

**AN ASSESSMENT OF BEEKEEPERS' HONEY PRODUCTION AND PROCESSING PRACTICES IN ABIA
STATE**



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Research Project submitted to the Van Hall Larenstein University of Applied Sciences in partial fulfillment of the requirements for the degree of Master in Management of Development, specialization Food, and Nutrition Security

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DEDICATION

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LIST OF ABBREVIATION

ADP- AGRICULTURAL DEVELOPMENT PROJECT

BSC BACHELOR OF SCIENCE

CEO CHIEF EXECUTIVE OFFICER

FGD FOCUS GROUP DISCUSSION

KII KEY INFORMANT INTERVIEW

LGA LOCAL GOVERNMENT AREA

MOU AU MICHEAL OKPARA UNIVERSITY OF AGRICULTURE UMUDIKE

MSC MASTERS OF SCIENCE

PH.D. DOCTOR OF PHILOSOPHY

SSI SEMI-STRUCTURED INTERVIEW

S

Beekeeping and honey production are beneficial to rural and urban people, the economy, and the environment (bees help pollinate wildflower species). This study examines honey production and processing practices of beekeepers in Abia State, South-East Nigeria, and how these practices affect the quantity and quality of honey in Abia state, Nigeria. The study is commissioned by Apifloral Resources, a training institution whose core business is the dissemination of sustainable eco-friendly beekeeping business and production. Three (3) local government areas: (Ikwuano, Umuahia North, and Isiala Ngwa North) were selected out from the seventeen (17) local government areas in Abia State and thus referred to as the study area.

The research employed a combination of quantitative and qualitative research strategies. This includes a desk research study, a questionnaire with 42 respondents, 15 interviews with beekeepers and key -informants, and a focus group discussion with 10 participants. The data collected were analyzed using descriptive statistical tools for quantitative data and a thematic approach for qualitative data.

Results from the study revealed that the quantity and quality of honey harvested are directly affected by the different methods of honey extraction, processing, harvesting period, type of equipment used, and type of hive used. The study also revealed constraints affecting honey producers spinning from honey hunters, bee absconding, excessive rainfall, and financial inadequacies. It is concluded these methods are not standardized across the different types of beekeepers identified and hence, results in low levels of honey produced in the study area.

The recommendation that can contribute to bolstering the level of honey production in the study area includes that includes a partnership with the ADP in Abia state, to carry extension service to beekeepers, and impact assessment of previous training, collaboration with NGOs and village head to manage the activities of honey hunters. Apifloral Resources should incorporate into his beekeeping training sustainable ways beekeepers can prevent pests from invading hives, and promote forums where beekeepers can be instructed on sustainable beehive management.

Chapter 1: INTRODUCTION

1.1 Background of the Study

In many countries today, beekeeping and honey production have become important agro-economic activities because of the important roles bees and bee products (such as honey and beeswax) play in preserving natural ecosystems, improving crop yield, and generating personal income, beekeeping is now considered an integral component of agriculture, rural development, and national economic development. (Moshunga et al 2019). For many millennia, humans have benefitted from bees, primarily, these benefits were in the form of the pollination of farm crops and fruits for human consumption, but with the evolution of several aspects of human existence, honey and other bee products became an integral part of the mix. (Lehébel-Péron et al. 2016), (Pilati and Prestamburgo 2016), (Bourkaa, 2013).

1.1.1 Historical Background of Beekeeping Around the World

The idea of beekeeping has been with man from time immemorial. According to (Eroglu & Yuksel, 2020), the very first depiction of an apiculturist was discovered in the murals in the year 1919, in a cave in Valencia, Spain. From these depictions, it was deduced that apicultural practice has a history of around 15,000 years. Also in recent years, scientists have discovered 3,200 years of dried honey in the series of studies conducted in the Pharaoh tombs in Egypt. According to the tablets discovered, it shows that historically, Egyptians have used honey for food, for medicinal purposes as well as for religious purposes dated back to 4,000 years ago (Ogbari & Ogbari, 2014; Eroglu & Yuksel, 2020).

According to (Dike et al, 2016) every year, the global trade in bee products is worth millions of dollars, and global honey consumption is so high that supply rarely meets demand. At the moment and in many countries of the world, beekeeping is one of the commonest agricultural practices (Yusuf et al. 2017). Based on extensive research, it has been discovered that there are around 56 million beehives spread in various countries and locations around the world, and approximately 1.2 million tons of honey are processed from them. The world market of honey is dominated by 20 honey producer nations, with China controlling the most beehive assets and producing about 211 thousand tons. The rate of honey production in China increased from 25,200 tons in 2001 to 505,000 tons in 2015, which may be linked to government sponsorship of beekeeping research (Xie et al. 2015). Other countries in this category of the world's top honey producers and exporters are; United States of America (USA), United Kingdom (UK), Italy, Germany, Japan, Austria, France, Switzerland, and many other EU countries (Eroglu & Yuksel, 2020). Globally, there are over 20,000 species of bees, with many yet to be classified (Patel et al, 2021). But the one with the most significance for its honey and other bee products is the Honey Bee (Vallido et al, 2018).

Ethiopia is Africa's largest honey producer and one of the top 10 in the world (Dong et al. 2016). Ethiopia has a wealth of flora and animals, which provides adequate nectar and pollen for foraging bees; the country has over 10 million honeybee colonies, and one out of every ten Ethiopian rural homes practices bee production (Kinati et al. 2012; Akessa 2016). Beekeeping is prevalent in Zimbabwe's eastern forestry areas, where it is generally linked with agricultural activities such as crop and animal production, as well as agroforestry (Mazorodze 2015).

1.1.2 Beekeeping in Nigeria

Africa is estimated to have 10% of the world's bee population, with Nigeria being one of the largest reservoirs. Records of primitive beekeeping practice in Nigeria can be traced back to the Zuma people of Zaria in Kaduna State, whereas modern beekeeping began at the International Institute of Tropical Agriculture (IITA) farms in Osun and Oyo States. Onwubiko et al (2016). Available records showed that between 1000 and 1500 AD, some Arab travelers in West Africa whose geographical inclusion comprises of some present-day Northern Nigeria, were involved in some trading activities. According

to (Adeyemi, 2015), beekeepers in Kaduna State, Nigeria use unbaked or mud hives, gourds, and calabashes with capacities ranging from 5 to 15 liters that are placed on trees 3 meters above the ground. Traditional beekeeping in trees is often done by men, whereas women own and harvest bee nests in pots and other ground structures. Part of what was traded at the time was the use of honey because of the acknowledgment of beehives from where honey was made (Azaiki, 2013). Also, (Akinwande *et al.* 2013) opined that beekeeping has been part of the normal traditional agricultural enterprise of the Oyos in Okeogun and Tivs in Benue.

Onwubiko and Onwuka (2016) found some of the taboos that previously prevented the people in Abia state from engaging in beekeeping. Bees are considered taboo in Abia State localities such as Amarchi Nsulu in Isiala Ngwa and Ukwu (Abia South) when they congregate around residences. Bee clusters are interpreted as an omen indicating that something awful is about to happen to the family or as a symbol of wicked activities committed by some members of the community. When a bee hovers about a person's home, it indicates that a guest is on the way. The presence of bees surrounding homes is linked to the anger of gods caused by the people's crimes in Ikwuano and Ibeku communities (Abia Central). Onwubiko and Onwuka (2016).

Today both traditional and modern beekeeping exists in almost all states in Nigeria. The traditional beekeepers make use of locally made hives such as gourd hive, clay pot hive, straw hive, and sometimes, hollow tree trunks hive. According to (Nwaihu et al, 2015), one of the advantages of this type of beekeeping is that it does not require a big plot of land or land ownership as the locally made hives are placed in the open forest. Secondly, it has served as a source of income for the rural people who practice this type of beekeeping, thus helping to reduce hunger. However, during harvesting, the locally made hives are crudely broken, then using smoke to suppress the bees without ensuring that harvesting was due. Many times, eggs, larvae, and pupa are harvested along with honey and the comb, which often lead to poor quality of products, delay in the time of re-colonization of the hive by bees, and sometimes total absconding from the hive by the bees. These disadvantages led to some beekeepers adopting modern beekeeping which involves better hive construction to ensure proper bee management. The modern beehives include (a) the Kenyan top-bar beehive (b) the William Broughton Carr beehive and (c) the Langstroth beehives used in America, Britain, Israel, and Nigeria. The modern beehives are also referred to as frame beehives and they allow periodic inspections to be made without unnecessarily disturbing the bees. Modern beehives are used mainly for commercial bee-keeping. while the traditional beehives are for small-scale bee-keeping. (Malaka & Fasasi, 2005).

However (Ebe et al., 2021) found that the productivity of the beekeepers in Ohafia agricultural zone of Abia State was 4.25kg/N. This indicates that beekeeping is profitable in Abia state's Ohafia agricultural zone. This is supported by evidence that beekeepers need to raise their production even more, because high productivity shows great beekeeping efficiency, and an effective beekeeper is assured of high company profitability. This follows an early study by (Dike & Onwuka, 2016), which found that entrepreneur perception, which stood at 89.40 percent, had a strong beneficial impact on the expansion of beekeeping in Nigeria's Abia State.

Honey is that thick, natural sweet substance made by honeybees from the fluid (nectar) of flowers (Babarinde et al., 2011; El Sohaimy et al., 2015; Liyanage & Horadugoda, 2017; Parson-Jacobik et al., 2020). In the broad and general context of apiculture, honey production and processing are an integral part and the economic base of this apicultural practice. According to a report by Grand View Research, In 2020, the global honey market was estimated at USD 9.21 billion, with a compound annual growth rate (CAGR) of 8.2 percent projected. High demand for nutritious food products, such as honey, is a prominent driver driving market expansion, as people become more aware of the benefits of living a healthy lifestyle.

For professional beekeepers in Nigeria, honey production has always been export-driven, while beekeepers from rural areas control the home market. Although the local consumption rate of honey in Nigeria is not known, data from the National Apiculture Platform put it at 380,000 tonnes in 2017, with a global price of around \$4.5 billion. (Chibuzor, 2021). The goal currently is to increase the amount of honey produced to service a wider and more diverse market of honey consumers, both locally and globally. (Chibuzor, 2021). Furthermore, the health benefits of honey cannot be overstated. Honey is widely utilized in the pharmaceutical and beverage industries as a pleasant-tasting food component, a sweetener for food and beverages, and a therapy for superficial wounds, sore throats, and other ailments. (ADP, 2007). Honey has also been proven to serve as a natural sweetener, and it is highly rich in carbohydrates, with a blend of glucose and fructose, and a small amount of sucrose (Chigbo & Ahaotu et.al, 2020).

1.2 Honey Consumption in Nigeria

Honey consumption has expanded over the world and is also predicted to increase from 2021 to 2028 at a compound yearly growth rate of 8.2% reaching USD 17.34 billion, as consumers have become more aware of its nutritional benefits in maintaining good health and treating various diseases. (Ismail et al., 2014; Cosmina et al., 2016; Grand View Research, 2020). With an increased output of honey obtained from tamed bees around the world, the enormous gap between supply and demand for honey has narrowed.

In 2017, Nigeria produced about 15,000 tonnes of honey, which is less than 3% of her potential production of 800,000. (Ayodele, 2017). However in 2018, Nigeria's production of honey liquid was two million metric tons, but the predicted production may be more than 20 million tons in years to come. A lack of effective record keeping in collecting the country's national output statistic is another concern harming the Nigerian beekeeping sector. (Abbas 2018; Chibuzor, 2021). However, with an enormous forest base and expansive agricultural lands, and diverse flora and fauna; there is enormous potential for foreign exchange earnings in beekeeping if only the government would look towards the direction to expand honey production. Although the government is trying so hard to diversify the economy and reduce its excessive concentration on revenue from crude oil, beekeeping provides a whole world of opportunity for additional revenue generation (Chibuzor, 2021).

According to the report by the Ministry of Agriculture and Rural Development, Nigeria consumes roughly 320 tonnes of honey per year but only produces about 20 tonnes. (Ayodele, 2017). According to recent forecasts based on household honey consumption, Nigeria's yearly honey import bill is around \$30 million. This prediction excludes the amount used by large industrial users such as pharmaceuticals, cosmetics, and beverage sectors, which use various grades of honey in their manufacture. (Alimi, 2021). Honey is in high demand in Nigeria because of its nutritional and therapeutic properties. This is aided by the abundant botanical endowment and natural biodiversity, which makes production extremely profitable. However, reports of available honey's physicochemical and sensory quality vary by state in Nigeria. (Ndife et al, 2014). This also resonates with the study conducted by (Arowosoge, 2018), she discovered that health benefits (96.5%), availability of honey (88.6%), colour and texture (86%), and packaging/branding (79.8%) are the factors that influence honey consumption in Ekiti State, Nigeria. It is appropriate to say that people are becoming more health-conscious. Also in Umuahia- North, and South in Umuahia Agricultural Zone of Abia, a study by (Uchechukwu et al., 2019) also showed that some of the factors that affect honey consumption were colour (25%), taste (45%), and low quality of honey (45.83%). However, consumers are exposed to various commodities which tend to change their preferences.

1.3 Apifloral Resources (Beekeeping Training Enterprise)

Apifloral Resources is a beekeeping enterprise established in 2002 and registered as a business entity in Nigeria in 2012. The enterprise has over 400 colonies of bees located in various apiaries within south-eastern Nigeria. The enterprise specializes in producing multiple bees by-products such as honey, propolis, wax, royal jelly, bee venom. The enterprise also offers various training programs in beekeeping to rural dwellers/local beekeepers. The enterprise was born out of the need and strong desire to conserve and preserve the indigenous African bee species, produce high-quality bee products, promote biodiversity, economic empowerment, and food security. Apifloral Resources is an advocate for sustainable beekeeping in southeast Nigeria.

1.4 Research Problem

Ibeneme (2018) through his study discovered that 45.8% of beekeepers in Abia state are small-scale producers, this he pointed out could be a reason for low honey production in the local market. Low production of honey could be the reason why the beekeeping industry is frequently overlooked and it is not regarded as a major economic venture. Olagunju, (2000). Several initiatives have been adopted by the federal and state government to enhance productivity in the apicultural sector such as the Youth for Apiculture Initiative (YFAI) and Nigerian Youth Beekeepers Summit (NYBS). Nonetheless, incomplete success has been achieved after the setup of the Nigerian Apiculture Platform (NAP), there's still a long way to go. (Chibuzor, 2021). There is a growing consensus that the Nigerian government should emphasize sustainable apiculture practices, where the current output is modest but sufficient, to meet the people's future dietary and quality honey needs and stimulate economic development. Honey production has been designated as a national agricultural commodity development priority by the Raw Materials Research and Development Council (RMRDC) and the Federal Ministry of Agriculture to promote its long-term viability as an agribusiness. (Daily Trust, 2020).

Honey has been produced in Abia State for a long time, however, data on the quantity and production methods are sparse. However, because of the enormous demand for honey, there has been an upsurge in honey adulteration. As a result of the honey adulteration, there appears to be a drop in consumer confidence. (Ijeomah et al., 2016) To foster economic development, there is a need to prioritize apiculture at the state level to enhance the high production of quality honey for the local populace and use eco-friendly honey harvesting techniques for honey production. Apifloral Resources lacks the knowledge on the reason why there is low production of honey after training on beekeeping practices has been done for the indigenes of the state.

This study seeks to identify the methods used by beekeepers in the selected local government area in Abia State for honey production and their harvesting techniques that directly or indirectly affect the quantity and quality of honey produced. The findings from this study will help to map out appropriate beekeeping development plans in the study area as well as aid in determining the optimal way of honey production and, as a result, lay the framework for any intervention that could help these beekeepers.

1.5 Research Objective

This research aims to understand the honey production and harvesting techniques that directly or indirectly affect the quantity and quality of honey produced by beekeepers in Abia State. Additionally, this study also aims to propose a recommendation to Apifloral Resources on the adoption of sustainable interventions that will help in improving the quality and quantity of honey production through sustainable beekeeping training

1.6 Research Question

How do the honey harvesting techniques and processing methods affect the quality and quantity of honey produced by beekeepers in Abia State?

Sub Questions

- a. What are the socio-economic characteristics of beekeepers in Abia State?
- b. What are the honey harvesting techniques used by beekeepers in the study area according to their socio-economic characteristics?
- c. What are the honey processing methods used by beekeepers in the study area according to their socio-characteristics?
- d. How do the beekeepers in the study area assess the quality of honey they produce?
- e. What factors determine the quantity of honey produced by the beekeepers?
- f. What are constraints faced by beekeepers that affect their honey production and processing in the study area?

1.7 Justification for the study

Different scholars have looked into different aspects of honey processing and production in Nigeria. Some of those studies include: Onwumere, Onwukwe & Alamba (2012), Akinwande, Badejo & Ogbogu (2013), Abdulahhi, Isekenegbe & Mohammed (2014), Ibegbulem (2014), Ogbari & Ogbari (2014), Senchi & Malami (2015), Ajao & Oladimeji (2015), Ojo (2016), Akinmulewo, Oladimeji & Abdulsalam (2017), Labe (2017), Babatunde & Omotesho (2017), Ndu (2017), Akinade (2019), Onisile & Philips 5 (2019), Alarape, Wahab & Arira (2020), Chigbo & Ahaotu et.al (2020). However, despite these studies and their contribution to knowledge, it is imperative for the commissioner to identify the different aspects of honey production and processing practices in the study area used by beekeepers. Therefore, this study would enable the commissioner to develop strategies that would integrate current practices with eco-friendly sustainable practices to increase the production of good and pure honey with Abia state.

Chapter 2: LITERATURE REVIEW

The literature review covers the conceptual framework of the research, the concept of beekeeping, a review of beekeeping practices in Nigeria, beekeeping factors that influence honey production in Nigeria, honey production and processing practices of beekeepers in Nigeria, honey harvesting techniques, and constraints of effective honey production.

2.1 The Concept of Beekeeping

2.1.1 Agriculture in Nigeria

Nigeria has a population of 180 million people, according to World Bank estimates, and a GDP OF N18.3 trillion. The Nigerian economy is divided into two parts: the oil sector and the non-oil sector. Agriculture is a non-oil sector in Nigeria. Crop production, livestock, forestry, and fishing are the four sub-activities of agriculture in Nigeria. Agriculture generated 22.35 percent of the overall Gross Domestic Product between January and March 2021, (Varrella, 2021). Over 70% of Nigerians partake in agriculture, primarily at a subsistence level. Despite its importance to the economy, Nigeria's agriculture sector suffers numerous obstacles that have a negative influence on productivity. These include a deficient land tenure system, insufficient irrigation farming, climate change, and land degradation. Others are low technology, high production costs and inadequate input distribution, restricted financing, substantial post-harvest losses, and limited market access. (FAO, Nigeria). This situation leads to low agricultural output in general and, as a result, poverty among those who rely on agriculture. As a result, finding sustainable ways of farming, such as beekeeping, that are both complementary and promote biodiversity, becomes critical for the agricultural dwindling in Nigeria. (Ibukun, 2016)

Beekeeping, according to Onwubuya et al. (2013), is the process of keeping and managing honeybee colonies in hives built by humans. The management of bees in the hive establishes ownership of the bee colony. Apiculture is widely regarded as a sort of animal husbandry as long as a honeybee is an animal. Beekeeping is an important element of agriculture all around the world. It can be done as a primary activity or as a secondary part-time activity. Beekeeping is frequently done on a modest basis. Land ownership is virtually unneeded in beekeeping, and beekeeping can be performed in both cultivated areas and natural ecosystems. Beekeeping operations can either be stationary or migratory, where the beekeeper moves colonies of bees in pursuit of honey or for the commercial pollination of crops. (Ibukun, 2016). *Apis Mellifera*, the honeybee, a type of bee, originated in Africa. As a result, honeybees thrive in Africa and other tropical countries in the Caribbean and Pacific. *Apis Mellifera* is the most common African honeybee in Nigeria. It can be found in the wild as well as intentionally kept by beekeepers. (Oluwaseun, 2009)

2.1.2 Beekeeping practices in Nigeria

Honey Hunting

According to (Ibukun Ojo, 2016), honey hunting is practiced in many countries and is frequently associated with subsistence farming. Honey hunting in the wild is a technique to diversify one's food supply while also selling honey as the end product. Honey hunting, on the other hand, involves the use of crude means to harvest honey thus fire and smoke are employed to drive the bees from their nests. It is also capable of igniting forest fires. Honey hunting is the cause of the non-sustainable loss of honeybee colonies and habitat in some locations. The practice of honey hunting has an impact on the ecology since pollination services will no longer be available if the bees are killed by fire. This jeopardizes the honey hunter's livelihood while also increasing the vulnerability of crops and other plants in the region. Furthermore, the honey and wax produced as a result of this method are of poor quality. Honey, for example, can be offered with pieces of honeycomb, ash, and brood (Hilmi,

Bradbear, and Mejia, 2011). In the past and even now in some communities in Abia State, the collection of honey was done via honey hunting practice. The people who practice this are called “Bee hunters” who set hives and trees on fire to harvest the honey (Ijeomah, 2012). Aside from honey hunting, there are two types of beekeeping practices: traditional beekeeping and modern beekeeping.

Traditional Method of Beekeeping

Traditional beekeeping is an ancient practice that has been observed in many parts of the world for centuries now. (Eroglu & Yuksel 2020). Traditional forms of beekeeping have evolved across Africa over the millennia. In this style of beekeeping, the small-scale farmer protects the bee colony in exchange for honey and wax harvests regularly. This protection may be as easy as allowing bees to occupy a hole in a wall, a clay pot, or a basket connected to a tree branch. This allows the beekeeper to gather honey without killing the colony or jeopardizing the bees' vital pollination functions. Traditional beehives are a highly successful technology that may be found throughout the world. Traditional hives are, however, becoming less popular because of the lack of large logs, which are commonly used to construct such hives. (Ibukun Ojo, 2016).

Most of the rural dwellers that engage in traditional beekeeping have several benefits that accrue to them as a result of such practice; like income generation from the sale of bee products and thereby providing themselves with employment opportunities and less reliance on society for their means of livelihood (Ajao & Oladimeji, 2013). For example, in Nigeria, traditional beekeeping has been known to employ the use of locally sourced hives and this ranges from one part of the country to another. In Zaria, for instance, a Northern state in Nigeria, traditional beekeeping was done through the making of hives on trees. The Kanuri people also employ the use of calabashes in trees as beehives. Coming to the southern parts of Nigeria and as observed in some states, traditional pots are kept on the ground, serving as hives in bee farming. In many Eastern states in Nigeria, palm wine is employed to attract bees to the already created traditional hives (Ajao & Oladimeji, 2013; Ogbari & Ogbari, 2014; Alarape, Wahab & Arira, 2020).

Regardless of the type of hive utilized, the core principles of traditional beekeeping in Nigeria are the same. To provide proper access for bees, entrance holes are dug. The hives are hung from trees at a convenient height. To attract bees, suitable bee baits are usually placed in the hives. Most of the time, once the hives are set up, the beekeepers don't return until the conclusion of the season (harvesting time).

The Modern Method of Beekeeping

Modern beekeeping involves the use of specially constructed hives in the shape of boxes with moveable frames separated by space for bees to attach their combs to the frames. With larger colonies, modern beehives enable honeybee colony management and the employment of higher-level equipment. This enables large-scale beekeeping. The hives not only allow for ownership of the bee colony and its products, but they also make harvesting honey easier because bees may be kept closer to the farm household and can be relocated more easily. (Ibukun Ojo, 2016)

Modern beekeeping arose in most states in Nigeria with the advent of the Agricultural Development Project (ADP), and farmers began receiving training in modern beekeeping, transforming beekeeping into an agro-enterprise. As a result, ADP began promoting improved box hive technology in the country to boost the quantity and quality of honey production, as well as beekeepers' capacity for better management of bees and hives for honey and other by-products. Ebe et al (2021). Modern apiculture technology (better beehives and accessories) has enabled bee colonies to be relocated from the bush to the garden and from trees to the ground. This has enabled different people from all walks of life to participate in beekeeping.

Modern beekeeping technologies seek to maximize honey crop yield season after season while minimizing harm to the bees (Nicola, 2002). Modern beekeeping entails the use of modern hives and hive equipment such as smokers and bee attire with veils and gloves, allowing beekeepers to work during the day rather than at night. The Langstroth hive, horizontal hives, and Kenya top bar hives, which are prevalent in the South Eastern States, are among the modern hives used in Nigeria. Nonetheless, Babarinde, et al (2011) pointed out that there are broadly two methods of harvesting honey which are the traditional and modern methods of harvesting. These harvesting methods, however, may have various effects on the quality and acceptability of the honey, as well as give the impression of adulteration when displayed on shelves.

2.2 Beekeeping factors that influence honey production in Nigeria

Several scholars have demonstrated that there is a link between people's socioeconomic status and beekeeping (Ebojei, Alamu, and Adeniji, 2008; Fadare, Ojo, and Imoudu, 2008; Lawal and Banjo, 2010). Fakayode, Babatunde, Olowogbon, and Adesuyi (2010) accept that beekeepers' economic performance is influenced by socioeconomic factors. To some extent, a person's managerial competence and access to specific production inputs are influenced by his age. Beekeeping experience is an important factor determining both productivity and production level in farming. But the effect of farming experience on productivity and production may be positive or negative. Fadare et al. (2008) opine that successful beekeeping is directly related to experience. In farming, agricultural experience is a key component in determining both productivity and output. Successful beekeeping, according to Fadare et al. (2008), is correlated with prior experience.

According to other studies (Micheal, 2008; Yahaya and Usman, 2008), many beekeepers have little or no experience. This is because modern beekeeping is a relatively new venture in many parts of Nigeria. This has ramifications for the level of beekeeping skill acquisition and exposure that these farmers have. In general, farming experience appears to have a good influence on beekeeping up to a certain number of years, after which it appears to have a detrimental effect. The number of hives or bee colonies owned in an apiary determines the size of a bee farm. This explains why production capacity varies. On a farm or homestead, an apiary is a site where honeybee colonies are kept. According to Abebe (2011), beekeeping does not necessitate a huge or fertile plot of land. It is possible to utilize uncultivated land. Even landless farmers with little parcels of land near their dwellings might participate in beekeeping.

According to Jony (2011), the number of bee colonies has a significant impact on honey production and income. This implies that the greater the number of colonies, the greater the income earned by beekeepers. This is plausible because beekeepers who have more colonies obtain higher income than those with a small number of colonies. A comparable finding by Mbah (2012) shows that the number of hives was positively significant with the output of honey. This was supported by the findings of Sekumade (2005), who obtained a similar result in a related study. However, according to the literature, the majority of beekeepers had between 20 and 40 bee colonies (Secumade, 2005; Babatunde et al., 2007; Yahaya and Usman, 2008). This shows that the majority of the beekeepers in the country are small-scale farmers.

This also transcends to the number of beehives owned by individual beekeepers either traditional or modern beekeepers. The amount of honey harvested or the amount a farmer expected to harvest at the end of the harvesting season is represented by the number of hives owned. The more the number of hives held, the more honey is harvested, and therefore the desire to diversify beekeeping products through value adds to establish a diverse economic source. The extent of value addition is influenced by the decision to add value (Ibukun Ojo, 2016).

Education is a critical tool for enhancing human capacities and achieving socio-economic development goals. A person's level of education is a key component in determining his or her capacity to make decisions about production, sale, and enterprise selection. Education gives farmers access to a variety of sources of information in their field of interest, which increases their learning capacity and farm management techniques. Divergent perspectives exist on the relationship between education and beekeeping. According to Tijani et al. (2011), years spent in formal schooling had a direct association with annual beekeeping revenue. According to Ajao (2009), having a good literacy level will aid in the understanding and implementation of modern beekeeping techniques. According to the findings of Fadare et al. (2008), respondents with a high level of education (60 percent have a secondary school education or more) will be able to acquire essential information that will promote honey production. Jony (2011), on the other hand, claims that beekeeping does not necessitate any special training. According to his research, educational attainment has no bearing on honey-producing earnings. This means that anyone, whether educated or not, can start a beekeeping business.

Training is a critical component in the growth of the beekeeping business (Pal and Thomas, 2002). An examination of the literature on extension training reveals a statistically significant relationship between extension training and yield (World Bank, 2008; Collett, 2009). According to Abebe (2011), training is critical for raising awareness of beekeeping technology, developing beekeepers' self-confidence in the technology, and increasing beekeeper productivity. According to Gezahegne (2001), there is a dearth of competent employees for beekeeping management, post-harvest handling, processing, and quality control of bee products, which contributes to the beekeepers' knowledge gap. Inadequacy in skills, according to Kugonza and Nabakabya (2008), can be solved by strengthening extension, particularly through the employment of the field school technique with active apiary demonstrations. (Ibukun Ojo, 2016).

Training may have a favourable impact on beekeeping, which can be explained by the fact that it teaches the skill to beekeepers. This will help them handle difficulties connected to beekeeping techniques, build product market links, and manage the natural and cultivated forests from which the bees sustainably harvest pollen and nectar. This will assure the enterprise's survival. Furthermore, training might help beekeepers produce and market their products at a high market value, which could help them improve their source of income and provide an ideal opportunity to make more revenue.

2.3 The Notion of Beekeeping and Women

Due to a combination of cultural and social considerations, as well as practical limits, beekeeping has traditionally been a male-dominated activity in most African countries (Mujuni, Natukunda, and Kugonza, 2012; Nel and Illgner, 2004; Shackleton, Paumgarten, Kassa, Husselman and Zida, 2011). Barriers to women's engagement in beekeeping operations were recognized by Qaiser et al. (2013) and Ejigu et al. (2007) as steps in the process that women, particularly young women, are less likely to do, such as colony transfer, queen catching, harvesting, and hive moving. As a result, the authors urge that women-specific training sessions be provided. Woldewahid et al. (2012) distinguish between traditional beekeeping as a supplemental income practice and "market-oriented improved beekeeping," the latter of which focuses on value chain growth and innovation to make the profession a primary source of income. The authors discovered that female-headed households used the conventional system more frequently than the market-oriented approach, implying that one barrier to participation could be higher input costs. Bianca et al., (2015).

An earlier study conducted by Ojo (2016) on the effect of beekeeping on the poverty status of women across two states in Nigeria: Ogun and Kaduna respectively revealed that *"young and active female population group dominates beekeeping in the study areas, with younger beekeepers from Kaduna State group."* In Nigeria, there have been several projects ongoing to involve women in beekeeping

operations, RFS (Resilient Food Systems) did an initiative to train women in beekeeping. The women were taught the skill of apiculture, including how to build, colonize, and manage hives throughout the year. They built their beehives out of inexpensive and readily accessible materials. The women were trained in groups on how to achieve good hive colonization, extract honey, and collect beeswax (RFS Nigeria 2020). Through user-friendly beekeeping technology, USAID has placed a special emphasis on women. USAID taught 1,200 bee farmers on beekeeping pollination services between 2012 and 2017 when the program terminated. According to USAID, it also organized 330 women into thirty beekeeping cooperatives. The USAID program focused on eight states that are especially favourable to beekeeping: Kaduna, Niger, Benue, Ondo, Cross River, Imo, Abia, and Edo. The USAID beekeeping operation in Nigeria operated on a limited scale. However, it hit all the right notes: the creation of a new business with export potential, a rural focus, and women's empowerment (Campbell, 2019).

2.4 Honey production and processing practices of beekeepers in Nigeria

Several countries, including countries in Africa of which Nigeria belongs, can boast of an age-old engagement in bee-keeping activities. For instance, Ethiopia is one country in Africa that has been known for beekeeping practices for centuries now (Hartman, 2004). Although in Nigeria, the practice of beekeeping is relatively a new venture; at least, not as old as in the case of Ethiopia. But even with the low entry of Nigeria into the bee farming arena, several studies have noted the immense potentials of bee farming for the Nigerian economy. Based on a study by Simona (2020), Nigeria has a total of 34million hectares of arable land with 6.5 million hectares dedicated to permanent crops and 30.3 million hectares dedicated to meadows and pastures. With this on the table, Nigeria has a lot of potential for beekeeping because of its vast arable land, flora, and fauna which provide nectar and pollen to foraging bees. However, this potential has largely gone untapped because commercial beekeeping is perceived to be virtually non-existent in Nigeria.

Based on the research conducted by Ajao & Oladimeji (2015), the authors posit that *“there are scanty of dependable statistics on nature of various indigenous bee farming structures, the volume of honey harvested and constraints faced by hunters and traditional beekeepers in most rural settings of Nigeria.”* However, the means and methods being used in the production and processing of honey in Nigeria are informed by the available traditional and modern of honey production and processing. Honey production is still of low quantity in Nigeria and the means of production does not guarantee the continued sustainability of the honey colonies, thereby reducing production and the potential income derivable from it. There have been reports on the widespread destruction of honey colonies due to unethical practices and methods being adopted. For example, Mulatu Wakgari & Gebissa Yigezu (2021) listed some factors to be responsible for the decline in honeybee colonies which are: *“climatic factors, relative humidity, shortage of water, deforestation of floral plants, human factors like poor apicultural practices, synthetic pesticides, diseases, and arthropod pests led to the decline of honeybee colonies and their products.”* There are also abiotic factors which according to VanVan Engelsdoro & Meixner (2010) are unsafe agrochemical pesticides and socio-economic factors.

Traditional beekeeping is an age-long tradition of people and it is also a means of sustenance of many poverty-stricken rural dwellers in Nigeria (Ajao & Oladimeji, 2015). Traditional beekeepers in Nigeria make use of hives which are sourced from local materials like clay pots, woven grass, and other locally sourced materials. The idea behind the hive is to encourage bees to nest in places where they are easily accessible to the bee farmers. The bees in turn build their nest inside the hive, depending on whatever hive type that is provided by the beekeeper. At the end of the day, the beekeeper breaks the nest to obtain honey and beeswax. Now, this process is crude and unsustainable because the bees may be destroyed in this process, although, this depends largely on the expertise of the beekeeper.

After some time, the hives destroyed may remain empty but start to attract other bees that would eventually make the emptied hive their new nest (Ajao, 2012).

Modern beekeeping, on the other hand, follows the notion of a box-like enclosure with removable tops or frames. The combs are housed in a wooden frame inside this box, which beekeepers can remove for inspection. The advantages of framed hives included effective honey harvesting and reduced production costs. In this style of bee management, bees are encouraged to build their combs from the underside of a succession of top bars, allowing beekeepers to inspect the combs regularly to monitor the performance of the established colonies. (Ibukun Ojo, 2016)

Honey production in Nigeria still has not attained that enviable height when compared with other countries around the world and in Africa. Despite the huge potential in honey production and processing, Nigeria still hasn't seen the need to invest in the technological side of it. For example, "Ethiopia produces an estimated 500,000 tons of honey and 50,000 tons of bee wax, generating over \$10m yearly, while Tanzania exports about 750,000 pounds worth of honey" (Kwaifa, 2020). On the other hand, it is estimated that Nigeria imports more than N3bn worth of honey into the country. It is also reported that only about 2000 tons of beeswax and 16,000 tons of honey are produced a year in Nigeria which is grossly inadequate to cater for the local consumption alone, which is estimated to be 380,000 tons per annum (Toriola 2013), talk more of exporting abroad.

2.5 Harvesting Methods Used by Traditional and Modern Beekeepers and the effect on the quality and quantity of honey production

There are two broad methods for harvesting honey which are traditional methods and modern methods. Either of the methods adopted usually has a long-run effect on the final quality of the honey being produced. It has been posited that the traditional method does not produce the goodness and quality that honey possesses at the end of the production. Babarinde *et.al* (2011) opined in their study that the *"lower quality of honey harvested using traditional method could be linked to the adverse effect of the burning during traditional harvesting and this usually create an impression of adulteration when displayed on shelves."* The traditional process usually involves the beekeeper visiting the bee colony that was already established in wood logs and make use of naked fire to destroy the insects to reduce their aggressiveness. Then, the honey, brood, and pollens were harvested together without any form of sorting whatsoever. Afterward, the combs were pressed using manual means for the honey to be extracted.

But one factor that usually precedes any harvesting methods in honey production is to find out whether the honey is matured enough to be harvested. Bee experts have come up with several methods of determining the maturity of honey and one of those methods is by determining the ripeness of the nectar by holding the *"uncapped comb containing honey on its side and give it a good sharp shake. If there is any loose nectar, wait until the ripening process is completed."*¹ On certain occasions, the measurement of proline is used to test honey ripeness.² Also, removing honey from the hives is best determined by what is most appropriate for the beekeepers. Other factors that also come into consideration when harvesting bees are: time of the year, the number of hives available, whether bees are robbing or not, and most importantly, location.¹⁴ Honey harvesting and production are location-specific because methods vary from one place to the other. For example, in some places, bee blowers and escape boards are used thereby allowing the bees to either fly out or walk out.

¹ Doug Somerville, Technical Specialist, Honey Bees, Goulburn

² Proline is an amino acid that can be synthesized by animals from glutamate

In the Pnar community of South Assam, India, the traditional harvesting methods include the lining of a bamboo basket with leaves for the collection of honey using smoke to frighten the bee and storage of honey in the bamboo pipes. The process begins with information gathering, and then it is followed by a definite time fixed for the extraction itself and making of arrangements for the required tools which then culminates into the final cutting of the beehives and filtration (Deori *et.al*, 2016). According to Singh (2014), the Nagaland traditional beekeepers of India were known to eat garlic, ginger, and other edible fruits from the forest and blow the hive to tame the bees. The author noted further that the main collector carries the fire touch to smoke the bees out of the hives. In the Kurumbas region of India, research has it that a person smokes below the hive and the main collector descends from steep rock by a ladder made up of wild creeper. The Nilgiris traditional beekeepers collect honey from beehives also hanging on huge rocks. And so, the use of a rope ladder to swing to reach the hive was therefore adopted. In Sundarban, a region in Bangladesh; Sohela (2013) found that the honey collector climbs up the tree to get to the beehive; while another person holds on to the long stick to ignite smoke from the ground.

There is no fast and hard rule about means of harvesting honey around the world because the methods adopted are similar. In Nigeria for example, Ogbari & Ogbari (2014) found that the traditional honey harvesting practice in Nigeria is similar to what we have seen in other places as documented above. The process involves allowing bees to breed in the wild and then finding and burning the hives to disperse the bees. However, this practice is not without its disadvantage because in the process, the bees are dispersed and some of them, are even killed in the process. But bee experts have concluded that *“the quality of the honey harvest does not depend on the type of hive, but on the care taken at harvesting, the cleanliness of the equipment and the methods used for extracting honey and storage”*³ and this is why honey harvesting methods go a long way in the determination of the honey product at the end of the day.

The modern harvesting approach entailed gathering from a colony built in man-made bees' accommodation known as hives. The beekeeper utilized smoke rather than a flame to reduce the aggression of the bees. As a result, the tendency to exterminate bees was considerably reduced. Following that, he picked matured honeycombs with care. The comb was considered ripe if the bees sealed up to 70% of its cells with wax. Brood and pollen broods were not removed from the hives. The honey was extracted manually by squeezing the combs without the inclusion of insects or other extraneous items. Babarinde et al (2011).

2.6 Honey Harvesting Techniques

2.6.1 Calming of Bees

According to *MyBeeLine*, being able to calm your bee is a valuable skill that every beekeeper must possess. There are several ways available to calming down bees. Usually, bee aggressiveness is premised on some factors which according to bee experts are: time of year, weather condition, availability of a queen, productivity of the queen, the presence of pheromones. Others include; the presence of predators, nectar robbing, bad behavior around the hive, Africanization, queen missing, grumpy queen, starvation, hive inspection, et. Cetera. However, several factors have been identified to calming bees, both modern and traditional. The first is to stay calm around the bee environment. According to Hilary (2017), staying calm around bees only takes practice that every beekeeper can cultivate. Just like every other animal, bees are also triggered by an uneasy calmness of the beekeeper around them and this can result in their aggressiveness. Other practices that beekeepers must cultivate in and around the bee environment as posited by Hilary are: not breathing on bees, not causing vibrations, not opening the bees up in poor conditions.

Most traditional beekeepers adopt the use of smoke to calm the bees down. Even though the use of smokers is not without its limitations and many bee experts don't usually advocate for it, it remains one of the methods available for calming bees before the inspection. Another method is the use of spraying water with dissolved sugar in it. Sartell (2018) believed that spraying the bees helps with calming them down and allows the beekeeper to easily work around the hive. Sartell does not completely agree with the idea of smoking the bees because it may spike a sense of danger of fire by the bees thereby triggering them from exiting the hive and recovering almost becoming impossible.⁴ Another thing that smoking triggers in bees are a release of venom droplet. In a study published by Gage (2018) and colleagues for the U.S. Department of Agriculture's Carl Hayden Bee Research Center and at BetaTec Hop Products; the following conclusion was arrived at:

"The release of the venom droplet took us by surprise. We didn't start out looking to record it. It became clear upon our first day of testing that some sting extensions released a venom droplet, while others did not," says Gage. The researchers write that the venom droplet "was more likely to be released with greater perturbation, and the probability of its release was reduced with smoke." In addition, when the strongest shocks were applied (8 volts), only hop smoke reduced the likelihood that bees released venom."

2.6.2 Cooling of Hives

When temperatures get to a certain threshold, bees may naturally be at risk and as the keeper, your intervention would be required in such circumstances. At certain temperature levels, bees have a natural way of cooling themselves in the hive. The first study to show that worker bees dissipate excess heat within a hive in a process similar to humans and other mammals cool themselves through their blood vessels and skin was done by Starks *et.al* (2014), a biologist at Tufts University School of Arts and Sciences. Research has documented that irrespective of the ambient temperature, *"the in-hive microclimate of a beehive at the central brood area must be kept at the average optimum temperature of 35°C for the colony to survive."* Hence, to survive both the cold winters and hot summers, honey-bearing bees usually employ diverse heating and cooling means to thermoregulate their hives at the best temperatures (Jarimi, Tapia-Brito & Riffat, 2020).

The first natural method adopted by bees to cool the hives is through ventilation. Research has found that when the air temperature in the brood nest is approaching 35°C, hundreds of bees, which are called *fanners* will position themselves throughout the beehive to take up the fanning position and force air circulation throughout the beehive. It is this process is known as the ventilation process. As the temperature increased to about 40°C, another group of bees moved externally of the small entrance into the screened platform and began another round of fanning activities. The stale air fanned out from the hive is then replaced and exchanged with fresh air from the external source which will enter passively into the hive where fanning bees were absent (Peters *et.al*, 2019). An earlier study by Bonoan *et. al* (2014) also revealed a process of heat shielding as a strategy by bees in protecting their broods. It involves the worker bees absorbing the heat by pressing the ventral side of their bodies against the heated surface. Afterward, the bees will then fly away to an area in the beehive that is cooler than the brood area and release the absorbed or stored heat.

Honey bees also employ the evaporative cooling system. In this system, worker bees will discharge the water that they carried to the beehives in their bodies. Other worker bees will then start fanning, actively creating cool humid air that circulates in the entire beehive. There is also the humidity and air quality control mechanism whereby the bees come together in a team to maintain different humidity in the different parts of the hive through an air ventilation system. Having examined this natural

system of cooling the hives by the bees themselves, it is important to also state that cooling the hives at unreasonable temperature levels is as important as the honey that is expected out of the process. Hives must be kept cool enough by honey bees to maintain the integrity and strength of the honeycomb. If the hive temperature gets excessively hot, the wax comb will be weakened, which might in turn collapse and damage is done to both the honey stores and wax cells that foster the future bees of the hive.⁵

Production estimates for honey hunting, traditional and modern beekeeping practices in Nigeria

(Abdullahi et al., 2010) discovered in his study that modern beekeeping practice is more profitable (economically viable) with an estimated gross margin of ₦5,264.2 (five thousand, two hundred and sixty-four naira two kobo), whereas traditional beekeeping practice is more technically feasible with an estimated gross margin of ₦1,391.93 (one thousand, three hundred and ninety-one naira ninety-three kobo), and the net farm income of modern beekeeping is ₦56,154.67 (Fifty-six thousand, one hundred and fifty-four naira, sixty-four kobo), whereas traditional beekeepers have ₦37,073.95 (thirty-seven thousand, seventy-three naira, ninety-five kobo); the difference in gross margin was attributed to the difference in quality price.

(Adeyemi, 2015), identified that the maximum amount of honey generated from 30-40 liters of ceiling voids for honey hunters was 5.33kg/structure at a rate of ₦1,300/kg. While a same-sized structure from traditional beekeepers, such as a mud pot, produced 6.35 kg of honey at a rate of ₦1300/kg. This resulted in a profit of ₦1,329 for the traditional beekeeper. This demonstrated that both honey hunting and traditional beekeeping are profitable, based on careful analysis of their effectiveness. This is because traditional beekeepers' materials are supplied locally, which indicates that with proper instruction and a fair market opportunity, the majority of honey hunters and traditional beekeepers could be encouraged to apply modern beekeeping practices for increased and quality output of bee products. (Adeyemi, 2015),

According to the findings of (Adeyemi, 2015), the type of beehive structure accessible, as well as the tradition, cultural, and occupational orientation of people in a particular location might influence the type of beekeeping practice activity in that area. It is worth noting that extensive wild bee structures in the form of natural tree cavities, termite mounds, and rock holes may impact the honey hunting behaviour of people during off-farming periods. Similarly, people's agricultural, traditional, and cultural callings, such as the usage of honey and other bees' by-products in traditional medicine, local manufacturing of commodities like pots, gourds, and calabash cultivation, may impact people's views on traditional beekeeping practices. Because hive components are readily available in the area and wild bee colonies are abundant (Duff and Furgala, 1986 and Ajao & Oladimeji, 2013).

Few studies have highlighted the existence of honey hunters, although honey hunters and traditional beekeepers may supply the majority of honey in the Nigerian local market. Ajao & Oladimeji (2015), Ojo (2016), Akinmulewo, Oladimeji & Abdulsalam (2017), Labe (2017), According to the report, both practices are profitable but are hampered by some constraints which may differ from state to state in Nigeria. However, if these constraints are properly addressed, the honey yield from these areas may increase. This will also catalyze the transformation of the bee sector from a subsistence to a modern sector (commercial production), elevating beekeeping to the rank of a principal vocation among the rural population. (Adeyemi, 2015),

The notion of adulterated honey in Nigeria

Honey is in high demand because of its strong nutritional and therapeutic properties. Because of the enormous demand for honey, it is scarce to come by at the local market. As a result, adulteration of the product occurs frequently, resulting in a loss in its nutritional and therapeutic properties. (Lawal et al., 2009). It is difficult to find pure honey, which may be influenced by consumers' lack of understanding about how to identify pure honey. Caramelized sucrose accounts for the majority of what is marketed in Nigeria (Omode and Ademukola, 2008). This caramelized sucrose sold, according to reports, has no medical value.

People prefer well packaged and branded honey, according to (Arowosoge, 2018), because packaging and branding help identify the producer. Another addition would be the positioning of nutrient content and the place of production on the package label. The information on the label would tell consumers about the product's quality and assist them in making decisions (Roman et al., 2013). Because of the prevalence of contaminated honey on the market, some individuals prefer imported honey (especially during the rainy season, when honey is not collected), which is well packaged and labeled with certification. (Arowosoge, 2018)

2.7 Constraints to Honey Production

Honey production has been marred by several constraints. It is also worth noting that these constraints are nearly the same from one location to another. What may be honey production constraints in Nigeria are almost the same constraints being faced by apiarists in Ethiopia or India, although with a slight difference almost too minute to notice. But in all, those constraints pose enough threats to the practice of apiculture in these areas. Goshme & Ayele (2020) identified pests, diseases, and predators, shortage of equipment, bad weather conditions, shortage of trained manpower and lack of knowledge, poor management practices, shortage of bee forage, different chemicals, weak research, poor infrastructure, lack of credit access, absconding and migration and marketing constraints as the major hindrances hindering effective production of honey in Ethiopia.

In Nigeria, Labe (2017) identified the following factors as the constraints facing honey production: ignorance and fear, bush burning, application of pesticides and insecticides, bee-killing, lack of flowering plants which are caused by deforestation, lack of modern beekeeping equipment which is as a result of their high cost, pest and predators, absconding of bees, inadequate technical skills, manpower problem, and adulteration of honey. Similarly, Ogbari & Ogbari (2014) also identified the activities of multinational companies as detrimental and a major constraint to effective honey production. He opined further that the use of dynamite and grenade in excavating the soil during oil exploration activities destroys the forest and environment the bees live. Also, Chigbo & Ahaotu *et.al* (2020) identified the following constraints: honeybee plants and flowering time, water resources availability, poisonous plants, honeybee pests and predators, insecticides and other chemicals application, availability of credit and extension services as the major constraints facing the production of honey in Idemili south local government area of Anambra State, Nigeria.

However, in Abia state, (Uchechukwu et al., 2019) identified that decrease in output, increase in production costs, and seasonality of honey were the key constraints. The second most important factor was a lack of bee forage, which forces bees to migrate to other locations where forage is abundant. (Uchechukwu et al., 2019) proposed that beekeepers should make use of training options provided by research institutes in the state to stay current on beekeeping technologies and techniques that will help in combating these identified constraints.

2.8 Conceptual Framework

The conceptual framework (Figure 1) explains the honey production and processes of beekeepers. Honey production of beekeepers is dependent on harvesting procedures such as cooling of hives,

calming of bees and testing honey for maturity, and harvesting techniques: extraction methods, harvesting season and storage methods available, knowledge and skill set of the beekeeper, the number of beehives, and equipment and tools available. As depicted in the framework, these variables significantly impact production as unavailability would constrain or mare the production process which in turn affects the quantity of honey produced. Also, from the framework, the socio-economic characteristics will depict the beekeepers' similar characteristics such as level of education, age, gender, etc in the study area. This will help in understanding the makeup of these beekeepers and the different priorities and different constraints.

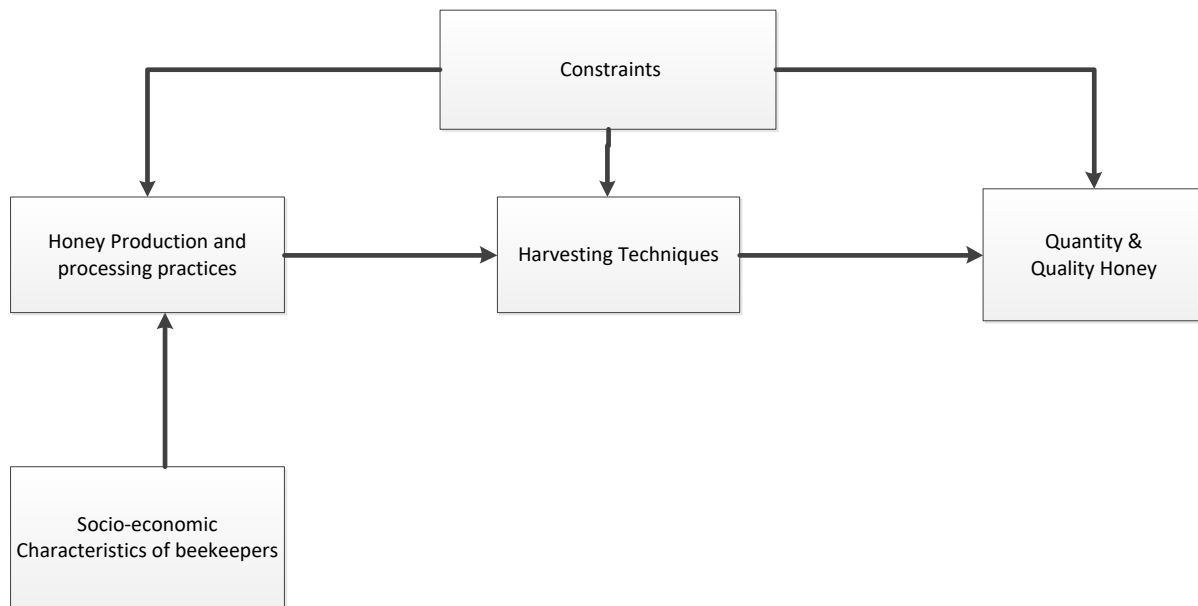


Figure 1: **Conceptual Framework of the study**

Chapter 3: RESEARCH METHODOLOGY

This chapter discusses the research method and approach employed to acquire and process data relevant to the study. It discusses the role of the researcher and the research assistant, the study area, the sampling technique, data analysis, and the constraints of the research, as well as the research data and processing collection schedule.

3.1 Study Area Selection

Abia State (Figure 2) is located in the South-East geographical zone of Nigeria, with seventeen Local Government Areas (LGAs), and great potential for Bee Farming. Three (3) local government areas: (Ikwuano, Umuahia North, and Isiala Ngwa North) were selected out from the seventeen (17) local government areas in Abia State and thus referred to as the study area. Abia State was selected for this study for two reasons. First, the commissioner of this research has trained beekeepers who have expanded to the area and the commissioner has several ongoing projects with regards to creating awareness for sustainable beekeeping practices in the region. Secondly, Abia State has an altitude of 122m above sea level, which tends to make it good for agriculture and apiculture as well. Agriculture is the primary source of income for the people of Abia State. This is due to the rich soil that stretches from the north to the south of the state. Subsistence farming is widespread, with approximately 70% of the population engaged in it.

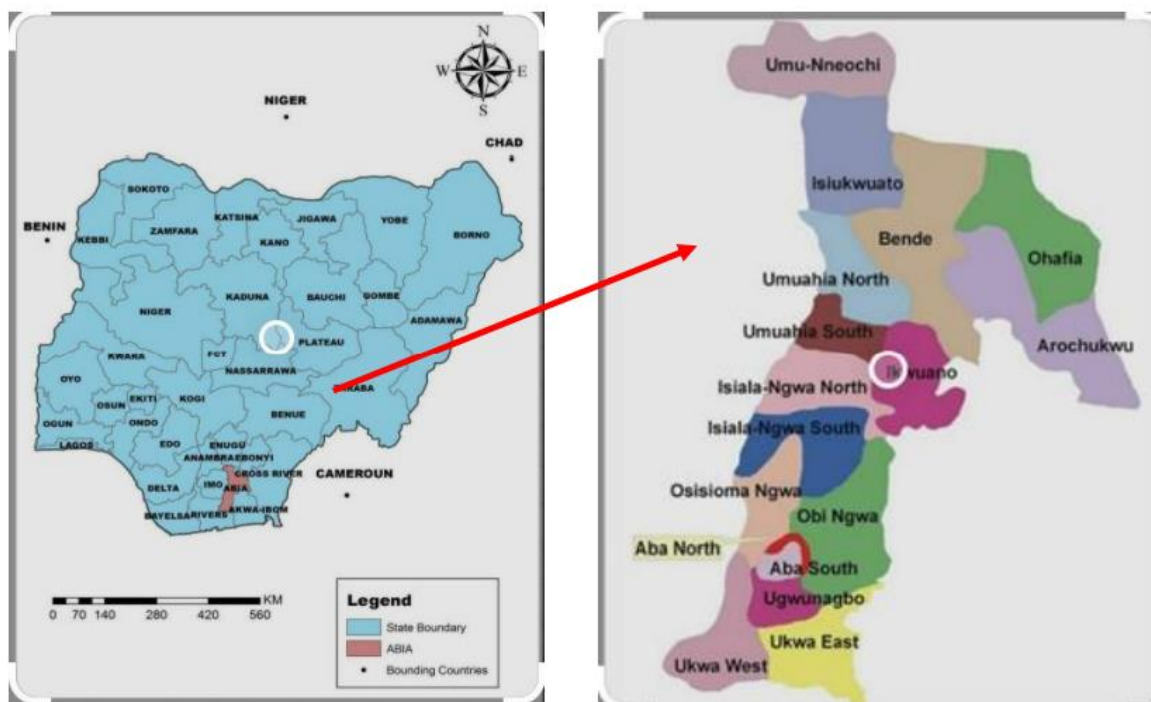


Figure 2: *Map of Abia State*

3.2 Research Design

The research design (Figure 3) included two strategies; quantitative and qualitative data-gathering strategies that involved the collection of primary and secondary data on beekeepers, honey production, and processing practices. The desk study aided in the review of the perspectives of other authors, knowledge on the subject, and significant concepts. Additionally, a desk study was undertaken to investigate various sorts of pertinent literature that aided in developing a thorough understanding

of the issue in light of the given research problem, objective, and research questions. This research employed a combination of quantitative and qualitative research data. This involved both primary and secondary data collection methods for quantitative and qualitative data. The primary data was gathered in Abia State. The research study was conducted by collecting data through questionnaires, interviews, and a focus group (FG) with beekeepers in the study area. The secondary data was collected through desk research using reports, journals, Google Scholar, and Greeni. These sources provided information on the background knowledge of honey, its quality, production, and its producers that are the beekeepers. The secondary data assisted the researcher in exploring and comprehending these research topics.

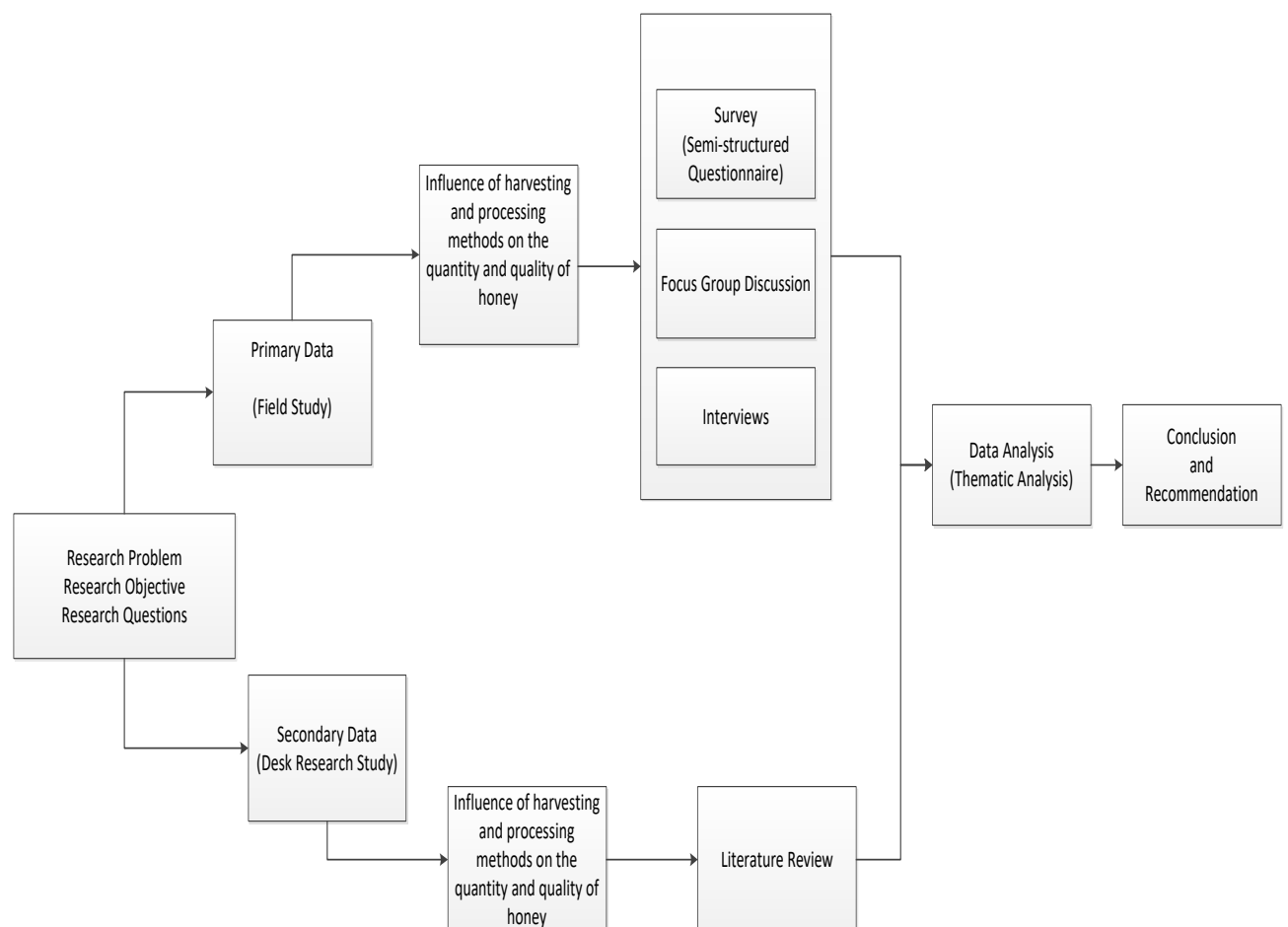


Figure 3: *Authors Research Design 2021*

3.3 Research Strategy

The study was an assessment that is required to explore and identify the beekeeping practices and constraints to effective honey production in the study area to develop sustainable strategies for improving honey production amongst the beekeepers in Abia State. The research, therefore, employed a quantitative and qualitative approach. These included the use of desk research, questionnaire, interviews, and a focus group discussion as shown in figure 1. This approach is driven by the need to fully explore the knowledge gaps and information deficit in the apiculture sector of the state that can be used to boost honey production and good beekeeping practices amongst beekeepers.

3.4 Research Strategy Justification

A quantitative approach was used to generate quantitative data on the socio-economics and demographics of beekeepers, an aggregate number of beehives, aggregate liters of honey produced per hive, types of harvesting, and processing methods. The purpose of utilizing this method is to have an understanding of the scale of demographics of beekeepers and ascertain the number of beekeepers who share certain qualities and hold a particular view on beekeeping operations.

A qualitative approach was used to generate qualitative data to enable the research to understand and identify why the beekeeping practices and techniques are used by the beekeepers in the study area and their implications on honey productivity. This qualitative approach (interviews and focus group discussions) provided in-depth information and knowledge about the individualistic context of honey production, its quantity, and processing practices of beekeepers which is subjective and difficult to generalize given the diverse factors that motivate beekeeping as a form of agriculture in the state. It allowed for deeper exploration into the underlying perceptions unique to beekeepers in the study area. This approach enabled the author to further gain a relative aggregate on the “numbers” and to further explore ‘why’ and ‘how’ these honey harvesting, extraction, and processing methods impact the quantity and quality of honey as shown in the conceptual framework.

3.5 Triangulation of Data Sources

The use of multiple sources of data (both primary and secondary) helped in an effective triangulation of the study findings which increased the confidence and quality of this study report. The finding obtained from the survey was triangulated with the findings from interviews and focus group discussion. The combination was again triangulated with findings from secondary data.

3.6 Sampling

Given that there is an absence of a verified database or directory of registered bee-keepers in public records or government parastatal in Abia state. The snowball sampling technique (Laws et al, 2013), was employed in the selection of 10 participants for the focus group discussion (FGD), fifteen (15) participants for the semi-structured interviews. This was initiated with referrals from the commissioner who had trained two (2) beekeepers who were the referrals and these referred respondents have established their apiaries in the state. One of the respondents referred the researcher to a social media platform (WhatsApp Group – “Beekeeper Forum”), while the second referral directed the researcher (with the research assistant) to beekeepers who are outside the social media (WhatsApp) platform – “Beekeepers Forum”.

Simple random sampling was used to select 42 respondents for the semi-structured survey in Abia State. The simple random sampling method helped the researcher to select respondents who identified on the beekeepers’ forum to having their apiaries in the study area.

Key informants from the Forestry Research Institute (FRI), Abia State chapter and National Apicultural Platform (NAP), Abia State, Chapter. The first key informant from FRI was selected to provide insights on policies, practices, and regulations affecting beekeeping given the interactions between beekeeping, land use, and forestry activities within the state. The second key informant from NAP was selected based on his knowledge, position (he is the secretary of NAP, Abia State chapter), and beekeeping experience of 15 years to generate insights about the coordinated activities of beekeepers in the study area and how NAP foster the activities of beekeeping operations in Abia State.

3.7 Data Collection

Table 1 shows the proposed data collection method and sources of data that will answer research questions

Table 1: Data Collection Methods

Data collection	Purpose/Justification	Data Collection tool	Source of Data
Secondary Data Collection			
Desk Research	Literature review on honey production and consumption in Nigeria, traditional beekeeping, modern beekeeping, constraints of honey production, honey production, and harvesting techniques.	Google Scholar, Greeni search engine	https://scholar.google.com/ (Google Scholar) https://www.greeni.nl/iguana/www.main.cls?url=home (Greeni search engine)
Primary Data Collection			
Survey	Socio-economic characteristics of beekeepers. The volume of honey per month, harvesting periods, harvesting methods, processing methods, and constraints	Questionnaire	42 respondents were randomly selected from a list of beekeepers whose apiaries are located in the selected LGA. These respondents are members of a WhatsApp Forum titled "BEE-KEEPERS FORUM"
Interviews	Quality criterion and acceptability of honey, honey extraction method, harvesting techniques, constraints faced by beekeepers.	Semi-structured interviews	2 KII (FRI and NAP) 15 respondents indicated their interest and availability for an in-depth interview concerning the focus of the study.
Focus Group Discussion	Harvesting periods, harvesting methods, processing methods, quality criterion and acceptability of honey, honey extraction method,	Checklist	10 participants were identified via snowball sampling technique in the study area

	harvesting techniques,		
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Source: Author, 2021

3.8 Research Instrument for Primary Data Collection

3.8.1 Survey- Questionnaire

The basic primary data for this study were gathered through the use of a well-structured questionnaire delivered using google form. The questionnaires were designed to elicit information about respondents' socioeconomic characteristics. simplified and streamlined for the collection of data necessary to compile pertinent information about farmers' socioeconomic characteristics. The questionnaire is attached in Annex 1.

3.8.2 Interviews

A set of open-ended interview questions and guide (Annex 3 and 4) was devised and used to enable the researcher to gain a thorough grasp of various beekeepers' knowledge and experiences with information, such as honey extraction and processing methods, how to determine the quality of honey produced, the quantity of honey produced per hive, honey production constraints.

Each response was documented by taking notes and voice recording by the researcher. Three of the fifteen interviewees were only available for interviews on the weekend (on Saturday and Sunday); the other seven were interviewed in the middle of the week (Tuesday and Wednesday). Five of the respondents were questioned on their farm because they could not be reached over the weekend or in the middle of the week. Each interview lasted 45 minutes.

3.8.3 Focus Group Discussion

One focus group discussion was held with participants from the three(3) local government areas (Ikwuano, Umuahia North, and Isiala Ngwa North) selected out from the seventeen (17) local government areas in Abia State. The reason for this discussion is to gather invaluable data on how they think about beekeeping practices, their explanations, and their understanding as they identified as traditional beekeepers. The session was held at the residence of one of the participants. A 1.5-meter setting distance was considered throughout the discussion as a preventive strategy for COVID-19. Throughout the discussion, the research assistant acted as a facilitator, monitoring and ensuring that all participants could offer their thoughts on the many themes discussed. Before starting the session, the research assistant obtains the participant's consent to photograph and record their voice. The ten participants were asked to establish their own ground rules to ensure a smooth debate following assent. Throughout the group discussion, each respondent's perspective was valued and documented.

3.9 Data Processing and Analysis

The data was gathered and analyzed using a quantitative and qualitative data analysis technique following the study's various themes.

Quantitative data collected via google forms were analyzed using excel spreadsheets. The analytical technique will include descriptive statistics such as frequency counts and percentages that were used to describe socio-demographic characteristics, and farm-based characteristics of beekeepers in the study area.

The qualitative analysis method began in the field with data collection and verification by cross-checking, processing, organizing, and coding under the dimensions employed in the study. Significant difficulties raised by respondents in response to the research sub-questions were organized and recorded in the pre-designed Microsoft excel sheet during this phase. Throughout each session, participants' quotes and statements were recorded. To avoid inaccurate data representation and to assure the acquisition of high-quality data, field data were rigorously analyzed.

3.10 Compilation of Data

This phase entailed determining the required data sources — primary and secondary data. This step identified the participants who were engaged, interviewed, and gave assistance in reaching the research objective. In other words, the compiling process entailed using several research tools and data collection methods during field operations, such as semi-structured and key informant interviews, as well as focus group discussions. This part of the study was also utilized to perform quality checks on data acquired, transcribe and write out observations from field data collecting, and analyze information obtained during the focus group discussion. Data quality checks were conducted via debriefing sessions with the research assistant to examine and refine the data collection process, as well as by following up with respondents to ensure that the information/data collected was clear. Additionally, this phase of the research was used to sort and review available documents referenced by respondents that contained the information necessary for answering the research questions, as well as to compile pertinent data from previously published works such as books, reports, and journals available over the internet.

3.11 Research Limitations

The limitation faced was a language barrier. Some of the focus group participants opted to answer questions in the local dialect, which differed from the central Igbo language spoken in the area. The research assistant had to change the questions to the local dialect for better understanding, even if though some of the English words had no direct translation to the local dialect. The second limitation is having to make appointments to interview the beekeepers which were done online; some complained of timing and busy schedules and requested to be contacted at a later time which the researcher did.

3.12 Ethical Considerations

Throughout the fieldwork, the researcher adhered to and noted all ethical considerations. Respondents were initially asked for permission to participate, and their anonymity was guaranteed. Before the focus group discussion, the researcher assistant obtained permission to record and photograph the participants. The researcher assistant, informed the participants about the goal of the research, which was strictly academic, and that there were no incentives for participating in discussions or contributing information. The researcher, through the assistant, adhered to all cultural customs and worked following the research community's laws and regulations.

Chapter 4: RESULTS

The chapter contains findings from a semi-structured questionnaire, interviews with key informants, and focus group discussions with beekeepers in the selected local government area in Abia State. The offered results seek to provide answers to the research sub-questions generated for this study.

4.1 Socio-Economic Characteristics of Beekeepers in Abia State

Table 1 and 2 shows the socio-economic characteristics of beekeeper identified in the study. This section includes respondents' sex, age groups, educational qualification, experience in beekeeping, sources of capital in beekeeping, number of hives owned, and their source of farmland.

Table 2: *Socio-Economic Characteristics of Beekeepers identified with survey*

Variable	Frequency	Percentage (%)
Sex of bee Keepers		
Male	33	80
Female	8	20
Age Groups (Years)		
18 – 25	1	2
26 – 35	18	43
36 – 45	11	26
46 – 55	10	24
56 and above	2	5
Educational Qualification		
Secondary School (WASSCE)	3	7
OND/HND	5	12
Bachelor Degree	18	42
Master's Degree	16	38
Experience in beekeeping		
1 – 5 years	8	19
6 – 10 years	19	45
11 -15 years	6	14
16 – 20 years	6	14
Above 20 years	3	7
Source of Capital for beekeeping		
Personal savings	38	90
Bank loan	1	2
Corporate loan	2	5
Government grant	1	2
Source of Farm Land		
Rented	15	36
Owned	27	64
Number of Hives in Apiary		
1 – 10	16	38
11 – 20	3	7
21 – 40	7	17
Above 40	16	38

Source: Author's Field Data Collection (2021)

Table 3: *Socio-Economic Characteristics of Beekeepers identified with FGD*

Variable	Frequency	Percentage (%)
Sex of bee Keepers		
Male	6	60%
Female	4	40%
Age Groups (Years)		
18 – 25	-	-
26 – 35	4	40%
36 – 45	4	40%
46 – 55	2	20%
56 and above	-	-
Educational Qualification		
Primary School	1	10%
Secondary School (WASSCE)	6	60%
OND/HND	2	20%
No formal education	1	10%
Experience in beekeeping		
1 – 5 years	4	40%
6 – 10 years	3	30%
11 -15 years	2	20%
16 – 20 years	-	-
Above 20 years	1	10%
Source of Capital for beekeeping		
Personal savings		
Bank loan	10	100%
Corporate loan	-	-
Government grant	-	-
	-	-
Source of Farm Land		
Rented	6	60%
Owned	4	40%
Number of Hives in Apiary		
1 – 10	5	50%
11 – 20	3	30%
21 – 40	2	20%
Above 40	-	-

Source: *Author's Field Data Collection (2021)***4.1.1 Sex Characteristics**

Finding from the survey of 42 respondents in table 2 shows there are 80% of males and 20% of females are involved in beekeeping within the study area. While findings from the FGD of the 10 participants on table 3 shows that were 60% male 40% female). This implies that more men take up beekeepers in the selected study area. This is consistent with the indigenous people's traditional belief that physical agricultural production is an activity for the male.

4.1.2 Age Group

Based on this data representation (figure 4 and table 1) from the 42 respondents (survey) on the age bracket of the beekeepers; the chart shows the age bracket with the highest number and that with

the lowest. According to the chart; the beekeepers with the age bracket (26 -35) have the highest frequency (43%), while the age bracket is 18 – 25 (2%) have the lowest number with the age bracket 56 and above following closely. This suggests that youths and young adults may be more engaged in beekeeping than the aged among the respondents. This demonstrates that older beekeepers are less economically active than younger beekeepers. This finding is similar to the FGD participants in table 2.

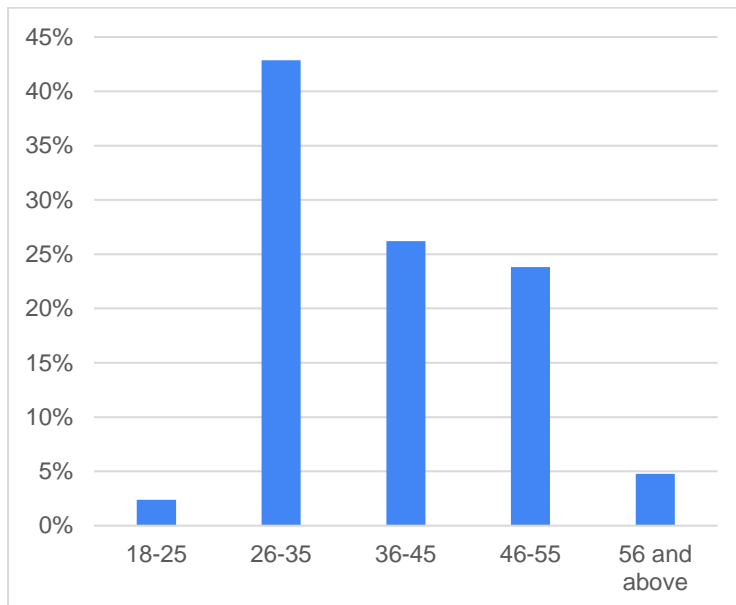
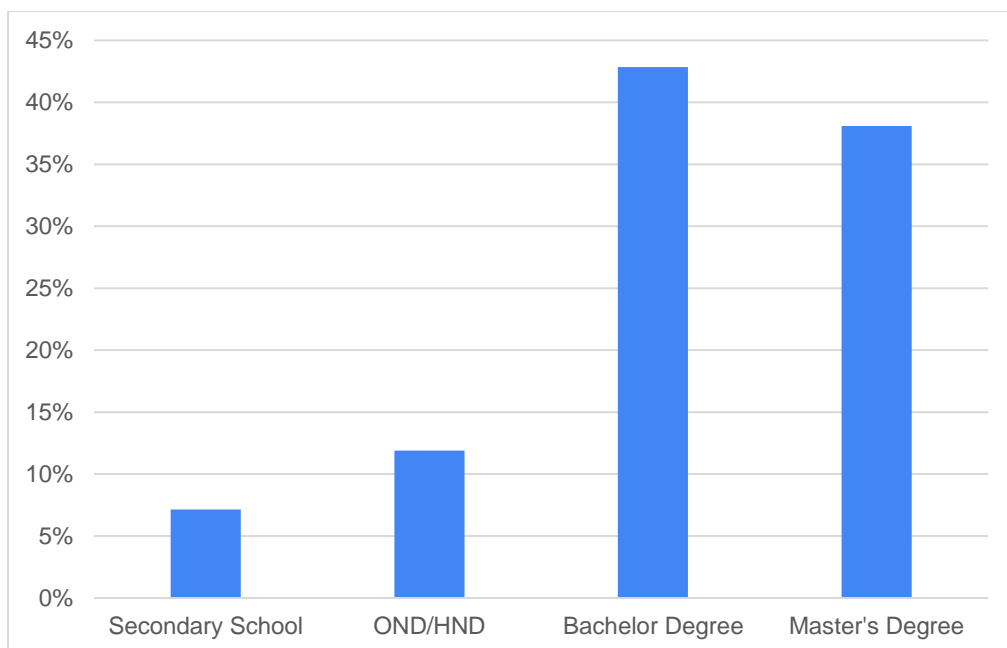


Figure 4: ***Age group of respondents identified via survey.***

4.1.3 Educational Qualification

Findings from the survey of 42 respondents (Table 1 and figure 5) show that the highest occurring frequency; 43% of the respondents had attained a bachelor's degree from a tertiary institution. 7% of the respondents had secondary school certification. For the FGD in table 1, findings also show that 60% have secondary education, 20% have Higher National Diploma, 10% primary school while 10% have no formal education. This result could also be attributed to the fact that many youthful persons in Nigeria have no access to white-collar jobs after graduation and this may have informed their choices of engaging in beekeeping at the subsistence level for income generation. Also for the FGD participants, There was a significant disparity, with only 10% of beekeepers having no formal education compared to 43% of respondents from the questionnaire. This could mean that basic education is not a criterion for starting bee farming, as knowledge can be acquired as a skill or through family lineage who practice beekeeping.

Figure 5: ***Educational Qualification of respondents***

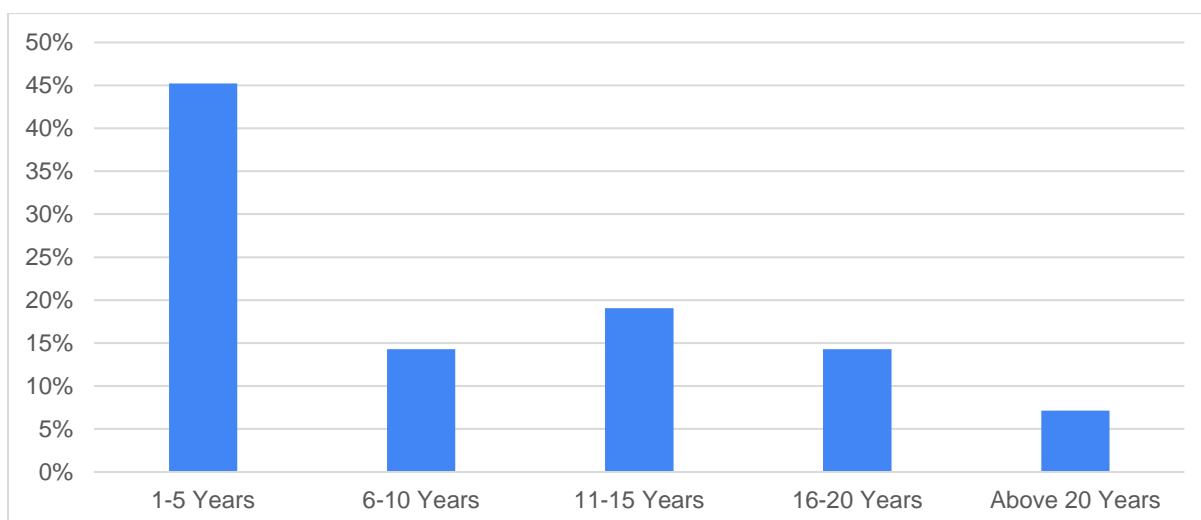


Source: Author's Field Data Collection (2021)

4.1.4 Experience of beekeepers

Figure 6 also shows the years of experience from the 42 respondents (from the survey), 45.2% show they have been in the business for between 1-5 years, 19.0% say they have been in the business from 11-15 years followed by 14.3% that claims they have been in the business for 6-10 years and 16-20 years respectively. For the FGD participants in table 2, 40% have 1-5 years experience, 30% have 6-10 years experience, 20% have 11-15 years experience while 10% have 20 years and above experience. This could imply that experience in the business of beekeeping is crucial for adjustments in the face of changing production demands and conditions. Beekeepers with long years of experience can adjust production to meet market demand and price fluctuation that may occur.

Figure 6: Years of Experience of Respondents in beekeeping

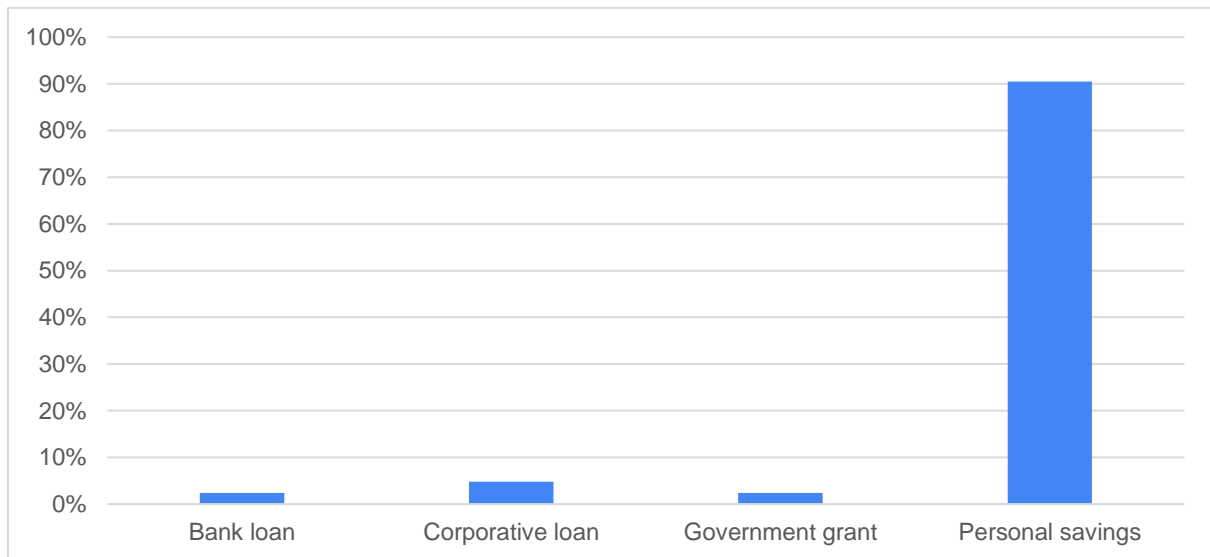


Source: Author's Field Data Collection (2021)

4.1.5 Source of Capital

Findings from the survey (Figure 7) revealed that 90% of the respondents used their savings as a source of capital for financing beekeeping production operations while the other 9% have access to financial incentives. For the FGD participants in table 2, 100% which represents the 10 participants use their savings as a source of capital. This shows that access to credit and financial incentives are low as beekeepers resort to their savings as a means of plowing back profit into the business.

Figure 7: Source of Capital of respondents

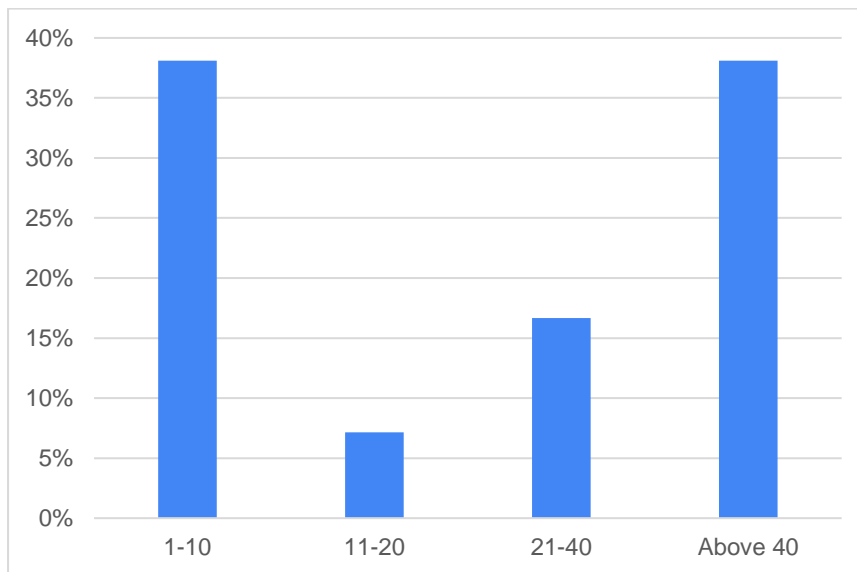


Source: Author's Field Data Collection (2021)

4.1.6 Number of Hives owned by beekeepers

Findings from the survey of 42 respondents (Table 1 and figure 8) depict the number of hives in their apiary. It can be deduced that 38.1% of the respondents said they have above 40hives. While 38.1% have between 1-10hives. 7% of the respondents owned 11 – 20 hives which was the lowest percentage of the respondents. The FGD participants in table 2, 50% owned 1-10 hives, 30% owned 11-20 hives while 20% owned 21-40 20%. This demonstrates that the addition of beehives would almost certainly increase the amount of honey produced.

Figure 8: Number of hives owned by respondents



Source: Author's Field Data Collection (2021)

4.1.7 Source of Farm Land

Table 1 shows the 42 respondents' responses on whether they own the land they practice beekeeping or leased it. 36% of the respondents said the land was either rented or leased, while 64% said they owned the land which they use for their beekeeping. The FGD participants in table 2, shows that 60% rented the land while 40% owned the land which they established their apiaries. This points out one of the benefits of beekeeping which is that a potential beekeeper does not necessarily need to acquire land nor rent one. The hives are also portable and can be moved to another farm if necessary.

4.2 Quantity of honey harvested

Findings from the survey showed that 47.8% (highest frequency) of the respondents harvest 6 – 10 liters of honey per hive, 33.3% harvest 1-5 liters of honey per hive, and 19% (Lowest frequency) harvest 1 – 5 liters of honey per hive. The FGD participants, the 50% who owned 1-10 hives harvests 10-15 liters of honey depending on the pot used, 30% who owned 11-20 hives harvests 15-20 liters of honey, while 20% who owned 21-40 hives harvests 20-25 liters of honey. This shows that the number of hives owned by a beekeeper directly affects honey output, which is to say the more hives a beekeeper have the more honey that will be produced.

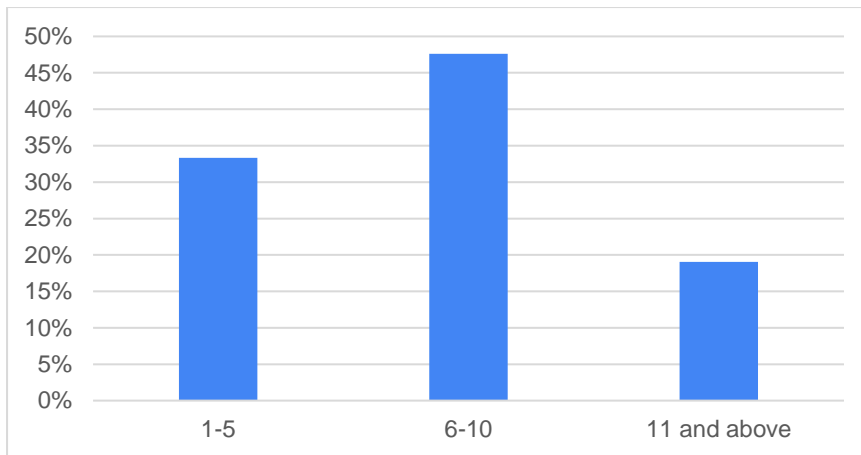


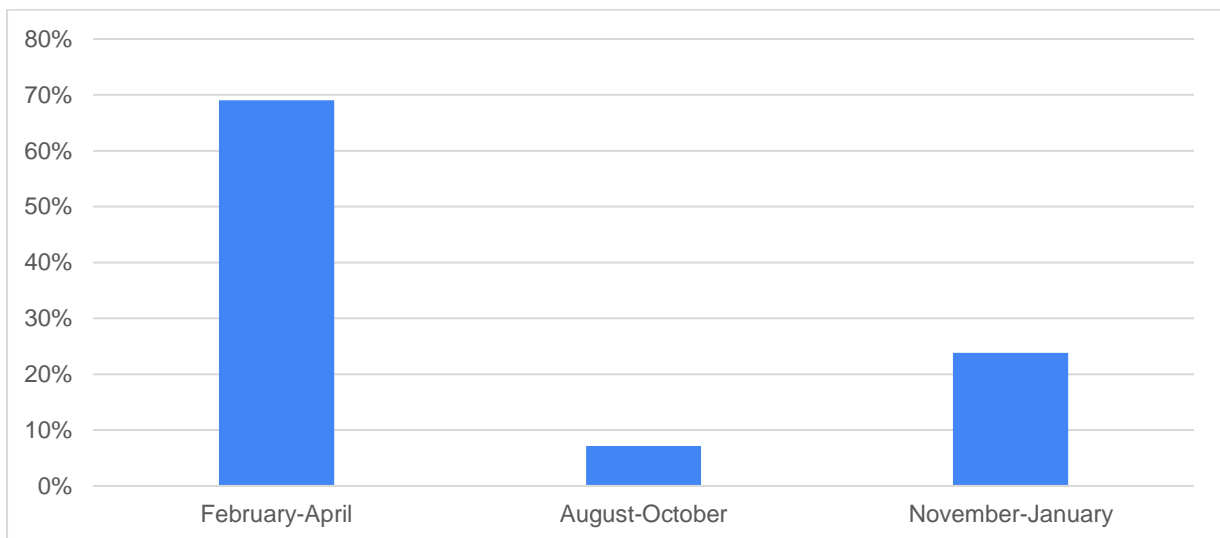
Figure 9: Volume of honey harvested by respondents.

Source: Author's Field Data Collection (2021)

4.2.1 Harvesting Period of honey

Findings from the survey showed that 69% of the respondents reported that honey is harvested between February - April and 23% harvest honey between November- January. 7% harvest honey between August – October. The FGD participants identified that they harvesting during the dry season which is November-January. However, there may be an early harvest between August-October. This shows that harvesting seasons vary according to the understanding and timing of each beekeeper, but observation shows that harvesting is done during the dry seasons.

Figure 10: Harvesting Period of honey identified by respondents

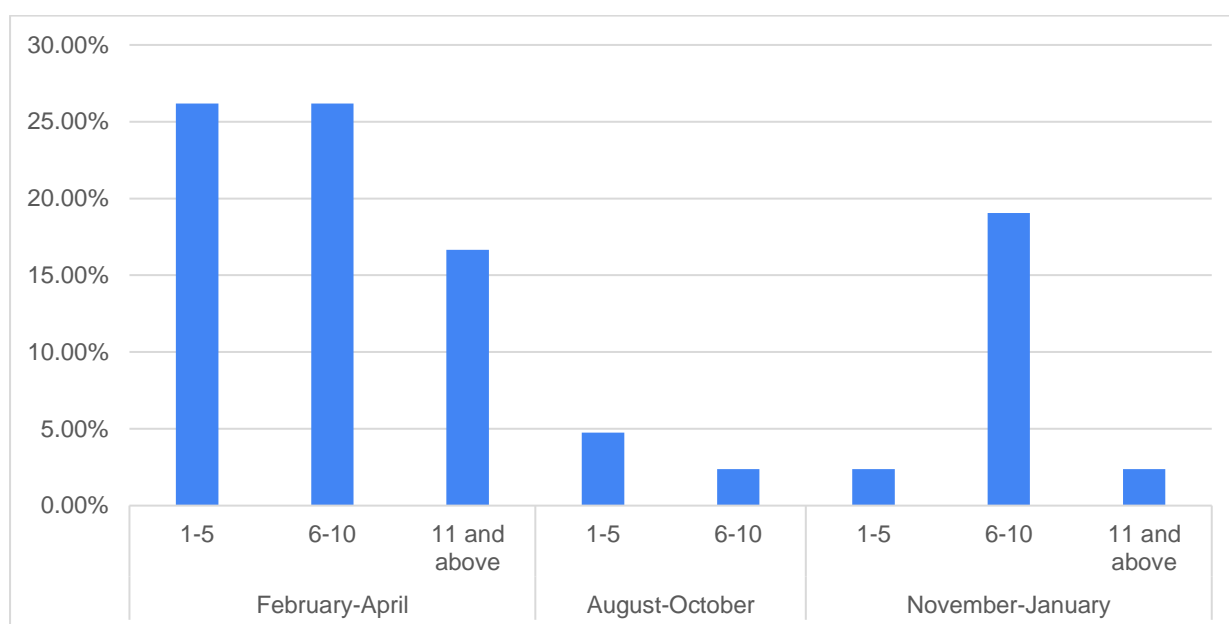


Source: Author's Field Data Collection (2021)

4.2.2 Quantity Harvested and Harvesting Period

The findings also show that the interaction between the volume of honey harvested and the harvest period identified. It was discovered that the peak period of honey harvesting is during the dry season (February – April).

Figure 11: Harvesting period and Quantity harvested



Source: Author's Field Data Collection (2021)

4.2.3 Types of beehives used by beekeepers and quantity of harvested from the beehives

The study also examined the type of hives used in the study area by the beekeepers.

Table 4: *Type of beehives used by beekeepers*

Type of beehive	Frequency	Percentage
Kenyan Top Bar Hive	33	78.6%
Langstroth Hive	10	23.8%
Local Hives	8	19%

Source: Author's Field Data collection (2021)

Table 4 shows findings from 42 respondents and 10 FGD participants, 78.6% of the respondents say they use Kenyan Top-bar hive, 19% say they use local hives, and 23.8 % say they use Langstroth hive. Finding from the FGD, reveal that local hives are usually made from a clay pot. Finding from the respondents who made use of Kenyan Top bar hive harvests more honey compared to the respondents who made use of local hives (usually from clay pots)

"I use Langstroth because it is large and retains a large swarm of bees hence there is no space for the bees to abscond. Although it is expensive to build because of the type of tree bark required".

Interview Bee-keeper

"our primary instrument is clay pots which we use as hives"

FGD participants

4.3 Method of Honey Extraction used by Bee Keepers

Findings from the semi-structured interviews and FGD with respondents in the study area reveal that they use a honey press, bucket method, and centrifugal extraction in extracting honey from the beehives.

Table 5: *Method of Honey Extraction*

Method of Extraction	SSI (%)	FGD (%)
Local Fabricated Honey Press	80%	-
Centrifugal Extractor	10%	-
Bucket collection	10%	70%
Use of sunshine	-	30%

Source: Author's Field Data Collection (2021)

Honey Press

The SSI participants stated that they use a honey press machine to extract honey from the honeycomb. This is done by placing the honeycomb underneath the pressure plate and force is applied from the handle, honey is released from the cell by crushing the honeycomb, which pours into a sieve bucket.

The press is locally fabricated equipment with a loading chamber for the honeycomb. When the top plate is lowered with the aid of a screw, the comb within the chamber is squeezed. The loading chamber is supported on four legs, and honey is extracted via a spillway made by the loading chamber's side. Honey that has been removed can be gathered directly from the spillway. The following materials are required: basin, sieve, cloth “

- Beekeeper

Another beekeeper reported that:

“I find this method easy and convenient, it is hygienic, and it gives me good and quality honey”

-SSI Beekeeper

Bucket collection Method

The FGD participants revealed that buckets are tied to the local hives, to allow the honey to drip slowly into the bucket or drum. This is usually done after dry grass has been used to generate smoke (fumes) to dose and slow the activities of bees in the hive. This is usually done at night.

Use of Sunshine

The FGD participants also reported honeycombs are left under the sunshine for 3 - 7 hours. The heat melts the combs, after which the honey is squeezed from the combs to extract the honey.

The sun allows honey-trapped in capped honeycombs to flow freely out of the matrix, whereas the basket method utilizes a basket to sift honey from shattered combs...He further said the reason he uses both methods is when there is no sun, I switch to using the other method”. yes, it is somewhat hygienic because for me I make sure I use a bucket that cannot allow dust particles to enter into the honey; however, using these two methods is time-consuming as one has to wait for two days for the bucket to be full.”

FGD Participant

4.4 Procedures used by beekeepers for calming the bees

4.4.1 Use of Smokers

Finding from the SSI with respondents and the FGD participants showed that smokers and dry grass are used to calming the bees. Smokers are locally fabricated equipment used to generate smoke (fumes). The smoker is placed under the hive harbouring the bees. This is usually done in the early in the mornings within 6.00 - 9.00 or late in the evenings (18.00) during sunset.

"...I use a smoker; it helps to relax the adrenaline of the bees and make them less aggressive."

- SSI Beekeeper

4.5 Procedures used by beekeepers for cooling of hives

Findings from SSI and FGD, respondents revealed that there are different two procedures used in cooling hives. Respondents reported that hives are placed under trees (with huge canopies and broad leaves) to serves as a source of natural ventilation for the bees. It was discovered that shades are artificially created to serve as cover for hives thereby cooling the hives. These artificially created shades are made of wood (tree or stems) and are then covered with leaves.

Another respondent said he uses natural and artificial shelter for cooling the hives, especially when the temperature is high. He said, "I have found out that placing my hives under big shady trees helps regulate the temperature in the hives; he further explained the process of knowing a matured honey, In the process of testing for honey maturity, the bee is first smoked, then I look for matured honey which is capped".

Beekeeper

4.6 Procedures used by beekeepers for testing for honey maturity

All respondents reported that the presence of a white membrane or layer of wax covering the honeycomb is an indicator used for identifying matured and market-ready honey. According to a respondent:

"I use my ideology to know when honey is matured for instance, if I see a white covering a thin layer of wax over the honeycomb."

-SSI Beekeeper)

"It requires some level of traditional expertise (beekeepers' sixth sense) to be able to know when a fully capped honey that is matured to avoid harvesting an unripe honey"

FGD Participant

Finding from the SSI and FGD with the respondents also showed that it takes approximately 4 - 6 months. The respondents also revealed that not all the honey is harvested from the hive. Rather, some honey is deliberately left behind to maintain the bee colony of the hive.

"Honey matures on an average of four months. If food (nectar) is scarce for the bees, it can take up to six months."

(SSI Beekeeper)

4.7 Honey harvesting processing practices identified by the beekeepers in the study area

Findings from the SSI and FGD shows that the beekeepers in the study area practice the following before harvesting honey: baits new hives before installing, maintain quality standard during honey processing, harvest honey in the early morning and evening, use of a clean and warm environment for honey extraction and use separate rooms for honey extraction.

"baiting of hives means rubbing something like beeswax, natural palm oil mixed with honey, so the bees perceive and come to forage and live".

-FGD participant

However, all respondents reported that before harvesting, sorting, and packaging honey, the equipment to be used is thoroughly cleaned and sterilized with boiling water at 100° Celsius and properly dried with sunshine. Other respondents also revealed that given the hygroscopic nature of honey, honey can be easily become contaminated with smoke or even water. According to a respondent:

"... so, during harvesting and processing, I thoroughly wash my equipment/tools. The sorting equipment I sterilize because if sorting isn't properly done it ferments the honey. I also put it in a presser to remove the honey. Finally, put it in a honey storage tank which is airtight. If not closed tightly it absorbs moisture"

(SSI Beekeeper)

Methods Used in Testing the quality of Honey

Finding from table respondents and key informant interviews, that there are no standardized methods of determining the quality honey produced in the study area. However, respondents revealed that honey produced is subjected to sensory tasting, smell, sight, and viscosity to determine if the honey produced is pure or adulterated.

Table 6: *Methods Used in testing for the quality of honey*

Methods for testing honey quality identified by respondents	Beekeeping methods	Respondents
Sensory tasting	Traditional and Modern Beekeepers	FGD and SSI
Longevity	Traditional Beekeepers	FGD
Viscosity	Traditional and Modern Beekeepers	SSI

Source: Author's Field Data Collection (2021)

One of the beekeepers reported that:

"... I can identify pure honey by the taste, smell, and with the use of viscosity (take a few drops on your finger and rub on your palm). If it is pure, it has a way of being thick, it generates heat. If you take it close to your nose and, you will perceive the odour, if it is honey, it has a smell of wildflower from the forest"

(SSI Beekeeper)

4.8 Factors that determine the quantity of honey produced

Findings from the key informants and SSI shows that the following determine the quantity of honey produced. These factors are the type of beehive used, vegetation around the beehives, and the population of the bee colony. If all these factors are okay and equal. The KTB can generate 6-15 liters per hive, the Langstroth hive can generate 10-25 liters per hive, horizontal beehive 10-20 liters of honey per hive.

4.9 Constraints affecting honey production.

Findings from the SSI and FGD in table 7 revealed that beekeepers encounter constraints that hamper the production of quality and acceptable honey. The constraints identified includes bees absconding, hive theft, vandalization of hives, price fluctuation, pest, disease and predators, shortage of equipment, shortage of bee forage, bush burning, predators (lizards, squirrels, and snakes), weather conditions (excessive rainfall), shortage of trained manpower and shortage of equipment. The FGD participants also mentioned financial constraints hampered the acquisition of more clay pots. The clay pots served as beehives for the participants

Table 7: *Constraints affecting honey production*

Constraints	Beekeeping practices	Respondents	Ranking
Pests such as ants, spiders, and predators such as lizards, squirrels, and even snakes	Traditional Beekeeping	FGD	1 st
Pests such as the termites, smaller hive	Modern Beekeeping	SSI	

beetle, greater wax moth, and large bee beetle			
Bees absconding	Modern Beekeeping	SSI	2 nd
Weather problem (excessive rainfall)	Traditional and Modern Beekeeping	SSI and FGD	3 rd
Hives theft & vandalization of hives	Modern Beekeeping	SSI	4 th
Shortage of bee forage	Modern Beekeeping	SSI	5 th
Bush burning and deforestation	Traditional Beekeepers	FGD	6 th
Shortage of equipment	Traditional and Modern Beekeeping	SSI and FGD	7 th
Shortage of trained manpower	Modern Beekeeping	SSI	8 th
Financial constraints and price fluctuation of equipment	Traditional and Modern Beekeeping	SSI	9 th

Source: *Author's Field Data Collection (2021)*

4.9.1 Excessive Rainfall

The study revealed that excessive rainfall affects the quantity of honey produced. It was discovered that heavy rainfall washes away nectar which is food for bees. Hence, the bees are less active and less honey is produced.

"Bees feed on plants (Nectar), If the rainfall is heavy and the nectars are available, the rain will wash away the nectars, the bees won't find anything to feed on and they won't even fly outside because of the rain. Much rainfall also increases the relative humidity of honey"

-SSI Beekeeper

4.9.2 Bee absconding

Findings from the SSI participants show that one of the problems encountered by these beekeepers is the absconding of bees, however, this phenomenon they said from observation happens when the hives are attacked by pests such as termites, wax moths, or small hive beetles.

"When a beekeeper discovers an empty hive, there is usually nothing but wax comb left. A tidy comb usually indicates that the bees left owing to a nectar shortage and impending famine. A shredded and uneven comb could have been damaged by robbing bees or yellowjackets. And comb that has been wrecked by little hive beetles or wax moths is frequently fully destroyed and full of dung and cocoons."

-Key Informant

Bees absconding, finance to buy modern beekeeping equipment, and difficulty in getting more land space.

-Key Informant

4.10 Suggestions from beekeepers/Key informants on how to improve the high production of honey

The key informants also made suggestions on how beekeepers can improve honey production according to their experience and what is obtainable.

“Sensitize people(both consumers and producers) on the importance of honey and how to identify pure honey, so they know the importance of beekeeping and bees to the environment, people should stick close to beekeepers for quality honey, For the beekeepers, they need technical knowledge of beekeeping operation whereby they know good beekeeping practices that are sustainable for example how to manage bee colonies, and also assist beekeepers to understand the importance of maintaining good hygiene in processing the honey to avoid honey contamination”

- Key Informant

Chapter 5: DISCUSSION

This chapter discusses the research's key findings and how they compare with past studies and their conclusions from the literature review. This discussion was conducted following the study questions to gain insight into traditional beekeepers' production and processing techniques in Abia State.

5.1 Socio-Economic Characteristics of Beekeepers in Abia State

5.1.1 Sex of beekeepers

Findings show that males outnumber females in beekeeping in the selected three local government areas in Abia state. First, in comparison to men, this study found that many women were not actively involved in beekeeping. This finding contrasts with the study of Ojo (2016), which revealed that the young and active female population dominates the beekeeping sector in Ogun and Kaduna State in Nigeria. This finding is in tandem with earlier studies by Abdullahi, Isekenegbe, & Mohammed (2014), Ajao & Oladimeji (2015), Teklu and Dinku (2016); Ndu (2017), Balogun et al. (2018), Alarape, Wahab & Arira (2020) and Chigbo & Ahaotu et al. (2020). All these studies showed that beekeeping practice is primarily male-dominated, and the reason is that certain activities surrounding beekeeping may not be favourable for women. For example, as opined by Gebretsadik et al. (2016), most "traditional hives are hanging on big tree branches in which some of the trees are as long as 50 meters and above. Women cannot climb up such big trees to do beekeeping activity, and as a result, women are not encouraged to participate in beekeeping activity."

5.1.2 Age Groups

The majority of the beekeepers in the study area are people within their young age of 26-35. This estimate is comparable to other studies like Saner et al. (2004) and Farinde et al. (2005). This finding indicates that beekeeping is popular among young people in the study area, which may be because unemployment is a major issue in Nigeria and many young people are looking for legitimate ways to make ends meet, of which agriculture provides a means of escaping poverty and a variety of social vices associated with youth and unemployment. Apart from the fact that beekeeping is prevalent among the younger population, the study demonstrates that beekeeping is also prevalent among the older age categories in the study region, which is equally noteworthy.

5.1.3 Educational Qualification

Table 1 also revealed that the majority (43%) had completed secondary school, 38% had completed a higher national diploma, 13% had completed a bachelor's degree, and 7% had completed a master's degree. Farmers' capacity to adopt updated technologies to boost productivity is aided by education. This is in agreement with Ajani and Agwu (2012) who stated that education will facilitate farmers' ability to use ICTs and appreciate their importance in farming activities

5.1.4 Experience in beekeeping

The findings in figure 4 and table 2 indicated that if the percentage of experience in beekeeping from the SSI and FGD are merged, it shows 85.2% have 1-5 years experience. The positive sign and relevance of beekeeping experience suggest that as the farmer's experience grows, their productivity will grow as well, as highly experienced farmers are likely to adopt improved techniques that will raise the productivity of their businesses (Ebe et al., 2017). This finding is consistent with (Ibeneme 2018), who found that as the number of years spent farming increases, so does the productivity of beekeepers. This indicates that beekeeping is on track and that apiculture in the research area has a bright future.

5.1.5 Number of Hives in Apiary

Table 1 demonstrates that the number of apiaries is one of the characteristics used to determine the size of a producer's operation. The number of hives set determines the amount of honey produced when the hives are properly managed. The findings on how the number of hives in an apiary affects the quantity of honey production indicated that many (38%) of the respondents had between 1-10 hives which is in the small-scale honey business. About 38% had above 40 hives which is a medium-scale for honey business, 17% had 21-40 hives, 7% had between 11-20 hives. This shows that within the beekeeping environment, there are beekeepers who are medium-scaled while some are small-scaled. This finding is consistent with Oladepo's (2004) observation that smallholder beekeepers dominate agriculture in Nigeria, and the consequence is that they cannot create adequate income, which may also impair their ability to acquire formal loans for their agricultural products.

5.1.6 Source of Farm Land

Table 1 shows the respondents' responses on whether they own the land they practice beekeeping or leased it. This is because access to land is referred to as a natural asset in the livelihood assets under livelihood sustainability. Beekeepers' accessibility to such assets would boost their ability to be able to sustain their livelihood. 36% of the respondents said the land was either rented or leased, while 64% said they owned the land which they use for their beekeeping. This result further corroborates the findings by Chigbo & Ahaotu et al. (2020) that most beekeepers do not necessarily need to own the land before they can practice beekeeping.

5.1.7 Source of Capital

Findings from the survey revealed that 90% of the respondents used their savings as a source of capital for financing beekeeping production operations in the study area. 2% of the respondents have a bank loan and government grant while 5% have a corporate loan as a source of capital. This finding somewhat agrees with Oladepo's (2004) that beekeepers cannot create adequate income, which may also impair their ability to acquire formal loans for their apicultural equipment and products.

5.2 Methods used in testing the quality of Honey from the identified beekeeping method in the study area

Respondents from the FGD and SSI revealed that honey produced is subjected to sensory tasting, smell, sight, and viscosity to determine if the honey produced is pure or adulterated. It was observed that both traditional and modern beekeepers who participated in this research use this means to test for honey quality. This finding is in line with Arowosoge (2018) who believes that adulterated honey is widely available in the marketplaces, hence people will only ingest gold and amber coloured honey with a high viscosity, which they feel is not adulterated. This contrasts with (Vanyi and Caspo 2009; Eleazu et al., 2013) who stated that physical criteria such as color and texture may not be helpful when evaluating honey because honey comes in a variety of colours based on the type of plants from which the bee collects nectar. Gold, white, amber, red, brown, and black are some of the colours available (Vanyi and Caspo 2009; Eleazu et al., 2013).

5.3 Method of Honey Extraction used by Bee Keepers

The methods employed by beekeepers for honey extraction in the selected study area showed that the FGD participants who identified as traditional beekeepers during the focus group discussion use the sun and basket method of extraction while the SSI respondents who identified as modern beekeepers during the interview use press method for honey extraction. This finding is in line with (Ogbari & Ogbari 2014) who said that Nigeria's traditional honey extraction practice is similar to what is done elsewhere. The process involves allowing bees to breed in the wild and then use smoke to disperse the bees. The authors (Ogbari & Ogbari 2014) noted that the practice is not without its demerits because the bees are lost in the process, either through absconding or the death of the bees.

Bee experts have also opined that “the quality of the honey harvest does not depend on the type of hive, but on the care taken at harvesting, the cleanliness of the equipment and the methods used for extracting honey and storage.”

Based on my findings, it is right to say that beekeepers in the area of study know that burning the bush to disperse the bees to extract their honey is harmful to the bees and the environment. However, the modern and traditional beekeepers have devised a means of dispersing the bees by using locally fabricated equipment called a smoker which is perceived by these beekeepers not to be harmful to the bees. This finding contradicts the study of (Babarinde et al. 2011), who posit that the “lower quality of honey harvested using traditional method could be linked to the adverse effect of the burning during traditional harvesting, which usually creates an impression of adulteration when displayed on shelves.” It was also discovered that different extraction procedures are available for various types of hives. Traditional beekeepers in the area of study use clay pots (local hive) use the bucket and sun method for extraction while for the modern beekeepers, the honey press is prevalent. This corroborates (Sahle & Negash et al., 2018) study on the basket method for beekeeping and honey processing and production in Ethiopia. This is in agreement with the findings of (Folayan and Bifarin 2013), who discovered that the majority of the beekeepers used traditional honey-extraction methods. This could be because traditional beekeeping requires less labor than other methods.

5.4 Procedures for calming the bees and cooling the hives

Findings indicated that respondents use locally fabricated equipment called smokers to calm bees and also employ natural and artificial methods for cooling the hives. Scholars like (Sartel's 2018, & Gage's 2018) studies don't agree with this method. Sartell believes smoking may spike a sense of danger of fire by the bees, thereby triggering them from exiting the hive and recovering, almost becoming difficult. Gage's conclusion on the use of smokers is also worthy of consideration here. Gage's study concluded that smoking might trigger the release of venom droplets from the bees. In testing for honey maturity, the bee is first smoked, then the matured honey is capped. This observation is in line with the submission of a bee expert and specialist Doug Somervill (Somervill, 2019)

5.5 Quantity of Honey Harvested and Harvesting Period

The findings also show that the interaction between the volume of honey harvested and the harvest period identified. It was discovered that the peak period of honey harvesting is during the dry season (February – April) and this period has the highest liters of honey harvested by both traditional and modern beekeepers. This is in line with (Onwubuya et al., 2013), who indicated that beekeepers extract honey before the peak of the rainy season.

5.6 Constraints affecting honey production.

Findings from the SSI and FGD revealed that beekeepers encounter constraints that hamper the production of quality and acceptance of honey. This resonates with Labe, (2017) who stated that bee absconding regularly has contributed to low colony establishment. As a result, many people find working with bees difficult. He further stated that pests and predators provide a significant problem to honeybees and beekeepers which can hinder the quantity of honey produced per hive. (Abdullahi et al., 2010) previously observed that the most pressing problem faced by traditional and modern beekeepers is hive vandalism by cattle rearers and hoodlums; the implication is that once these hives are destroyed, beekeepers find it difficult to replace the majority of the hives due to a lack of funds.

5.7 Factors that determine the quantity of honey produced

Findings from the key informants and beekeepers show that the following determine the quantity of honey produced: 1) the Type of beehive used, 2) vegetation around the beehives, 3) the population of the bee colony. Habitat loss has been recognized as the most major factor affecting the honeybee

population, according to Dieteman et al. (2009a, b) and Tesfaye et al. (2017). The availability of nectar and pollen determines the viability of honeybee colonies in terms of productivity (Esteves et al. 2010). According to Mbah and Amao (2009), various plants in South-eastern Nigeria serve as key sources of pollen grain and nectar for bees. Their research also discovered that farmers and hunters purposefully set fire to bushes around villages and farmlands, especially during the dry season and at the start of the food growing season. This method though supposed to force tiny animals out of hiding for hunters and stimulate the development of fresh grass for calf rearing, also burn off bushes and flower plants that provide a natural food supply for honey bees. This goes on to show that the vegetation around beehives, as well as the number of the bee colony, can have an impact on the amount of honey produced in an apiary.

REFLECTION ON THESIS WRITING

The researcher learned an essential lesson from the need to fully probe interviewees and ensure that the interview questions were stationed on the checklist. Because the researcher was overwhelmed by the information provided by interviewees at one point, it was difficult to direct the dialogue to correspond with the checklist. However, because some interviewees had weak internet connections, the online fieldwork hampered probing. Due to time spent attempting to secure a reliable internet connection, the researcher was unable to dig deeper. In the future, in a similar situation, the researcher must ask specific questions. The research assistant encountered challenges during the field data collection, including an inadequate road network in getting to the proposed area for the gathering. Fortunately, all the respondents were willing to cooperate with the research assistant to respond to the checklist questions. Additionally, the researcher gained practical experience and information regarding building a focus group discussion guide.

The researcher firmly believes that future research projects will not be as challenging in developing problem statements, main research questions, and sub-questions. This research provided the researcher the opportunity to learn and use some qualitative and quantitative data analysis methods. Both processes presented the researcher with the chance to learn more about beekeeping activities, the techniques involved in honey production, and the numerous ways it contributes to household food and nutrition security. The supervisor's feedback was critical, as she expressed her neutral opinion with prompt feedback. The researcher adjusted to the feedback and in the process learning independently. At times, the researcher wondered if she was doing the right thing. Good a thing it aided the researcher's knowledge expansion. However, the improvements were significant, and they improved the research's quality.

Triangulation was critical to this research since it enables the collection of comparable data from many sources and the confirmation of responses from multiple respondents. The limitation of this study could be addressed in future research as the research focused on the assessment of honey production and processing practices beekeepers. Further research is needed to determine the feasibility of innovation platforms to expand livelihood possibilities for beekeepers in Nigeria with distinct ecological zones.

The study is significant because it provided the researcher with a comprehensive understanding of current beekeeper characteristics, honey production techniques, including extraction and processing procedures, and how these approaches affect the quantity and quality of honey produced. In conclusion, there were no unanticipated alterations to the study technique, and there was no conflict of interest in the research because the researcher did not personally know the respondents or their backgrounds. As a result, there was no way to influence research responses based on the researcher's personality or industry experience.

Chapter 6: CONCLUSION AND RECOMMENDATION

This chapter highlights the study's conclusions based on the triangulation of research data sources and research methodologies; at the end of the chapter, there are evidence-based suggestions for the commissioner (Apifloral Resources) gathered from the study. The applicable recommendations are created to address the study's research objective.

6.1 CONCLUSION

The main question and focus of the research to is understand how honey production and harvesting techniques directly or indirectly affect the quantity and quality of honey produced by beekeepers in Abia State. Additionally, this study also aims to propose a recommendation to Apifloral Resources on the adoption of sustainable interventions that will help in improving the quality and quantity of honey production through sustainable beekeeping training. A quantitative/qualitative approach was used. Thus, a semi-structured questionnaire, interviews with key informants, respondents, and a focus group discussion (FGDs) were used. Respondents who participated in this research are actively involved in the apicultural sector and they were selected for interviews and focus group discussion. The following are the findings of the study's conclusions:

The socio-economic characteristics of beekeepers in the study area show that beekeeping to some extent still is a male-dominated operation when it comes to honey production. This could be linked to certain physical activities (hanging hives on big tree branches) surrounding beekeeping and thus not be favourable for women which has caused it to be male-dominated. Also, beekeepers are small-scale bee farmers who are in their active years with an average of fewer than 2 years of beekeeping experience. The majority of them (about 70%) had access to land temporarily. Also, the majority of the respondents have formal education, average beekeeping experience, number of hives but have low access to proper financing. Beekeeping should be regarded as a significant (primary or secondary) source of job creation for rural residents to alleviate poverty.

The outcome of the study also revealed that the majority of farmers who identified as modern beekeepers use smokers and before harvesting, sorting, and packaging honey, equipment to be used are thoroughly cleaned and sterilized with boiling water at 100° Celsius and properly dried with sunshine. It was also revealed by one of the key informants that given the hygroscopic nature of honey, honey can be easily become contaminated with smoke or even water hence the reason to maintain the highest level of cleanliness during the processing and extraction of honey.

The findings from this study also established that the beekeepers in the selected local government area maintain good hygiene during harvesting honey and processing; however, the output is low due to pests and predators, bees absconding, and excessive rainfall. The study also pointed out that that beekeeping operations are profitable and economically viable in the study area. However, it is technically inefficient, which may have been why market penetration has been weak and ineffective. The study has shown the study area has appropriate natural resources, good cultural tradition of beekeeping.

It was also discovered that the beekeepers in the study area make use of honey press – a locally fabricated equipment, bucket method, and centrifugal extraction as a medium of extracting honey from the beehives. The distinctiveness of these beekeepers has made them create good ways on how to place hives under trees (with huge canopies and broad leaves) to serves as a source of natural ventilation for the bees. It was also observed that the beekeepers have developed a “sixth sense” to

know that the presence of a white membrane or layer of wax covering the honeycomb is an indicator used for identifying matured and market-ready honey.

It was established there are no standardized methods of determining the quality of honey produced in the study area. However, respondents revealed that honey produced is subjected to sensory tasting, smell, sight, and viscosity to determine if the honey produced is pure or adulterated. It was also established that mixing honey from sources reduces the purity and good quality of honey.

Findings also highlighted some of the factors that determine the quantity of honey produced by the beekeepers in the study area as the type of beehive used, vegetation around the beehives, and the population of the bee colony, as these are the push and pull factors that can mare the quantity of honey produced. The constraints identified includes bees absconding, hive theft, vandalization of hives, price fluctuation, pests(ants, spider, termites, smaller hive beetle), shortage of equipment, shortage of bee forage, bush burning, predators (lizards, squirrels, and snakes), weather conditions (excessive rainfall), shortage of trained manpower and shortage of equipment.

In conclusion, the honey production techniques and processing methods identified during the study affects the quantity and quality of honey produced in the selected local government areas. These techniques are different for the beekeepers identified, although the volume of honey is almost the same based on the quantity of honey harvested per hive. The respondents who practice traditional beekeeping highlighted that the honey output depends on the clay pot used, this is to say that different sizes of clay pot produce a different quantity of honey. However, the respondents who practice modern beekeeping, who made use of Kenyan top bar hive, harvest more honey compared to the respondents who made use of local hives (usually from clay pots). The Kenyan top bar hive generates 6-15 liters of honey per hive, the Langstroth hive generates 10-25 liters per hive, horizontal beehive 10-20 liters of honey per hives.

This could be ascribed to the unregulated nature of the beekeeping industry in the state and because its activities are not monitored. These honey production methods and practices in tandem with other environmental factors such as excessive rainfall, pest, and predators, etc and institutional factors have led to relatively low levels of honey production (1 – 40 liters of honey harvested every 4 - 6 months which is about 0.039tons of honey).

6.2 RECOMMENDATIONS

The objective of the study is to understand how honey production and harvesting techniques directly or indirectly affect the quantity and quality of honey produced by beekeepers in Abia State. Additionally, this study also aims to propose a recommendation to Apifloral Resources on the adoption of tactical interventions that will help in improving the quality and quantity of honey production through sustainable beekeeping training. The following recommendations derived from the research will be critical in accomplishing the aforementioned goal.

- ❖ Apifloral Resources should incorporate into his beekeeping training sessions sustainable ways beekeepers can prevent pests from invading hives, and promote forums where trained beekeepers can be instructed on sustainable beehive management. Production and processing of honey are highly constrained by physical related factors such as bees absconding, hive theft, vandalization of hives, pest, disease and predators, shortage of equipment, shortage of bee forage, bush burning, predators (lizards, squirrels, and snakes), weather conditions (excessive rainfall), shortage of trained manpower and shortage of equipment.

In terms of apiculture, global warming primarily affects productivity by modifying the rainfall pattern and temperature of the area, which amplifies flood, drought, or causes seasonal volatility. These beekeepers can also be educated on the appropriate adaptive capacity to deal with the effects of climate change.

Agricultural extension agencies(ADP) must also start good beekeeping extension programs to supply beekeepers with enough knowledge on improved beekeeping management. Simple management measures such as the use of the salt solution or wasted motor oil should be taught to beekeepers to control predators such as the wax moth, wall gecko, lizards, and termites.

- ❖ Findings show that the number of women involved in beekeeping is low. APIFLORAL RESOURCES should take a radical approach to this and ensure sufficient awareness is raised across the communities in the state. This can also be done by reaching out to the youth development centers under the Abia State ministry of women affairs to host beekeeping training/workshops targeted towards young girls and women.

It should be noted that gender-related constraints of beekeeping were outside the scope of this study. Hence it would be recommended that further research should be carried to understand and identify how young girls and women can be supported in bee-keeping.

❖ **Sensitizing beekeepers on their role in the apicultural sector**

Both traditional/ modern beekeepers are the primary honey producers in the study region. They must learn what kind of honey quality is in demand in the market and which types of honey consumers are willing to pay a premium for. Furthermore, it is recommended that the beekeepers form cooperatives to gain easier access to finance, and technical beekeeping training in the use of sustainable beekeeping processing techniques that can enhance the quantity of honey produced in the region. The cooperatives can also collaborate with the agricultural credit loans board in Abia State to solicit sustainable interventions(financially or through an empowerment scheme) on ways to get modernized honey processing machines to boost the quality of honey produced. In addition, beekeepers should be more cautious to limit the threat of hive theft and vandalism. This they can do through their cooperatives by setting up a task force to monitor and regulate the activities of honey hunters and creating awareness campaigns for honey hunters and local people on how their actions affect honey production and the income of the beekeepers who experience this. Ascertain that an effective recurring community awareness program is in place to educate, enlighten, and alert local honey hunters about the dangers of their actions.

- ❖ Findings show that these beekeepers suffer from pests and predators and this affects the quantity of honey produced. It is recommended that as members of a cooperative group, beekeepers should combine their resources to obtain credit from micro-finance institutions. This will help them buy processing/storage equipment and environmentally friendly chemicals, which will help them get rid of pests and predators.
- ❖ Findings revealed that some beekeepers only harvest their honey once a year. Apifloral resources can collaborate with NGOs focusing on rural development in the study area to launch quarterly summits and workshops on beekeeping to provide enough information on the number of production and honey harvesting cycles in a year, as well as honey processing, storage, and marketing strategies. This will ensure that beekeepers have a thorough understanding of technical beekeeping techniques and applications, as well as motivate them to produce in large quantities to earn more money and improve their living conditions.

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APPENDICES

Annex 1: Snip Questionnaire used for the study. The full questionnaire can be accessed [here](#).

QUESTIONNAIRE FOR RESEARCH ON HONEY PRODUCTION AND PROCESSING PRACTICES

Greetings!

My name is Mercy Chikezie, a Master's student of Management of Development: Specialization (Food and Nutrition Security) at Van Hall Larenstein University of Applied Sciences in The Netherlands. As a prerequisite to complete my study, I am required to carry out an applied research in the area of Food and Nutrition Security. I have therefore decided to examine the honey production and processing practices of beekeepers. Your participation will contribute immensely towards the success of this research, and by accepting to participate in this questionnaire, you help the researcher to conduct a study in this time of Covid-19 pandemic. Be Rest assured of the anonymity of your identity, and all responses received will be treated in absolute confidentiality and will be administered solely for this research. Thank you for your willingness to participate in the research.

Please tick [✓] the option that agrees with your opinion.

 adudujosef@gmail.com (not shared) [Switch account](#)



What is your age bracket?

- ☐ 18-25
- ☐ 26-35
- ☐ 36-45
- ☐ 46-55
- ☐ 56 and above

Annex 2: CONSENT FORM FOR RESPONDENTS

My name is Solomon Obiora, and I will collect data on behalf of Mercy Chikezie. Mercy is a Nigerian student studying in the Netherlands. She was unable to make this journey due to the COVID-19 restrictions. This research aims to examine the honey production techniques and processing practices of beekeepers and their effect on the quantity and quality of honey produced. This research project is part of the requirement for a Master of Science (MSc) in the Management to Development degree at Van Hall Larenstein University of Applied Sciences, The Netherlands. The research will consist of open-ended questions regarding honey production and harvesting practices and about livelihood assets, strategies, and the vulnerability context of beekeeping. The following open-ended questions will provide you with the opportunity to discuss your ideas, beliefs, and knowledge related to the issue. The research should last for approximately one hour and thirty minutes. Expectations are that the research questions will center on the objectives of the study. To make a note of information, it will be handwritten. Also, in the body of the final report, audio and video recordings will be recorded and anonymized if necessary. No specific comments will be attributed to any individual unless a prior agreement has been ordained. All documentation will be treated with the utmost confidentiality. You are under no obligation to take part in this research project. If you choose not to participate, you may withdraw at any moment without incurring any consequences. This study is optional for you. At any point, you are free to exit from the activity without penalty.

Name: _____

Signed: _____

Date: _____

Annexe 3: Semi-Structured Interview Guide

Duration: 45mins

- Part I: Questions on honey production and processing practices
- What can you say about the harvesting honey methods by traditional/modern beekeepers?
- What methods do you use to calm bees, cooling of hives, and testing for honey maturity?
- How have weather conditions affected your bee colony in recent times?
- How many months does it take to get mature honey, and do you harvest in the evening or early morning.?
- Does the level of rainfall affect beekeeping practices?
- How do the problems you encounter affect honey production and your income?
- Do you maintain quality standards in processing honey?
- What is the number of beehives owned, also? Can you elaborate on the amount of honey harvested from each hive?
- What are the methods of honey extraction used by the beekeepers in the study area?
- How long have you been involved in beekeeping?

Key Informant Interview Guide

- **DEMOGRAPHIC DATA**
- ➤ **Gender () M () F**
- ➤ **Education**
- ➤ **Marital status:**
- ➤ **Source of income:**

- How long have you been in your parastatal? How long have you been a beekeeper?
- Can you tell me a little bit about honey production?
- Can you describe any recent weather events that resulted in reduced honey production and abscondment of bees?
- What effect does this shift in temperature have on beekeepers' income?
- What programs or policy is available to help traditional beekeepers when they are affected?
- How do the majority of the beekeepers extract honey?
- What can you say about these extraction methods?
- Are their laws or policies available for the promotion of apicultural activities in the community?

Annexe 4: Focus Group Discussion Guide

- 10 participants
- 100-120 minutes long.
- Venue: The Ibe's compound
- Facilitated by Solomon Obiora

Greetings everyone, welcome to this gathering. Thank you for being present at the meeting. Your participation will contribute immensely to this research's success. By accepting to participate in this focus group discussion, you help the researcher conduct a study in this time of this Covid-19 pandemic; you are free to express your views on the preceding questions. Rest assured of the anonymity of your identity as initially stated on the consent form. All responses received will be treated with absolute confidentiality and will be administered solely for this research. Once again, I appreciate your willingness to participate in the research.

There are only a few basic rules to keep in mind while participating today:

- 1.) Everyone is expected to be an active participant.
- 2.) there are no "right" or "wrong" answers.
- 3.) Speak freely but remember not to interrupt others while they are talking.
- 4.) Note-taking is for reporting purposes only and will be used for analysis.
- 5.) Names are not attached to the notes; rest assured the identity of every participant and all that will be discussed will be strictly confidential.
- 6.) All information gathered will be analyzed to determine trends and make recommendations to the Commissioner to design relevant intervention programs.
- 7.) All feedback today will remain anonymous. To maintain anonymity, I just ask that everything said during our session is not repeated outside of our session

Interview Questions
Introduction (names) – Please, introduce yourself and how long you have engaged in beekeeping.
Can we discuss the procedures used by traditional beekeepers to calm the bees, cool hives, and test for honey maturity?
How do you harvest honey? Do you in any way use insecticide?
What assets do you need/would like to have or to have more to increase your honey production?
What are your harvesting methods/practices?
What problems do you experience during the harvesting of honey?
As beekeepers in Abia state, have you been exposed to any form of shock(pests/diseases) or trend that has affected your beekeeping practices over time?
What are the production constraints faced in beekeeping? What are the methods of honey extraction used by the beekeepers in the study area?

Annexe 5: FGD Demographic Information (Female)

Respondent	Age	Education	Source of income	Duration of stay in the area	Marital Status	Years in beekeeping
FDG 1	35	Secondary school	Farming/beekeeping	Native	Married	6
FDG2	40	College	Beekeeping/nurse	Native	Married	5
FDG3	37	Primary	Petty trader/beekeeping	Native	Married	3
FDG4	44	Secondary school	Small business/beekeeping	Native	Married	15

Annex 5 (contd): FGD Demographic Information (Male)

Respondent	Age	Education	Source of income	Duration of stay in the area	Marital status	Years in beekeeping
FDG5	50	illiterate	Farming/beekeeping	Native	Married	35 years
FDG6	47	Secondary school	Transport business/farming and beekeeping	Native	Married	10years
FDG7	30	Higher National Diploma	Electrician /beekeeping	Native	Single	2years
FDG8	38	Secondary school	Farming/petty trader/beekeeping	Native	Married	5years
FDG9	45	Secondary school	beekeeping	Native	Married	12years
FDG10	27	Secondary school	Mechanic /beekeeping	Native	Single	1 year

Annex 6: SSI Demographic Information

Respondents	Age	Education	Source of income	Duration of stay in the area	Marital Status	Years in beekeeping	sex
SSI1	46	Bsc/Seminary	Clergyman/beekeeping	20 years	Not married	18years	Male
SSI2	35	Bsc	Small business/beekeeping	Native	Married	5years	Male
SSI3	40	Higher National Diploma	Petty trader/beekeeping	Native	Married	10years	Male
SSI4	32	Bsc	Tailor/beekeeping	Native	Single	3years	Female
SSI5	50	College of education	Teacher/Farmer/beekeeping	Native	Married	20years	Male
SSI6	35	College of education	Teacher/Farmer/beekeeping	Native	Married	8years	Male

SSI7	29	Higher National Diploma	Tailor/beekeeping	Native	Single	2years	Female
SSI8	36	Higher National Diploma	Carpenter/beekeeping	Native	Single	4years	Male
SSI9	41	Higher National Diploma	Small business/beekeeping	Native	Married	7years	Male
SSI10	30	Bsc	Teacher/beekeeping	Native	Married	1 year	Female
SSI11	39	Msc	Lecturer/beekeeping	7years	Married	4years	Male
SSI12	34	Secondary school	Farming/carpenter/beekeeping	Native	Married	10years	Male
SSI13	27	Bsc	Administrative officer/beekeeping	15years	Single	3years	Female
SSI14	42	Bsc	Administrative officer/beekeeping	10years	Married	5years	Male
SSI15	33	Bsc	Administrative officer/beekeeping	Native	Married	5 years	Male

Annex 7: Key Informants Demographic Information

Respondent	Age	Education	Source of income	Sector	Years of experience in beekeeping	Marital Status	Sex
KII1	44	PhD	Civil servant/beekeeping	Forestry Research Institute	4years	Married	Female
KII2	34	BSc	Research Fellow/beekeeping	MOU AU	8years	Single	Male

Annex 8: Pictures of traditional hives for beekeeping

Photo Source: Legit.ng



Clay pot hive



Grass hive



Gourd hive



Log hive