and bee venom (Dolgov et al., 2017).

Beekeeping is evidently one of the widespread agricultural activity around the world. For instance in Turkey, 200,000 organisations engages in apiculture in which of 20,000 organisations conducts apiculture mainly as a source of income (Yilmaz, 2016). Research shows there are approximately 56 million bee hives producing more than 1.2 million tons of honey worldwide (Bunde and Kibet, 2016). On the other hand, sub-Saharan countries contribute 23.5% of the beeswax and account for 9.8% of global honey production.

Likewise, Tanzania like other East African countries is also among major producer of honey ranking as second highest producer in Africa with estimated 9200 tonnes. Moreover, the sector contributes 1% of the Tanzanian annual GDP (URT Beekeeping Development Report, 2012). Despite the conducive agro ecology for honey production and the number of bee colonies the country is endowed with, the level of honey production is significant low. One of the prominent factors affecting such productivity is traditional hives. Most of the hives are not kept in accordance to hygiene principles thus leads topoor quality of the produced honey with undesirable smoke smell (UNIDO Annual Report, 2012).

As beekeeping sector is currently experiencing serious difficulties in production of high quality bee products, the use of modern beekeeping technology can be regarded as an exception (Gaga and Esaulov, 2016).Literally works shows the conducive environment for intensive technologies and deployment of modern facilities such as electric extractors, tractors, special centrifuges for wax production, wax melting using furnace, and packing honey using machine enhance the efficiency of the beehives (Kiros and Tsegay, 2017). Most of the developed countries have been successfully in production of high quality of bee products through adoption of modern technologies for instance China ranks number one with 27% shares, followed by Turkey (6%), Argentina (4.8%), Ukraine (4.4%), Russia (4.1%), and USA (4.0%) (Demircan et al., 2016).

Several studies have shown adoption of modern technologies plays crucial role in high quality production of bee products and successfully beekeeping. For example Njenga et al. (2016) found socio-cultural factors such as marital status, household

size, cultural beliefs, land size, and household head have both negative and positive impact on adoption of modern technologies in beekeeping. Similarly, Donovan (2017) revealed adoption of modern technologies such as flow hive and flow frame enhanced production and harvesting process in beekeeping through saving space, time, and heaving lifting energy.

Kiros and Tsegay (2017) on the other hand identified factors were likely to affect adoption of modern technologies in beekeeping particularly frame hives includes quality of wax and lack of equipment. Likewise, Bunde and Kibet (2016) revealed significant relationship between adoption of modern technologies and production in beekeeping. Their results also indicate factors such as age, gender, family size, and education affects the adoption of technology. Additionally, beekeepers were found to face several challenges on adoption of modern technology including lack of capital and extension support. However, most of the peer studies did not investigate perception of the beekeepers on the adoption of modern technology in terms of usefulness and ease of use.Present study assesses such relationship by employing Technology Acceptance Model (TAM) in Tanzania context particularly Iringa region.

1.3 Statement of the Research Problem

Iringa district council comprises potential areas for effective beekeeping. These areas are covered with natural forests and trees endowed with natural sources of water that forms conducive environment for beekeeping. According to URT Beekeeping Development Report (2012), the district has forest area totalling to 191,000 hectares with a game reserve of 773 km^2 which is surrounded by 21 districts, making it one of

the potential site for honey production. The district has about 10,000 traditional hives and 4,000 transitional top bar beehives.

Despite the large number of bee colonies available in the district, there is insignificant production of bee products and the economic gains are limited to farmers (Mwakatobe and Machumu, 2011). According to Mwakatobe and Machumu (2011) 99% of beekeeping in Tanzania including Iringa region uses traditional methods (such as grass hive, gourd hive, log hive, barrel hive, and clay-pot hive).

Furthermore, most of the bee keepers in the area are traditional farmers with less knowledge on modern beekeeping technologies (top-bar hives) (Mwakatobe and Machumu, 2011). Consequently, low productivity and poor quality of bee products are the major economic impediments for beekeepers (Njenga et al., 2016). Moreover, there is little/no evidence ofpeer study that has been done to investigate perception of beekeepers on adoption of modern technologies (top-bar hives) in beekeeping and its potential in honey production. Thus, this research is conducted to assess perception of beekeepers on adoption of modern technologies in beekeeping in the Iringa Township in West part of Tanzania.

1.4 Research Objectives

1.4.1 General Objective

The general objective of this study is to assess the perception of beekeepers on adoption of modern technologies (top-bar hives) in beekeeping.

1.4.2 Specific Objectives

i. To identify factors affecting ease of use of beekeeping modern technologies.

ii. To assess level of usefulness of modern technologies in beekeeping

iii. To examine the extent to which perception of modern technologies facilities influence adoption of the modern technology in beekeeping.

1.5 Research Questions

i. Why do beekeepers perceive modern technologies not ease to use in beekeeping?

ii. To what extent are modern technologies useful in beekeeping?

iii. How do perception on modern technologies facilities influence adoption of modern beekeeping?

1.6 Significance of the Study

This study intends to add value to the stakeholders that are concerned with beekeeping or affected by the impact of apiculture. Thus, researcher articulates the significance of the study in respect to beekeepers, government, and other researchers.

To the Beekeepers: Findings of this study will capture necessary factors that influence farmers to adopt modern technologies in beekeeping. Beekeepers will therefore acquire significant knowledge on why modern technologies are fundamental to their achievement of apiculture goals.

To the Government: this study will add value to governmental programs that are carried out to support beekeeping. Moreover, the findings will enlighten government to understand the perspectives of beekeepers on adoption of modern technologies and identify key challenges that slowdown acceptance of technology among beekeepers.

To other Researchers: this study will help researchers uncover detailed findings on critical areas of adoption of modern technologies in beekeeping, and will also act as a guide for future reference in relevant studies.

1.7 Delimitations of the Study

Cross-sectional design was adopted to carry out the study. The study involves only single survey. On the other hand, population of the study involves beekeepers only from Iringa district. Subsequently, the questionnaire was employed as data collection instrument thus avoided bias in results in terms of emotional feelings due to its close-ended format.

1.8 Organization of the Study

Chapter one of this study introduced the background of the study, statement of problem, the objectives of the study, research question and the significance of the study. Chapter two presents a review of literature and relevant researches associated with the problem addressed in this study. The study is supported by literatures from different researchers from different areas within and outside the country. Chapter three presents the methodology that was used in this study and which comprises the research design, area of the study, population of the study, sample size and sampling design, sources of data, data collection tools, reliability and validity of data, data analysis and presentation and the expected results. Chapter four presents research findings and discussion. This is followed by chapter five which covers the summary of the main findings, conclusion, recommendations and areas for future studies.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This part presents the theoretical and empirical literatures relevant adoption of modern technologies in beekeeping. It includes conceptual definitions of key terms, theoretical literature and empirical literature of relevant studies, research gap, and conceptual framework.

2.2 Definition of Conceptual Key Terms

2.2.1 Beekeeping/Apiculture

Beekeeping/ Apicultureis an art of managing bees aiming to gain maximum return in terms of profit from bee products sales with a minimum expenditure (Cheney and Heaf, 2007). Bee products include honey, wax, queens, and royal jelly.

2.2.2 Modern Beekeeping Technology

These are modern day ways of conducting beekeeping activities. They involve advanced and more sophisticated tools to prepare and harvest honey. For example top bar hives.

2.3 Theoretical Framework

2.3.1 Technology Acceptance Model (TAM)

This theory was primarily proposed by Davis (1989) basing on the Theory of Reasoned Action (TRA) which was developed by Ajzen and Fishbein (1980). TRA states that, individual behaviour is driven by attitude and intention or social norm towards that particular behaviour. Furthermore, the theory stresses intention is

predicted by individual attitude and can be shaped by his/her behaviour. According to TAM, degree of technology acceptance of an individual is determined by Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) (Davis, 1989). Davis (1989) defined PEOU as the extent to which an individual believes technology would set him/her free from using energy while PU is the extent to which individual believes technological means would improve performance of a job.

TAM stresses that, PEOU determines PU as user find technology ñusefulò when it is ñease to useò. The theory provides causal relationship of the two core variables (PEOU and PU) and three other variables including attitude, actual use, and behavioural intention as depicted on figure 1. Both PEOU and PU are deemed to determine user attitude towards using technology as user develop positive attitude when he/she finds technology is ease to use and useful. Davis (1989) on the other hand, defines BI as the extent to which individual has constructed ideas or set his/her mind ready on carrying out or not to carry out specific behaviour. According to TAM, BI is determined by PU and attitude as user develop positive intention when he/she finds technology useful. Likewise, user develop intention to use specific technology when acquire positive attitude. Therefore, technology actual use is shaped by behavioural intention of a user.

Several studies found TAM useful and predictive to explain perceptions of user and technology acceptance including Alharbi, *et al.* (2014); Revythi and Tselios (2017); Ghavifekr and Rosdy (2015) and Fathema, *et al.* (2015). Contrary, the theory was criticised to be limited in studying educational application in the past as it was designed for studying technology acceptance in organisations (Fathema et al., 2015).

However, recently TAM has become one of the most useful theory on studying e-learning processes and modern technologies acceptance in social sciences such as apiculture (Park, 2008).

Present study adopted TAM to explain the extent to which beekeepers perceive modern technologies influences ease of use and usefulness of beekeeping.

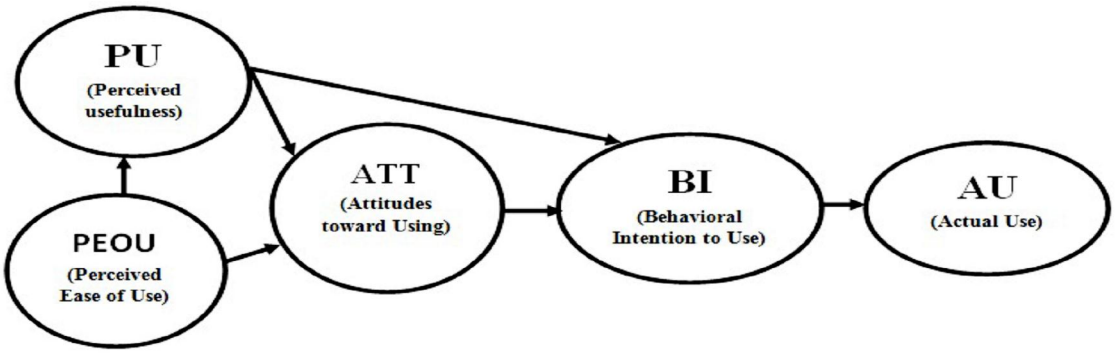

Figure 2.1: Technology Acceptance Model (TAM)

Source: (Davis, 1989)

2.4 Empirical Literature Review

2.4.1 Adoption of Modern Technologies in Beekeeping

Various studies have shown modern technologies have positive effect on beekeeping at global scale and sub-Saharan context. Leiby (2014) carried out study in USA to investigate factors that influences adoption of Varroa Sensitive Hygiene (VSH) technology on honey breeding. Survey was employed to gather information from 228 queensô breeders. Several factors were identified to influence adoption of the technology including risk preference, sales attributes, demographic characteristics, information sources and level of income. Moreover, findings revealed there was significant relationship between level of education, income, risk preference and adoption of technologies. Similarly, Modvala et al. (2016) examined acceptance of

technology in pastoral beekeeping in Moldova. Results revealed technology enhanced honey quality and productivity of bees.

Another peer study was conducted by Kumar (2018) to assess constraints facing adoption of beekeeping technology in India. Multistage sampling was employed select 200 beekeepers. Interview on the other hand was adopted as data collection instrument. Findings revealed several constraints were found to hinder transfer of technology including low price of honey, unavailability of reliable market, poor technical guidance, and lack of genetically superior bee queen. Likewise, Kumar et al. (2018) carried out another study in India to assess knowledge among beekeepers on scientific beekeeping adoption. The study consisted of 200 beekeepers to collect data using interview. Result indicated beekeepers knowledge influenced adoption of technology. Moreover, result indicated positive relationship between knowledge and apicultural technologies.

Similar study was done by Sharma and Das (2018) to investigate factors that affects beekeeping adoption. Questionnaire and interview were employed to gather data from 100 beekeepers. Results identified several factors including inefficient working capital, lack of skills, and inadequate safety equipment. However, reviewed studies in America, Asia, and Europe context did not focus on perception of beekeepers particularly in technology adoption. Thus, present study aims to fill in such particular gap.

In Africa context, various studies were carried out to ascribe the same scenario for instance Udo (2014) studied technology attributes that influence adoption of

production technologies on beekeeping in Nigeria.60 apiary farmers were selected using purposive and multistage random sampling. Data were gathered used survey questionnaire. Furthermore, descriptive statistics showed technological attributes that were adopted included beehives baiting and hive setting. Bivariate probit regression on the other hand revealed non adoption of apiary technologies were influenced by technology complexity, technology adaptability, and technical competency.

In the same manner Kiros and Tsegay (2017) assessed level of preferences on hive technology and honey-bee production practices in Ethiopia.156 beekeepers were selected using randomly and proportional sampling techniques. Formal survey and secondary sources were deployed in data collection. It was revealed adoption of hive technology was affected by lack of equipment, availability problems, and wax quality. Furthermore, their study recommended improvement of equipment, wax quality and availability before the adoption of the technology.

In Ethiopia, Abeje et al. (2017) examined determinants that influences adoption modern bee hive among beekeepers.Multistage sampling was employed to select 268 beekeepers involving random and proportional techniques. The respondent were thereafter interviewed. Descriptive analysis revealed that demographic characteristics such as level of education, age, annual income, and number of local hives affected beekeepers decision on adoption of technology. Their study also identified number of constraints affecting adoption including lack of equipment, drought, and predators and pests. Likewise, in East Africa Muya (2014) investigated determinants of modern beekeeping technologies among women groups in Kenya. 116 beekeepers were purposively selected. The study employed questionnaires,

interviews, and observation guides as data collection instruments. Findings revealed adoption of modern technology was influenced by technical, human and conceptual skills. On the other hand, results showed adoption of new technology influenced farmersô net benefits and yields.

Similarly, Bunde and Kibet (2016) assessed socio-economic factors that influences modern beekeeping technologies adoption.294 beekeepers were selected using random and purposive sampling methods. Primary data were collected using questionnaire. Results reveled several constraints affecting adoption of technology including lack of beekeeping materials, poor capital, and extension support. Moreover, their findings revealed adoption of technology enhanced beekeepers householdsô income.Muriuki (2016) on the similar manner examined adoption of beekeeping technology in arid and semi-arid lands.

Formal interviews were carried out to 170 randomly sampled beekeepers. Descriptive analysis yielded cost, capacity, and availability to practice regime management of beekeeping technology were the major determinants of adoption. Other factors included gender, householdsô size, access to extension services, and size of land holding. However, none of the reviewed study in Africa and East Africa context investigated perception of beekeepers on adoption of the particular technology in which the current study aims to study.

2.5 Research Gap

Most of the reviewed studies articulatethe role of modern technologies (top-bar hives) in beekeeping has influenced significant changes in terms productivity

increase and rise of beekeepers household income. The studies also examined major determinants which influence adoption of modern beekeeping technologies including socio-demographic features such as level of education, age, household size, and gender (Abeje et al., 2017; Bunde and Kibet, 2016; Muriuki, 2016). Other factors deemed to influence adoption were adaptability and complexity of technology as well as technical competency (Udo, 2014).Literally works also identified major constraints facing beekeepers to adopt modern technologies including inefficient capital, lack of beekeeping equipment, and extension support (Kiros and Tsegay, 2017). In Tanzania context, none of the recent reviewed study assessed adoption of modern technologies in beekeeping.

However, few/no literature has investigated perception of beekeepers on adoption of modern technologies. Moreover, adoption of theoretical model to study behaviour and perception of beekeepersô towards acceptance of technology. Therefore, present study intends to fill this gap through adoption of TAM which is one of the most useful model to study perception of users towards technology adoption particularly in ease of use and usefulness. Current study also determines relationship between perception of beekeepers on ease of use and usefulness and level of modern technology (top-bar hives) adoption.

2.6 Conceptual Framework

Conceptual framework of this is conceptualised from the Technology Acceptance Model (TAM) as depicted on figure 2. It involves three types of variables independent, intervening, and dependent variable. Perception on ease of use and usefulness were treated as independent indicating their role as determinants of the

study outcome. On the other hand, adoptions of modern beekeeping technologies were regarded as dependent variable. The relationship between dependent and independent variables was measured using multiple linear regressions. Moreover, figure 2.1 depicts constraints facing beekeepers from effective adoption of modern technologies as intervening variables. Three factors were investigated as constraints including demographic, socio- economic, and institutional factors.

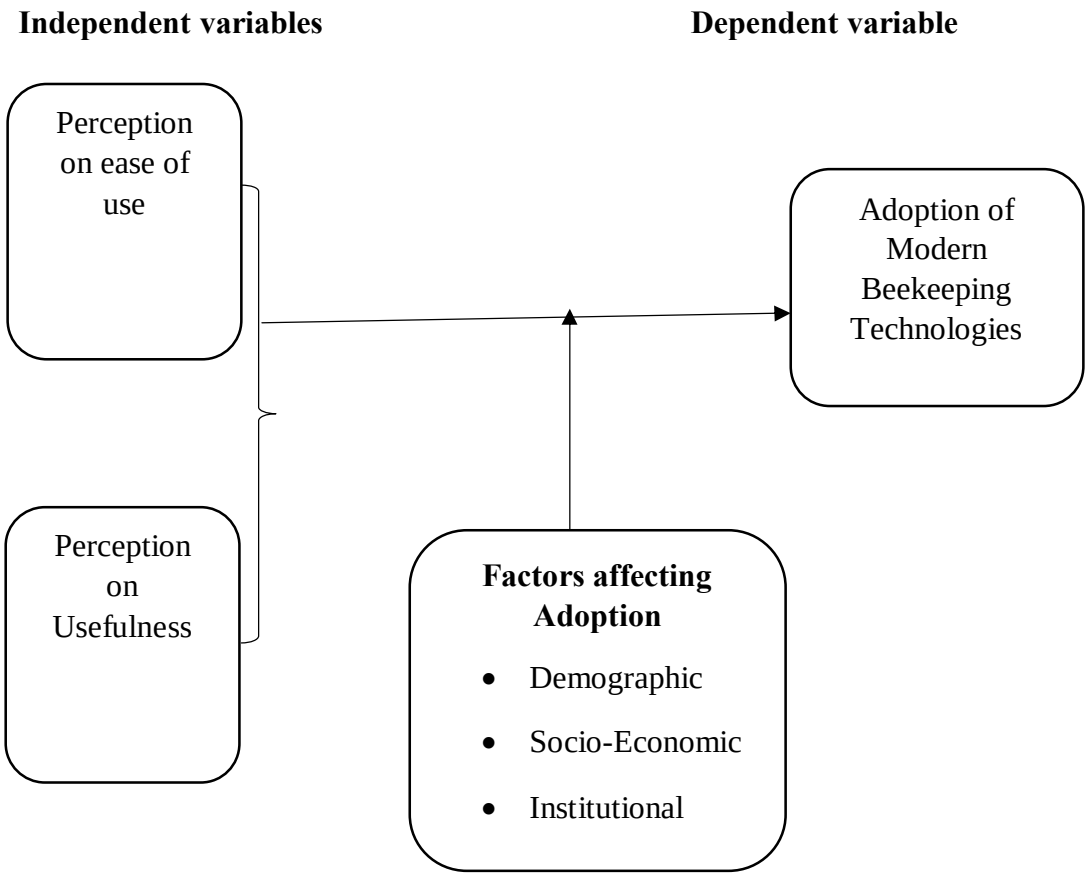

Figure 2.2: Conceptual Framework

Source: Researcher (2019)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Overview

This chapter presents research methodologies and approaches adopted in this study. It comprises research paradigms, design, survey population, sampling techniques, data collection tools and analysis techniques in detail.

3.2 Research Design

Kothari (2004) defines research design as group of tasks that have been categorised in logical order essential for data collection, analysis, and measurement. Research design identifies suitable approach to be employed in analysis and collection of data. Selltiz and Cook (1962) stresses that research design comprises conditions to guide a researcher in data collection and analysis in a way that ascertain relevance of research and economy. This study adopts cross-sectional study design which is one of the quantitative study design based on number of contacts as claimed by Kumar (2014).

Cross-sectional design is notably useful when conducting a research aiming to investigate ubiquity situation, phenomenon, problem, or attitude, it is carried out by cross-section of study population. Researcher adopts this design because it allows a researcher to decide what should be investigated, identify population of the study, sample size selection, as well as contacting the study participants for data collection. Cross-sectional designs are considered cheap and easy in data analysis due to involvement of solely one contact with the sample size. However, it is criticised for its failure to measure change. Change can be determined by involving at least two

points of data collection, meaning for the cross-sectional design to measure change it should be conducted twice at different period of time on the same population (Kumar, 2014).

3.3 Study Area

This study was conducted in Iringa district located in Iringa region. The district has about 10,000 traditional hives and 4,000 transitional top bar beehives. According to URT (2012), the district has forest area totalling to 191,000 hectares with a game reserve of 773 km^2 which is surrounded by 21 districts, making it one of the potential site for honey production. The area was selected because of ease accessibility of data concerning beekeeping.

3.4 Target Population of the Study

Target population of the current study is 2500 beekeepers situated in Iringa district as estimated by URT (2012).

3.5 Sample size and Sampling Procedures

3.5.1 Sample Size

The minimum sample size obtained was 100 beekeepers as calculated basing on the Slovin (1967)ǿs formula

$$n = \frac{N}{1 + N(e)^2}$$

Where,

n = minimum sample size

N =Population size (525)

e = Standard error (0.05)

n = **100** beekeepers

3.5.2 Sampling Procedures

Scholars suggest two philosophies that guide sampling techniques selection in both quantitative and qualitative approaches of research. Kumar (2014) argues that, selection of sample in quantitative approach is based on preconception and representation of the population while in qualitative research several factors are considered including, situation or event of interest, knowledge of a person, and ease of access of potential respondents. In this study random sampling technique was employed to select beekeepers.

Random sampling is a technique of which the population has an equal chance of being selected. The interest could be on the entire population; however, few of them can be picked with the intention to represent the intended audience (Babbie and Mouton, 2006). According to Morgan and Krejcie (1970), it is important to know the population size under study in order to determine the representative sample.

3.6 Data Collection Methods

3.6.1 Primary Data

Primary data are data collected for the first time. In this study there were two groups of primary data collected. The first group of data were collected from beekeepers. Primary data was obtained through self administered semi-structured questionnaires which were distributed to respondents and semi structured interview was also

conducted Personal interview provided the opportunity for the interviewer to clarify issues.

3.6.2 Secondary Data

The researcher also used the already worked data i.e. secondary data from various data banks. Published and non published materials were used as a source of data to supplement primary data. The sources included research reports, and other readily available documents (compendia) including office reports, brochures and documents. Additional information was obtained from the World Wide Web (www)-internet.

3.7 Data Collection Instruments

Mugenda (1999) provides that, data collect tools are the instruments used in data collection. However, Deuscombe (2008) stresses that, the choice of the research instruments depends on the purpose of the research and research questions under investigation. Present study used questionnaire as data collection tool.

3.7.1Questionnaires

Questionnaire is referred as the data collection instrument that entails questions form used for enquiring research respondents information (Olsen, 2004). It encompasses distinctive type of conversation. According to Kothari(2004), questionnaire as data collection tool has numerous advantages including, low cost even when geographical area is widely spread, bias-free since it is based on respondents own words, sufficient time for respondentsô answers, and convenient tool in approaching difficulty respondents. Questionnaire was adopted as the data collection tool in this specific study. The tool was distributed and administered to participants using

collective administration. However, before administering questionnaires pilot studywas carried out so as to measure reliability of the instrument. Kothari (2004) recommends pilot survey to be carried out for testing reliability of the questionnaires as it is imitation and preparation of the main survey.

3.8 Data Analysis

Data were cleaned before processed. Quantitative techniques were employed in data analysis including inferential and descriptive statistics based on specific objectives. Inferential statistics consists of T-test, multiple regressions, and non-parametric techniques while descriptive statistics involved measures of the central tendency (mean, median, mode, frequency) and measures of dispersion (variance and standard deviation). The first objective which aims to identify factors affecting ease of use of beekeeping modern technologies was measured using descriptive statistics including frequency, mean, and standard deviation. The second objective which aims to assess level of usefulness of modern technologies in beekeeping was measured using descriptive statistics by employing frequency and percentage. The third objective on the other hand was measured using multiple linear regressions to determine relationship between perception of ease to use and usefulness, and adoption of the modern technology in beekeeping. Results were presented in figures and tables.

3.8.1 Multiple Linear Regression Analysis

Multiple linear regressions modelling technique used to determine simultaneous relationship of several independent variables and one continuous variable (Eberly, 2007). It is used to predict the values of outcome variable Y, provided set of independent variables (x1, x2...) (Tranmer andElliot, 2008). Researcher will deploy

this technique to analyse relationship between perception and level of adoption. Before running the analysis, assumptions of multiple regressions was tested. Ignoring the assumptions may lead to wrong results of the analysis (Antonakis and Deitz, 2011). On the other hand, when assumptions are not met may results to Type I and Type II error or over-or-under estimation of the direction and strength of the relationship (Osborne and Waters, 2002). Therefore, five assumptions of multiple regressions were tested including linearity, normality, autocorrelations, collinearity, and homoscedasticity. Regressions model was developed basing on general equations of regressions as follows;

From

$$Y = \alpha + x_1\beta_1 + x_2\beta_2 + ..x_n\beta_n + \varepsilon$$

Then,

$$y = \alpha + PEOU\beta_1 + PU\beta_2 + \varepsilon$$

Where,

Y= *Level of Adoption of Technology*

PEOU= *Perception on Ease of Use*

PU= *Perception on Usefulness*

α = *Constant*

Ů= *Standard Error*

Another equation was also developed to analyse the moderating effect of intervening variables on dependent variable as suggested by Jaccard and Turrisi (2003);

$$y = \beta_0 + \beta_1 X + \beta_2 M + \beta_3 MX + \varepsilon$$

Where,

β=*Coefficient Value*

X=Independent Variable

Y=Dependent Variable

M= Moderating Variable (Demographic, Socio-Economic, and institutional factors)

ε=Standard Error

3.9Ethical Considerations

Ethics can be described as standard of behaviour of people and their relationship (Blumberg, 2005). Research ethics requires a researcher to follow appropriate guidelines and rules for protecting participantsô dignity as well as publishing relevant and ethical oriented information (Fouka and Mantzorou, 2011). In this study, appropriate values of ethical guidelines and rules were observed including, anonymity, confidentiality, privacy, and plagiarism. The considerations were followed by requesting introduction letter from Open University of Tanzania.

3.9.1 Privacy and Confidentiality

In this study, respondents were assured of the right to privacy, anonymity and confidentiality. The real names of the participants were not used but their assumed names to observe anonymity. According to Mugenda (2003), anonymity refers to keeping secret and observing ethnic or cultural background of respondents. Also, the information collected were treated with confidentiality so as to maintain peopleôs integrity. It is important for the researcher to enhance honesty by protecting respondents from physical or psychological harm and promise to protect the collected information unless prior consent from respondents is given (Akaranga and Makau, 2016).

3.9.2 Plagiarism

A writer is accountable to quote or cite the original material appropriately to acknowledge other authors work (Akaranga and Makau 2016). The study observed originality of the study by citing texts from other publication or authors. To avoid plagiarism, the researcher acknowledges the contributions of others and the source of ideas and words regardless of whether paraphrased or summarized, acknowledge the sources used in writing, accuracy in citation and reference, and use of quotation marks in verbatim text (Bahadori and Hoseinpourfard, 2012).

3.10 Data Reliability Analysis

The study ensured that the collected data are valid and reliable to answer the research objectives. Reliability can be referred as the quality of a measurement procedure that provides repeatability and accuracy (Kothari, 2004).

Table 0.1: Reliability Analysis

Question	Number of Respondents	Cronbach's Alpha	Number of items
Perceived Ease of Use	100	0.815	3
Perceived usefulness	100	0.812	3
Adoption of modern technology	100	0.826	3
Demograhic factors	100	0.924	5
Socio-Economic factors	100	0.951	5
Institutional factors	100	0.936	5

Source: Primary Data, 2019

To ensure consistent and accurate results, standard designed closed-ended questionnaire, interview guide was used to collect the information from the study sample, through which researcher controlled the results of responses. Reliability was

tested by using SPSS, the Cronbanchôs Alpha which measures internal consistency. Cronbach alpha ranges between 0 and 1, the closer the Cronbachôs alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale (Grayson, 2004). The results of reliability test depicts data collection instrument was statistically reliable since Cronbachôs coefficient was above 70% in all variables questions (refer Table 3.1). Reliability coefficient of 0.7 or higher is considered acceptable in most social science research situations (Sekeran, 2004).

3.9.3 Validity Analysis

Validity can be referred as the technique for testing how truthfully the research instrument can measure intended data and how openly research results are (Joppe, 2000). In other words, validity can be defined as the extent to which research tool is reliable. However, an instrument can be reliable without being valid (Kimberlin and Winetrstein, 2008). In this study, Researcher conducted test-retest pilot study to ensure validity of the data tools. 20questionnaires were distributed and administered to the respondents. After one week same procedure was repeated to the same participants. According to Lee et al. (2014), it is important to pre-test data collection instruments as it ensures reliability and validity of the tools before the main survey.

CHAPTER FOUR

PRESENTATION OF FINDINGS

4.1 Overview

This chapter presents analysis of the findings based on each specific objective of the study. It starts with descriptive statistics factors affecting ease of use of beekeeping modern technologies, followed by level of usefulness of the technologies, and ends with multiple regressions analysis showing the extent to which perception of modern technologies facilities influence adoption of the modern technology in beekeeping.

4.2 Demographic Characteristics Analysis

Table 0.1: Demographic Characteristics

Characteristics	Category	Frequency	Percent
Gender	Male	71	71.0
	Female	29	29.0
Age			
	Below 20 years	4	4.0
	20-30	46	46.0
	31-40	16	16.0
	Above 40	34	34.0
Education Level			
	Primary Education	36	36.0
	Secondary Education	40	40.0
	Diploma/Degree	13	13.0
	Postgraduate	11	11.0
Experience			
	Below 3 years	21	21.0
	3 years ï 5 years	56	56.0
	5 years-10 years	14	14.0
	Over 10 years	18	18.0
Marital Status			
	Married	67	67.0
	Single	33	33.0

Source: Field Data, 2019

Several factors were considered on the analysis of demographic characteristics of the respondents. These factors included age, gender, education level, marital status, and

working experience in beekeeping. The study employed descriptive statistics mainly frequency and percentage to examine the characteristics as depicted on Table 4.1.

4.2.1 Distribution by Gender

Result indicate majority of the beekeepers were males (71.0%) compared to female beekeepers (29.0%) (Table 4.1) .This in turn imply beekeeping is highly dominated by more males than female counterpart as matter of statistical evidence (Figure 4.1). Considering the present findings, Eforuoku and Etukudo(2017) found majority of beekeepers were males and were likely to be the dominant users of modern technologies in beekeeping. Similarly, Yilmaz (2016)ός findings supports the current result.

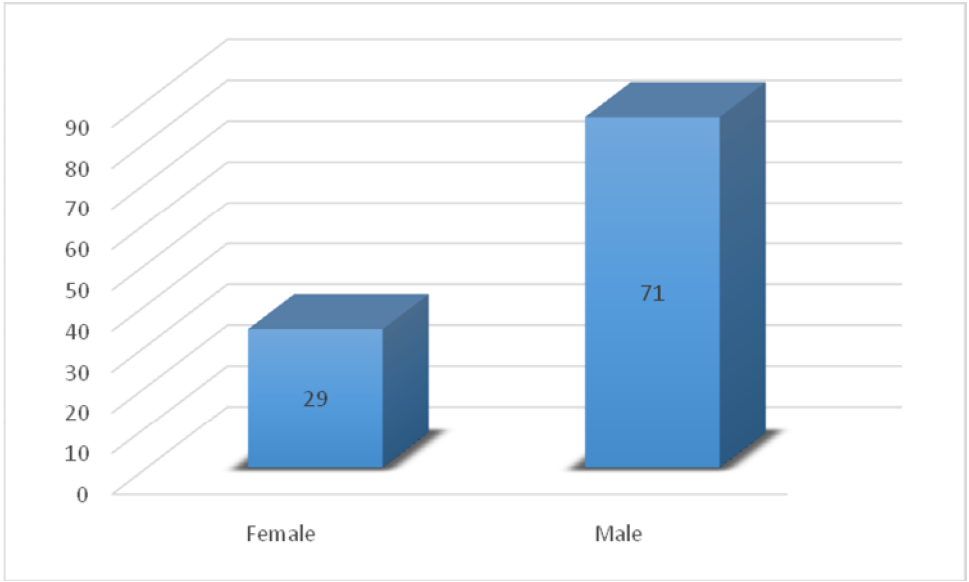

Figure 0.1: Gender Distribution

Source: Field Data, 2019

4.2.2 Distribution by Age

As depicted on Table 4.1, majority of the respondents were youth aged between 20 and 30 years (46%), followed by adult respondents aged over 40 years (34%). In

addition, participants aged between 31 and 40 were 16% whereas only 4% were below 20 years. Result suggest beekeeping is likely to be practised mostly by youth and adult people in the study area as referred on Figure 4.2. Same scenario was observed by Yehuala et al. (2013) such that majority of participants were youth aged individuals.

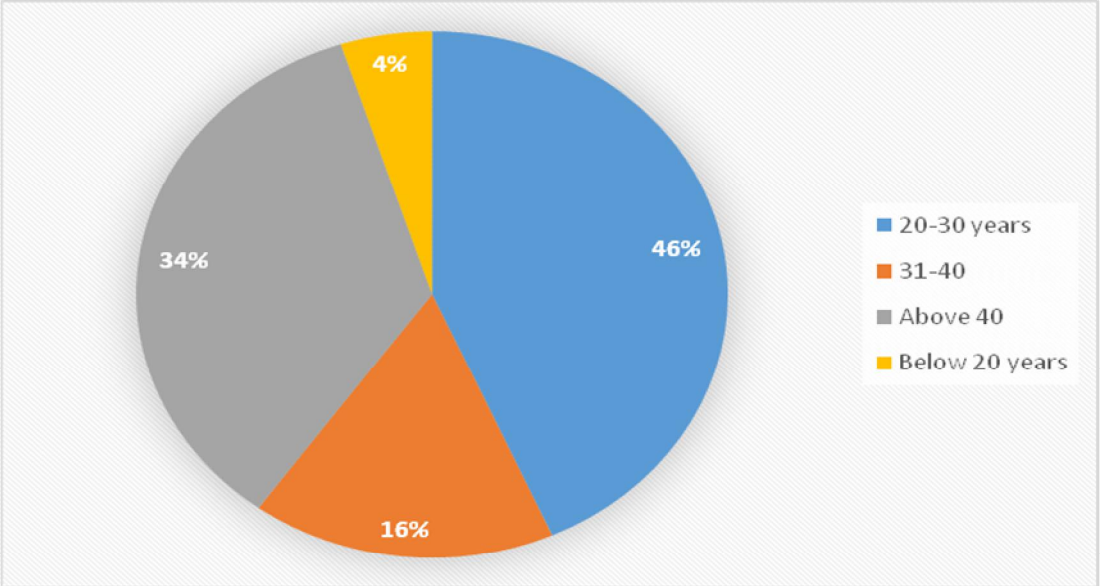

Figure 0.2: Distribution by Age

Source: Field Data, 2019

4.2.3 Distribution by Education Level

Majority of respondents were found to attain secondary level of education (40%) followed by primary level of education holders (36%). However, few beekeepers had postgraduate level of education (10%), and diploma/degree education (13%) (Refer Table 4.1). This implies most of the beekeeperswere literate occupying reasonable level of education. In addition, it provides an evidence that most of the participants had satisfactory understanding and knowledge on apiculture as depicted on figure 4.3.

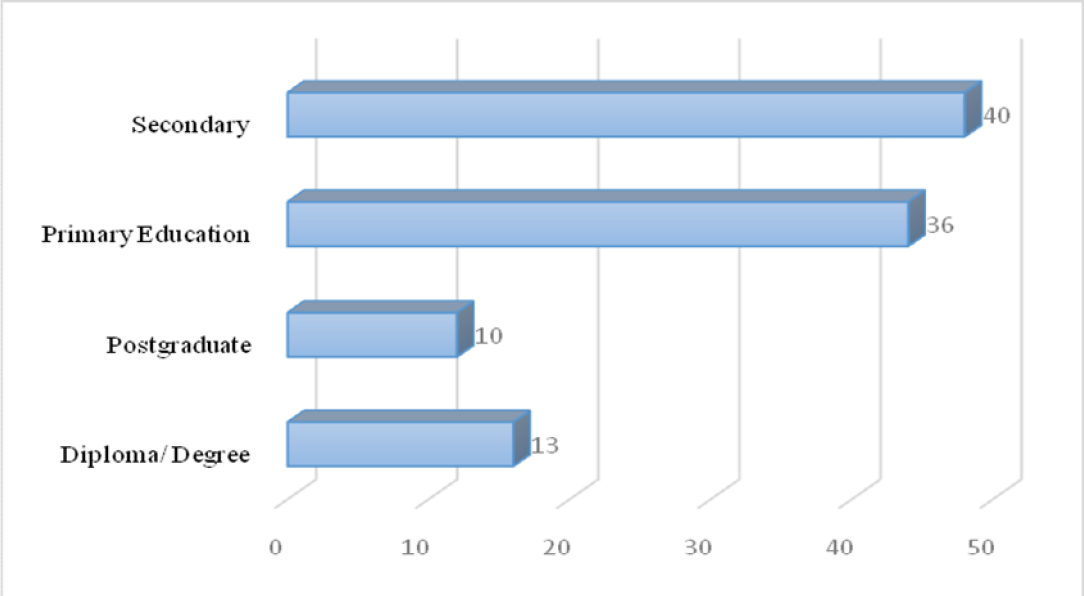

Figure 0.3: Distribution by Education Level

Source: Field Data, 2019

4.2.4 Distribution by Experience

Result revealed that most of the beekeepers had 3 to 5 years of experience (56%) in beekeeping. Whereas, 21% of the respondents were below 3 years and 14% were between 5 and 10 years. However, 18% were over 10 years of experience in apiculture (Table 4.1). Similar results can also be supported by Yehualaet al. (2013) that most of beekeepers particularly adopters of modern technologies more than five years of experience implying they were conversant with beekeeping business as well as its practices.

4.2.5 Distribution by Marital Status

Findings suggest married customers (67%) were higher in number compared to single beekeeping (33%) (Table 4.1). This instance was likely to be associated with large number of adult participants during the survey.

4.3 Factors affecting ease of use of Beekeeping Modern Technologies

Ease of use beekeeping modern technologies was associated with various factors. Based on the survey, these factors were categorised into three groups namely demographic, economic, and institutional factors. One sample T test was used to analyse the findings as portrayed on Table 4.2, 4.3, and 4.5.

4.3.1 Demographic Factors

Table 0.2: Demographic Factors Affecting ease of Use of Technology

	N	Mean	Std. Deviation	Sig. (2 tailed)
Family Size	100	3.01	1.467	.000
Education status of the household head	100	.74	.441	.000
Sex of the household head	100	.29	.456	.000
Age of the household head	100	34.25	9.522	.000

Source: Field Data, 2019

Based on Table 4.2, result shows there was significant difference ($p<.000$) on family size among beekeepers on adoption of modern technologies with mean score of 3.01. This implies that, most of the families adopting modern technologies have at least 3 family members. Further, majority of adopters of the technology in beekeeping were somehow literate revealing a mean score of 0.74 with a significant difference among household heads ($p<.000$). On the other hand, results suggest significant difference among household head sex on adoption of the technology with a mean score of 0.29 indicating male domination. Moreover, most of the beekeepers adopting modern technology were found to have a mean age score of 34. Similar findings can be

related to Hailesselassi (2016) who also found significant difference among demographic characteristics of the adopters and non-adopters of beekeeping modern technology.

4.3.2 Economic Factors

Table 0.3: Economic Factors Affecting Ease of Use of Modern Technology

	N	Mean	Std. Deviation	Sig. (2 tailed)
Size of land	100	3.76	.922	.000
Cultural beliefs	100	.79	.409	.000
Owning a mobile phone	100	.83	.378	.000
Owning a radio	100	.98	.284	.000

Source: Field Data, 2019

As shown on Table 4.3, there was significant difference ($p<.000$) on the size of land owned by beekeepers on adoption of modern technology with an average land hectares of 3.76. In addition, majority perceive cultural beliefs to affect adoption of modern technology (M=.79, SD=.41). Further, most of beekeepers were found to own a mobile phone (M=.83, SD=.38) and radio (M=.98, SD=.28).

However, there was significant difference on ease of use of the technology as result implies most of the adopters of modern technology in beekeeping have more land hectares compared to non-adopters. Contrary, ownership of mobile phone and radio tend to have no effect on ease of use of the technology regardless of the significant difference among adopters and non-adopters. In harmony with the present findings, Al-Ghamdi et al. (2016) also found no significant difference between adopters and

non-adopters of modern technology in terms of mobile phone, radio, and land regardless their difference on adoption of the technology. Similarly, Hailesselassi (2016) supports same scenario such that, ownership of mobile, radio, and many hectares has positive association with ease of use of modern technology in beekeeping. It is therefore attest that, ease of use of modern technology can be affected by technological facilities such as mobile phone and economic resources (i.e. land).

4.3.3 Institutional Factors

Table 0.4: Institutional Factors Affecting ease of Use of Technology

	N	Mean	Std. Deviation	Sig. (2 tailed)
Access to price information	100	.65	.479	.000
Access credit service	100	.79	.409	.000
Distance to input market	100	5.31	2.929	.000
Distance to product market	100	4.87	2.827	.000

Source: Field Data, 2019

Table 4.4 suggest that, average number of beekeepers (M=.65, SD=.48) had access to price information towards adoption of modern technology. Contrary to that, majority were found to access credit service (M=.79, SD=.41). However, results reveal significant difference (p<.000) towards ease of use among beekeepers. On the other hand, average distance to input market was 5.3km whereas average distance to product market was 4.9 km. moreover, there was an evidence of significant difference (p<.000) among beekeepers on adoption of the technology and distance to input market and product information. Findings imply that, adoption of modern

technology is likely to be affected by ease of access to price information and credit service. In addition, distance from the households to input and product market also has significant effect on ease of use of the technology.

Level of usefulness of Modern Technologies in Beekeeping: Descriptive statistics were employed to assess the level of usefulness of modern technologies among beekeepers with regard to the trend of usage on past three years. Several types of beekeeping methods were subjected to the analysis basing on usage level as indicated on Table 4.5.

Table 0.5: Level of Usefulness of Beekeeping Methods

Beekeeping Types	**2016**	**2017**	**2018**
Tanzania Top bar hive	13 (13%)	17(17%)	17(17%)
Tanzania Commercial Hive	3(3%)	5 (5%)	10(10%)
Local Beehives	84 (84%)	78(78%)	73 (73%)

Source: Field Data, 2019

As shown on Table 4.5, both local and modern beekeeping methods were considered during the analysis. Modern beekeeping methods involved top bar and commercial hive. Results shows that, local beehives was the most used method in the past three years with a remarkable highest score in 2016 (84%), 2017 (78%), and 2018 (73%). However, despite the remarkable relative high score on usage of local beehives on the past three years, results attest drop rate of the method from 84% to 78% in 2016 and 2017, and from 78% to 73% in 2017 and 2018 respectively. On the other hand, commercial hive was revealed as the least method used in beekeeping marking 3% in 2016, 5% in 2017, and 10% in 2018. Similarly, top bar hive evinced lower usage

compared to local method such that, 2016 (13%), 2017 (17%), and 2018 (17%). However, results evince increase of the usefulness rate of the modern beekeeping methods, for instance, top bar hive increased from 13% to 17% in 2016 and 2017 whereas the use of commercial hive has widely increased in consecutive three years from 3%, 5% to 10% in 2016, 2017, and 2018 respectively.

Findings imply that, regardless of the relative high usage of local beekeeping methods, the level of adoption of modern technologies is gradually increasing in the study area. Besides, the level of using local methods is currently slowing down. Present findings were consistent with various peer literally works (Sharma and Das, 2018); Kumar et al., 2018) such that, their findings revealed positive adoption of modern beekeeping technologies with respect to time.

4.4 Extent to which Perception of Modern Technologies Facilities Influence Adoption of the Modern Technology in Beekeeping

Multiple linear regressions was used to examine the effect of perception of beekeepers on modern technologies influences adoption of the technology. Several indices were involved in the analysis as portrayed in the study conceptual framework, including dependent and independent variables. However, prior to analysis, five assumptions of multiple regressions were tested to affirm the significance of effect size and estimates as suggested by Osborne and Waters (2002).

4.4.1 Assumptions of Multiple Linear Regressions

4.4.1.1 Linearity Assumption

This assumption states that, relationship between predictors and outcome should be

linear in nature, that is, dependent and independent variables should have a significant linear relationship. Stevens (2009) suggest to test this assumption using correlation matrix as shown on Table 4.6.

Table 0.6: Pearson Correlation showing Linearity Assumption

Variable	Measurement	Perceived Ease of Use	Perceived Usefulness	Adoption of technology
Perceived Ease of Use	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	100		
Perceived Usefulness	Pearson Correlation	.901**	1	
	Sig. (2-tailed)	.000		
	N	100	100	
Adoption of technology	Pearson Correlation	.946**	.929**	1
	Sig. (2-tailed)	.000	.000	
	N	100	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Field Data, 2019

As indicated on Table 4.6, the analysis revealed strong positive linear relationship between dependent and independent variables. In particular, adoption of modern technology significantly related with perceived ease of use (r (100) = .95, p<.000) and perceived usefulness (r(100) =.93, p<.000).This attests that, the assumption was statistically satisfied.

4.4.1.2 Normality Assumption

Normal distribution among variables ensures errors are normally distributed and a plot of residuals values will estimate a normal curve (Keith, 2006). This assumption was examined using Skewness and Kurtosis as shown on Table 4.7.

Table 0.7: Normal Distribution Test

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
Perceived Ease of Use	100	-.793	.241	.626	.478
Perceived Usefulness	100	-.863	.241	.523	.478

Source: Field Data, 2019

Based on Table 4.7, both perceived ease of use and perceived usefulness variables were normally distributed as skewness-kurtosis values were observed very low below ±2.58 (Stevens, 2009).

4.4.1.3 Homoscedasticity Assumption

Homoscedasticity assumption checks whether there is equal variance of errors among independent variables. It aims to ensure consistency spread of errors among variable for easy interpretation of the estimate predictions (Stevens, 2009). The assumption was testedby plotting standardized residuals against predicted values as depicted on Figure 4.4.

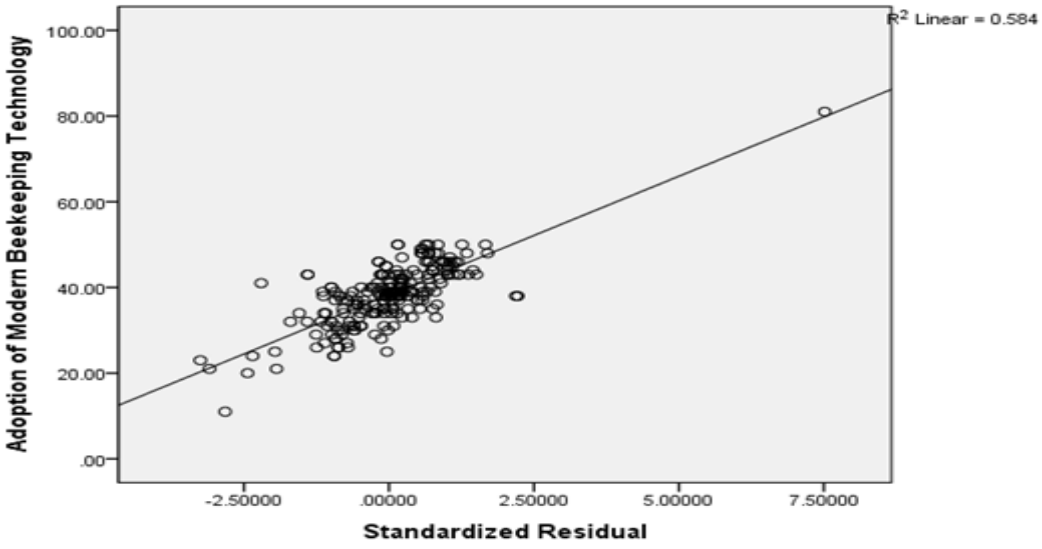

Figure 0.4: Scatter Plot Showing Homoscedasticity Test

Stevens (2009) suggest homoscedasticity tend to be satisfied when there is random scatter creating even distribution of residuals across horizontal line as shown on Figure 4.4.It is therefore affirm that, the requirement of the assumption was statistically met.

4.4.1.4 Autocorrelation Assumption

Autocorrelation sometimes is referred as independence of errors. This test assumes errors among variables are independent from one another suggesting that subject respond independently (Keith, 2006). The assumption was tested using Durbin-Watson coefficient as suggested by Field (2009).

Table 0.8: Durbin-Watson Showing Autocorrelations Test

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.963[a]	.926	.925	6.488	1.802

a. Predictors: (Constant), Perceived Usefulness, Perceived Ease of Use

b. Dependent Variable: Adoption of technology

Source: Field Data, 2019

Table 4.8 obtained that, Durbin-Watson coefficient fell within acceptable range of values (1.8) with a basis of rule of thumb. Field (2009) suggest that, Durbin-Watson coefficient between 1.5 and 2.5 indicate absence of autocorrelations among independent variables.

4.4.1.5 Multicollinearity Assumption

This assumption check if independent variables are uncorrelated, a researcher is able to interpret the regression coefficients to determine effects of independent variables

on dependent variable when collinearity is low (Keith, 2006).

Table 0.9: Multicollinearity Test

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Perceived Ease of Use	.188	5.332
	Perceived Usefulness	.188	5.332

Source: Field Data, 2019

Table 4.9 indicate low multicollinearty among independent variables since tolerance rate was very lowwhereas VIF was large. Keith (2006) suggest large VIF (>5) and low tolerance (<1) imply low collinearity.VIF ranges between 1 and 10while tolerance values ranges between 0 and 1(Stevens, 2009).

4.4.2 Multiple Linear Regressions Analysis

Relationship between dependent and independent variables was examined using multiple regressions after satisfying its five assumptions. Results of the regressions were depicted on Table 4.10 and 4.11.

Table 0.10: Model Summary Results

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.963[a]	.926	.925	6.488

a. Predictors: (Constant), Perceived Usefulness, Perceived Ease of Use

Source: Field data, 2019

As shown on Table 4.10, results reveal powerful relationship between dependent and independent variables as the predictors were found explaining 92.6% of the variation

of the model. In other words, results implies that, perceived ease of use and perceived usefulness have significant relationship with adoption of modern beekeeping technology.

Table 0.11: Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	10.166	4.394		2.314	.023
	Perceived Ease of Use	1.130	.125	.577	9.079	.000
	Perceived Usefulness	.787	.122	.409	6.433	.000

a. Dependent Variable: Adoption of technology

Source: Field Data, 2019

Table 4.11 presents regression coefficients such that, constant value predicts 10.2% of the beekeepers adopts modern technology when they have zero perceived ease of use and perceived usefulness. In addition, both perceived ease of use (Beta=.58, p<.000) and perceived usefulness (Beta =.41, p<.000) were found as significant predictors of adoption of modern beekeeping technology. Further, the slope for perceived ease of use was 1.13. This implies that, when perceived ease of use increase by 1 unit, adoption of the technology increases by 1.13. Besides, the slope of perceived usefulness was 0.787. This implies that, when perceived usefulness increases by 1 unit, adoption of modern beekeeping technology increases by 0.787. Based on Table 4.17, regression model equation was developed as follows;

From

$$Y = \alpha + x_1\beta_1 + x_2\beta_2 + ..x_n\beta_n + \varepsilon$$

Then,

$$y = \alpha + PEOU\beta_1 + PU\beta_2 + \varepsilon$$

Hence,

$$y = 10.2 + PEOU(1.13) + PU(0.79)$$

4.4.3 Moderating effect of Intervening Variables on Adoption of Modern Beekeeping Technology

Path analysis was employed to determine moderating effects of intervening variables on dependent variable. Preacher et al. (2016) suggests that, path analysis is useful when effects of independent variables depend on the effect of another variable known as moderator. In this case three intervening variables were involved in the analysis which is demographic, socio-economic, and institutional factors.

To determine this relationship, six hypotheses were theorized as follows;

Ho: Demographic factors have moderating effect on adoption of modern beekeeping technology.

Ha: Demographic factors have no moderating effect on adoption of modern beekeeping technology.

Ho: Socio-economic factors have moderating effect on adoption of modern beekeeping technology.

Ha: Socio-economic factors have moderating effect on adoption of modern beekeeping technology.

Ho: Institutional factors have moderating effect on adoption of modern beekeeping

technology.

Ha: Institutional factors have no moderating effect on adoption of modern beekeeping technology.

Path analysis was drawn and calculated using partial least square - structural modelling equation software known as smart PLS version 3. Results were depicted on Figure 4.5 portraying that, intervening variables have insignificant low moderating effect (0.026) on dependent variable. In other words, demographic, socio-economic, and institutional factors fairly influenced adoption of modern technology among beekeepers. Besides, intervening variables moderates negatively (-0.027) independent variables on dependent variable. This is to say that, ease of use and useful and usefulness are negatively moderated by demographic, socio-economic, and institutional factors towards adoption of modern beekeeping technology.

More specifically, ease of use and usefulness have a powerful direct effect on adoption of the technology explaining 96.6%. However, these variables have also indirect effect on the modern technology adoption by 16%. In case of moderators, institutional factors were found with highest moderating effect accounting between 19.5% and 88.1%, followed by socio-economic factors which accounts between 65.5% and 66.6%, whereas lowest moderating effect accounted by demographic effect was between 35.6% and 36.5% respectively. Subsequently, both intervening and independent variables have significant powerful moderating effect on modern technology adoption as they accounts for 92.6% variation.

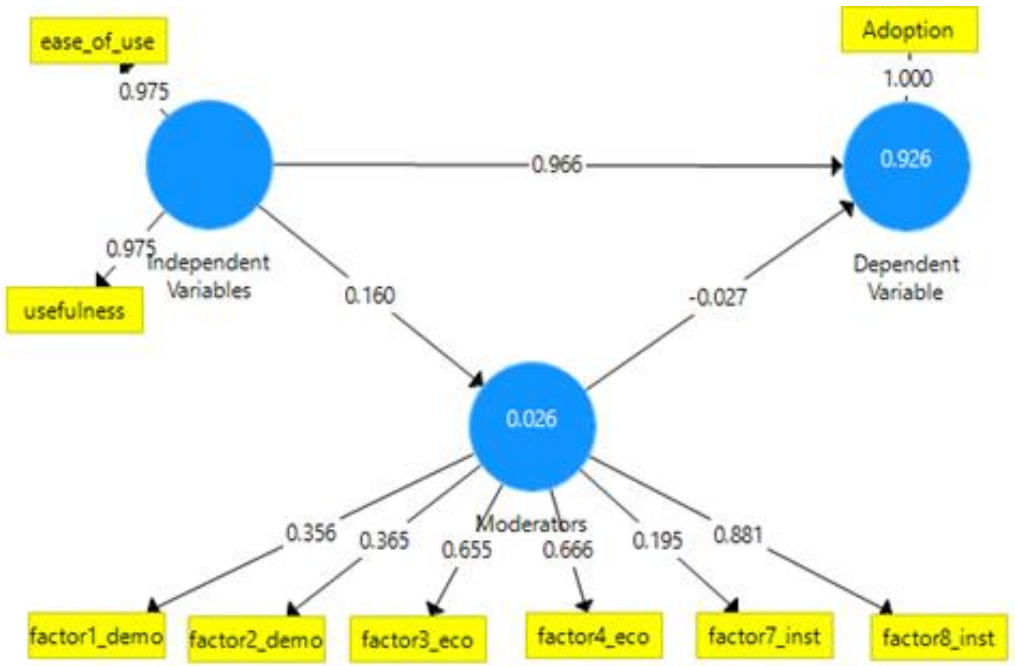

Figure 4.5: Path Analysis Showing Moderating Effect of Intervening Variables

Whereas;

Independent Variables

Ease_of_use: Perceived Ease of use

Usefulness: Perceived Usefulness

Dependent variable

Adoption: Adoption of technology

Moderating variables

Factor1_demo: Family Size

Factor2_demo: Education status of the household head

Factor3_eco: Size of land

Factor4_eco: Cultural beliefs

Factor7_inst: Access to price information

Factor8_inst: Access credit service

Considering the forwarded six hypotheses of path analysis, Figure 4.5 depicts that, there is no moderating effect between demographic factors and technology adoption thus null hypothesis was rejected. Also, socio-economic factors have moderating effect on dependent variables implying that, the null hypothesis was accepted. Further, institutional factors were found to have moderating effect on adoption of modern technology indicating that, null hypothesis was accepted.

4.5 Discussion of the Findings

4.5.1 Factors Affecting ease of Use of Beekeeping Modern Technologies

Based on the analysis of the findings, several factors were deemed significant and greatly affects ease of use of modern beekeeping technologies. These factors include demographic, socio-economic, and institutional factors. Results implies that, ease of use of the technology is associated with level of education, age, family size, and sex of the household heads. For instance, majority of the beekeepers adopting modern technology were found to have at least 3 family indicating availability of working labours.

Moreover, the beekeepers had at least primary education with 3 to 5 years of beekeeping experience. With regards to socio-economic factors, majority of modern technology adopters were significantly not beholders of cultural beliefs and occupied large size of land. For instance, majority owned average of above 3.7 hectares of land. Same instance can be also referred in the position of ownership of mobile phones and radio. Additionally, adopters of modern technology were also found to have higher access to credit service and price information compared to non-adopters of technology.

Present findings were in line with Hailesselassi (2016) who also found an evidence for significant difference between adopters and non-adopters of modern beekeeping technologies in terms of educational level, labour availability, and access to loan services particularly among household heads. Similarly Al-Ghamdi et al. (2015) revealed relative higher number of the technology adopters have higher education level with an experience up to 10 years in beekeeping. Abeje et al. (2017) also suggests that, decision of beekeepers towards adoption of modern technologies is more likely to be affected by educational level, livestock number, and number of local hives. However, their results also identified several factors including pests and predators, insufficient bee accessories and equipment, and drought as major constraints towards adoption of modern beekeeping.

At different perspective, Kleij and Simukoko (2012) stresses that, gender aspect can also be subjected in this discourse of factors affecting technology adoption. For instance, their results found beekeeping practices were predominantly a male occupation in Zambia. The scenario was seemingly associated with the nature of this business as it requires physical strength such as climbing for honey collection. Also, honey harvesting requires high amount of time which on the other hand may interfere with domestic responsibilities of women. Results are therefore providing number of evidences that, adoption of technology is affected by number of different factors as discussed in this section. However, these factors may also be related with gender aspect among beekeepers.

4.5.2 Level of usefulness of Modern Beekeeping Technologies

Results of the present study highlights that, for the past three years (2016.2017, and

2018), there have been an increasing trend of using modern technologies particularly top bar and commercial hives. For instance, results suggest that, number of adopters of commercial hives have increase from 5% to 10% whereas top bar hives adopters have increased from 13% to 17% in 2017 and 2018 respectively.

However, there are significant indices suggesting the domination of local beekeeping technologies among beekeepers as it is more widely adopted by majority approximately 78% of the beekeepers. Despite its remarkable higher usage, local technologies are currently dropping due to an increasing rate of modern technologies. This implies that, modern beekeeping technologies tend to be more useful compared to local technologies regardless of the number of constraints facing its adoption.

Current findings are in harmony with Njenga et al. (2016) whom results suggests that, sociocultural factors have great influence on adoption of modern technologies. Their findings claim an increase or decrease trend of the technologies adoption relies on sociocultural influences such as family size, sex, and marital status as they can have either positive or negative impact on adoption of technologies. Conversely, Nwaobiala (2014) claims that, the trend of modern technologies can be affected by non-adoption rate of the technologies due to various reasons. For instance, his results show that, technology complexity, technology adaptability, and technical competency have significant influence on non-adoption of modern beekeeping technologies. In the same vein, Sharma and Das (2018) found level of adoption of modern technologies increased more among beekeepers with adequate beekeeping equipment, sufficient capital, and protection against pests and predators.

4.5.3 Extent to which Perception of Modern Technologies Facilities Influence adoption of the Modern Technology in Beekeeping

The relationship between perceived ease of use, perceived usefulness and adoption of modern beekeeping technologies was found significantly positive with regards to findings analysis. The variables were found to explain 92.6 of the model variation indicating powerful effect on adoption of technology. Result implies that, perceived usefulness and perceived ease of use of technology suggest the position of beekeepers on decision towards adoption of modern beekeeping technologies.

With consistency to present results, Eforuokuand Etukudo (2017) also revealed significant relationship between perception of beekeepers and adoption of modern technology. Their result suggests that, attitude, knowledge, and demographic characteristics such as education and age have strong link to effective use of technology. Besides, beekeepers who highly participated on training were highly knowledgeable on modern technologies. Yehuala et al. (2013)ô findings were also in line with these results such that, perception of beekeepers towards adoption of technology was likely to be influenced by participation in training and demographic variables such as land holding size, participation in farmers associations, sex, availability of labour, and age.

In the same vein, Gebremichael and Gebremedhin (2014) stresses that, beekeepers perceives adoption of technology enhance quality and quantity of honey and avoid bee mortality. In addition, their results found that, adoption of improved box hive technology positively influences profitability than traditional hives.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of the Study

This study intends to assess the perception of beekeepers on adoption of modern technologies in beekeeping. It comprises three specific objectives namely, factors affecting ease of use of beekeeping modern technologies, level of usefulness of the technologies, and the effect of perceived of ease of use and perceived usefulness on adoption of modern beekeeping technology.

Prior to analysis of the specific objectives, the study conducted reliability and validity analysis. The reliability of the research tools was found high reliable based on Cronbachôs Alpha coefficient. On the other hand, the instruments were significant valid with regards to test re-test observation conducted on pilot study. Additionally, demographic characteristics analysis was conducted to assess gender, educational level, age, marital status, and experience of the beekeepers. Results show that, males were higher in number compared to females (Table 4.1).Majority were youth aged between 20 and 30 (Table 4.1). In terms of educational level most of the beekeepers possess primary and secondary level of education (Table 4.1). Further, majority were found married with experience from 3 to 5 years of beekeeping activities.

The first objective used one sample T-test to assess factors affecting ease of use of modern beekeeping technology. Results revealed three categories of the factors namely, demographic, socio-economic, and institutional factors. In particular, demographic factors includes family size and education status, sex, and age of the household head (Table 4.2). Socio-economic factors includes size of land, cultural

beliefs, ownership of mobile phone and radio (Table 4.3). Institutional factors includes access to price information and credit service, distance to input and product market (Table 4.4).

The second objective employed descriptive statistics to assess the level of usefulness of modern beekeeping technologies. It involved the assessment of the three past years with regards to usage of both local and modern beekeeping methods. Results revealed local technology was more useful compared to modern technology due to its usage level. However, the usefulness of modern technology increases based on the trend of usage among beekeepers whereas usage of local technology declines substantially (Table 4.5).

The third objective was examined using multiple linear regressions to assess the relationship between dependent and independent variables. Before the analysis five assumption of the regressions were tested including linearity (Table 4.6), normality (Table 4.7), autocorrelations (Table 4.8), homoscedasticity (Figure 4.4), and collinearity (Table 4.9). Thereafter, multiple regressions were carried out, results found independent variables were powerful explained 92.6% of the model variations (Table 4.10).

Subsequently, model equation was develop based regression general equation (Table 4.11). Lastly, path analysis was conducted to determine moderating effect of intervening variables. It was found that, demographic factors have no moderating effect on modern technology adoption while socio-economic and intuitional factor accounts for significant variation of moderation.

4.2 Conclusion

This study intends to assess perception of beekeepers towards adoption of modern beekeeping technologies. With regards to the findings, there is strong link between perception and adoption such that, perceived ease of use and perceived usefulness directly influence the extent beekeepers adopts and effectively use modern technologies. This is evident through observed trend of using modern technologies over local technologies in the past three years as more beekeepers tend to adopt more modern technologies than local.

In particular, there are factors that are ascertained to affect adoption of beekeeping modern technologies specifically on ease of use of the technology. These factors are likely to be entailed in three aspects namely demographic, socio-economic, and institutional factors. Position of beekeepers in these aspects determines the extent he/she perceive adoption of technologies. However, there are indices of significant differences between adopters and non-adopters of modern technologies. For instance majority of adopters evinced high socio-economic attainment such as land size, labour availability, and access to input and product information as well as services.

Further, results suggest increase of the level of beekeeping modern technology use and adoption among beekeepers within the past three years. However, despite the increase of modern technologies particularly commercial and top bar hive, local technology still seem a major practice adopted by majority regardless of its drop in these recent years. Considering present findings and the respective peer studies, it can be affirmed that, the extent of modern beekeeping technologies among beekeepers is positively influenced by their perception particularly on ease of use

and usefulness.

4.3 Recommendations

Based on the findings, present study provides various implications on perception and adoption of modern beekeeping technologies. However, there are some issues which were not captured and calls for further investigations. Hereby the recommendations of the study.

i. Government should initiate training programs to beekeepers on the importance of modern beekeeping technologies. Most of the non-adopters were found having no awareness of the role of modern beekeeping technologies. This will change their perception towards adoption and improve technology use.
ii. Further studies should carried out to investigate constraints facing beekeepers

4.4 Areas for Further Studies

Further studies should carried out to investigate constraints facing beekeepers

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APPENDIX

Questionnaire

Dear Respondent,

I, Amina Said, MBA student at Open University of Tanzania currently engaged in a study titled; **Assessment of Beekeepers' Perception on Adoption of Modern Technologies in Beekeeping in the Iringa Region.** In this connection I request you to respond on all items listed in this questionnaire. The information given will be held confidential and used purely for academic purpose only. Thank you

I. Background information

Instruction: Please put a tick in one box only and fill in where necessary

1. Gender:

☐ Female ☐ Male

2. Age:

☐ Below 20 ☐ 20-30 ☐ 31-40 ☐ Above 40

3. Education Level

☐ Primary Education ☐ Secondary Education ☐ Diploma/ Degree
☐ Postgraduate ☐ Not Educated

4. Marital Status

☐ Single ☐ Married ☐ Divorced
☐ Widow

5. Experience

☐ Less a year ☐ 1 year - 3 years ☐ 3 years - 5 years
☐ Above 5 years

Factors affecting ease of use of beekeeping modern technologies Demographic factors

s/n	Statement	Option	Response
1	Family Size	In numbers	
2	Education status of the household head	0) Literate 1) Illiterate	
3	Sex of the household head	0) Male 1) Female	
4	Age of the household head	In numbers	

Economic Factors

s/n	Statement	Option	Response
1	Size of land	In hectares	
2	Cultural beliefs	0) No 1) Yes	
3	Owning a mobile phone	0) No 1) Yes	
4	Owning a radio	0) No 1) Yes	

s/n	Statement	Option	Response
1	Access to price information	0) No 1) Yes	
2	Access credit service	0) No 1) Yes	
3	Distance to input market	(In km)	
4	Distance to product market	(In km)	

Institutional factors

Level of usefulness of modern technologies in beekeeping

Tick in the appropriate box

s/n	Statement	Response		
		2016	**2017**	**2018**
1	**Tanzania Top-bar hive**			
2	**Tanzania Commercial Hive**			
3	**Local Beehives**(i.e. grass hive, gourd hive, log hive, barrel hive, and clay-pot hive)			

Adoption of modern beekeeping technology

The following is a list of key drivers influencing the adoption of new technologies in Beekeeping projects, kindly indicate the ones that affect your group.

Tick in the appropriate box for the level of agreement about the following statements whereas 1=Strongly Disagree, 2=Slightly Disagree, 3= Neutral, 4= Slightly Agree, 5= Strongly Agree

s/n	Statement	Response				
		5	**4**	**3**	**2**	**1**
1	Availability of finance					
2	Timing of projects					
3	Training needs					
4	Age of the beekeeper					
5	Education level					
6	Own land holding status					
7	Average house hold size					
8	Household assets .e.g. livestock					

Farmers' perception on modern beehive technology

Tick in the appropriate box for the level of agreement about the following statements whereas 1=Strongly Disagree, 2=Slightly Disagree, 3= Neutral, 4= Slightly Agree, 5= Strongly Agree

s/n	Statement	Response				
		5	4	3	2	1
1	Modern hive beekeeping is profitable as compared to traditional hive.					
2	Management of modern hive is not difficult as compared to traditional hive.					
3	Modern beehive technology does not need expensive equipment and accessories.					
4	Modern beehive technology gives high quality honey yield.					
5	Modern beehive technology is not vulnerable to different bee diseases.					
6	Modern beehive technology is not vulnerable to different bee pest.					
7	Modern beehive technology is not labor intensive.					
8	You will adopt the technology in the future.					

Thank you for your responses