CHARACTERIZATION, AWARENESS OF PRODUCTS, AND TECHNICAL EFFICIENCY OF BAOBAB CANDY RETAILING IN KENYA

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MASTER OF SCIENCE

(Agricultural and Applied Economics)

JOMO KENYATTA UNIVERSITY

OF

AGRICULTURE AND TECHNOLOGY

2024

Characterization, Awareness of Products, and Technical Efficiency of Baobab Candy Retailing in Kenya

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Agricultural and Applied Economics of the Jomo Kenyatta University of Agriculture and Technology

2024

DECLARATION

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

Signature……..... Date…….

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This thesis has been submitted for examination with our approval as the University Supervisors

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DEDICATION

This thesis is dedicated to my wife Jane, my parent Mrs. Grace Muyanga, and my siblings Martin, Patrick, and Yvonne for their support and encouragement during the entire period of the study.

ACKNOWLEDGEMENT

This thesis would not have been complete without the support and assistance of various people and groups to whom I am so grateful and highly indebted.

Special gratitude goes to my supervisors Prof. Kavoi Muendo and Prof. Dagmar Mithöfer for their incredible advice, guidance, and constructive criticisms toward this work, may God reward them abundantly. I am also grateful to the entire fraternity of the Agricultural, Resource, and Economics Department, JKUAT for their immense support and encouragement during the entire period of the study. Appreciation is also expressed to my course mates, Collins, Mervyn and Dennis for their insightful engagement and encouragement during the entire period of the study.

My special heartfelt appreciation goes to Germany Federal Ministry of Food and Agriculture (BMLE) through the Federal Office of Agriculture and Food under Value chain, Post-Harvest losses and Producer associations" component for funding the entire research. It would not have been possible without their financial support. Finally, I sincerely thank my respondents and research enumerators for their assistance during data collection exercise.

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ACRONYMS AND ABBREVIATIONS

AE	Allocative Efficiency
ANOVA	Analysis of Variance
ASAL	Arid and Semi-Arid Lands
BCC	Banker, Charnes and Cooper model
BTS	Bartlett's test of sphericity
CA	Cluster Analysis
CCR	Charnes, Cooper, and Rhodes.
CRS	Constant Return to Scale
DEA	Data Envelopment Analysis
DMU	Decision Making Units
EE	Economic Efficiency
FAO	Food and Agriculture Organization
IFT	Indigenous Fruit Trees
KMO	Kaiser-Meyer-Olkin
Ksh	Kenya Shilling
OTE	Overall Technical Efficiency
PCA	Principal Component Analysis

PTE	Pure Technical Efficiency
SA	Situational Awareness
SFA	Stochastic Frontier Analysis
TE	Technical Efficiency
VRS	Variable Return to Scale
ZTP	Zero Truncated Poison model

ABSTRACT

Globally, baobab tree is among the leading Indigenous Fruit Trees (IFTs) with extensive benefits such as a source of nutritious food, income, and raw materials in food processing. The tree grows in harsh climatic conditions where crop production is difficult. Despite the great importance of baobab, the tree remains underutilized and its market operates informally through weak value chains and few market players. Retail sector plays a crucial role in economic development and represents the largest proportion among agricultural value chain actors. However, baobab products remain few in the retail markets. Baobab candy is the common traded product by retailers in Kenya. Moreover, there exist knowledge gap regarding baobab retailing. Hence, this study sought to characterize baobab candy retailers, establish their awareness levels of baobab products, and estimate the technical efficiency (TE) of candy enterprises in the rural township and urban markets. The study adopted purposive and cluster sampling designs to draw a random sample of 352 respondents. A structured questionnaire was used for data collection. Multivariate statistical technique of principal component analysis (PCA) and cluster analysis (CA) was used to characterize candy retailers. A zero-truncated poison (ZTP) model was used to assess the determinants of retailer awareness toward baobab products. While Data envelopment analysis (DEA) and Tobit models were employed to establish the level of TE and its determinant respectively. The study results revealed that candy retailers are heterogeneous in nature and can be classified into three clusters namely: low-volume, average-volume, and high-volume retailers. Descriptive statistics indicated a low product awareness across the markets (mean=10) from a list of 28 products. ZTP model showed that gender, age, education level, years of retailing, and group membership significantly influenced retailers' awareness positively whereas, distance to the market and income from other sources had a negative influence on awareness. DEA results indicated that candy enterprises attained a TE score of 0.69 in constant return to scale and 0.85 in variable return to scale. The model also revealed that majority of candy enterprises (94%) operated at an increasing return to scale. Gender, access to formal training, business registration, distance to the market and income from other sources significantly influenced the TE of candy enterprises. The study, therefore, recommends the need to develop strategies that can improve awareness and TE in baobab retailing. This includes; designing policies that promotes awareness and technical efficiency in the baobab sub-sector through training and educational programs. Similarly, gender-related issues should be addressed to bridge the gap of TE and awareness levels between female and male retailers. Likewise, county and national governments should invest in the baobab value chain and infrastructure to enhance access and availability of products in the markets. Hence, promote market development and commercialization of novel food products, particularly baobab.

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Access to quality, healthy and nutritious food is a fundamental human right and a prerequisite for people to attain their full physiological potential. However, access to safe, nutritious, and sufficient food across the globe has remained a challenge (FAO *et al*., 2023). Climate change, population growth, high cost of healthy foods, and over-reliance on conventional food systems are among the main causes, especially in developing countries (United Nations, 2021). However, the use of indigenous fruit trees (IFTs) has been identified among the pathways with the potential to contribute to food security, health, and income (Chivandi *et al*., 2015). IFTs thrive well in harsh climatic conditions where crop failure is common (Kehlenbeck *et al*., 2013). However, over the years, IFTs have remained neglected and underutilized, and their markets operate informally. Hence, their products realize limited commercialization (Muok, 2019; Omar *et al*., 2016). Baobab tree is an example of an IFT that remains underutilized and under-commercialized (Buchmann *et al*., 2010).

Baobab *(Adansonia digitata L.)* is among the leading IFTs that continues to provide non-timber benefits (NTB) with an annual income projection of about $1 billion for producer countries (UNEP, 2006). It is a deciduous tree majorly found in the African savanna and other tropical regions across the world (Wickens & Lowe, 2008). In West and Central Africa, baobab occurs along the coastal line, while in North-Eastern countries such as Somalia and Eritrea, they are found in Semi-desert Scrubs. In South African countries like Angola and Namibia, they occur in mature woodlands (Sidibe & Williams, 2002). In Kenya, baobab tree grows in Eastern parts of the country. It is distributed in the bush and scrub savanna vegetation in the Eastern and coastland lowlands regions. The Eastern inland belt originates from the Tanzania border, East of Mt. Kilimanjaro and covers Taita Taveta, Makueni, Kitui counties all the way to Tharaka-Nithi county. The Coastal belt is

found along the coastal region, directly on the seashore of coral fossils. It covers Lamu, Kilifi, and Kwale counties (Gebauer *et al*., 2016).

Globally, baobab is a multifunctional plant with benefits ranging from a source of nutritious food, medicine, fodder, clothing, and raw material for processing (Rahul *et al*., 2015). The fruits are composed of seeds and pulp. The seeds are used for oil extraction, while the pulp is majorly used as a source of nutrients since it contains high levels of vitamin C, calcium, iron, phosphorus, carbohydrates, and dietary fibers (Muthai *et al*., 2017). Pulp is also used as an ingredient in processing. For instance, in Tanzania, baobab pulp is used in beer processing. Tender leaves from the tree are often used as a sauce and vegetable during the dry season (Chadare et al., 2008). Besides being a source of food, leaves and pulp are also used as medicine to cure asthma, diarrhea, dysentery, measles, and fever (Sidibe & Williams, 2002). The bark is used to manufacture clothes, ropes, hats, and bags (Kozanayi *et al*., 2014).

Baobab products offer a great opportunity for income generation, particularly for poor households, retailers, and processors in sub-Saharan Africa, where it occurs naturally (Venter & Witkowski, 2013). The magical tree supports local communities in Africa as it grows in arid and semi-arid regions where long periods of drought, floods, and rising poverty levels are common (Wanjeri *et al*., 2020). In Kenya, baobab is among the high-priority trees due to its multiple uses (Kehlenbeck *et al*., 2013), as it grows in regions characterized by few income-generating activities such as beekeeping and charcoal burning (Kaimba *et al*., 2020). Therefore, baobab products can be used to supplement the income of people in such regions. To fully realize the potential benefits of baobab, its products need to be made available and accessible in the market.

The markets for baobab products remain undeveloped, operate informally and are characterized by weak value chains (Jäckering *et al*., 2019). Retailers play a central role in any agricultural market by ensuring access to a wide range of products in the markets for the final consumers and other interested market actors. They represent the most significant proportion of enterprises within distributive trade (Záboj, 2008). Additionally,

they also act as an interface between consumers, wholesalers, and processors (Raff & Schmitt, 2016) and are the main gatekeepers in the introduction of new products to the markets as they have the ability to control the variety of products they trade with (Shaikh & Gandhi, 2016). In Kenya, the retail sector plays a crucial role in economic development (Kiptoo, 2017). Nevertheless, the empirical evidence regarding baobab retailing remains scanty.

Following the acceptance of baobab pulp as a novel food product by the European Union (European Union, 2008) and the US Food and Drug Administration, new international markets have emerged. As a result, the European market alone recorded over 300 products containing baobab as an ingredient (Gebauer *et al*., 2016). In Africa, Buchmann et al. (2010) recorded a wide range of products with over 300 different uses, while in Burkina Faso, Schumann *et al*. (2012) noted that local people harvest baobab due to its multiple uses of over 25. A prior study by Darr *et al*. (2020) disclosed a high presence of baobab products in Malawi retail markets (Approx. 78). Hence, baobab products holds a high market potential and the sub-sector is expected to employ over 2.5 million housholds across Africa (Sanchez et al., 2010). The magical tree also ensures environmental sustainability since its products can be harvested without affecting forest structure (Asogwa *et al*., 2021). Therefore, trading with baobab not only conserve the environment but also provides a great opportunity for income generation, particularly for rural communities and other stakeholders in sub-Saharan Africa (Abdelrham & Adam, 2020).

In Kenya, the economic value of the baobab surpasses the use value (Kehlenbeck *et al*., 2013). However, baobab remains rare, and only a few informally processed products are traded in the markets. Pulp on seed, pulp, and candy are the commonly traded products in Kenya. Moreover, retailers majorly trade with baobab candies (Jäckering *et al*., 2019). Therefore, baobab products occupy a relatively small market share in the retail sector. The purpose of this study therefore was to establish the various clusters of baobab retailers, their awareness levels of various baobab products and the technical efficiency of candy retail enterprises in Kenya.

1.2 Statement of the Problem

With increasing food insecurity and malnutrition in arid and semi-arid regions, IFTs such as baobab has been identified as one of the pathways with a potential to address these challenges. Baobab grows in harsh climatic conditions where crop and animal production is difficult. Hence, its products can be used to supplement income and dietary needs of individuals in such regions. Despite great importance of baobab to livelihoods, the markets for its products remain underdeveloped and are characterized by weak value chains and few market players.

Retailers play a central role in the agricultural markets as they act as an intermediary between consumers, processors, and wholesalers. They also have the ability to control the access and availability of various products to the markets for the final consumers and other interested market players (Raff & Schmitt, 2016). Ultimately, retailers are the main gateway to production and consumption. In Kenya, the retail sector plays a key role in economic development and is ranked second most developed in Africa. Nonetheless, few baobab products exist in the sector.

In Kenya, the problem is that baobab products have largely remained unknown and rare among market actors, especially retailers who form the largest proportion of market players in any agricultural commodity market. Baobab candy is the most preferred and commonly traded product by retailers (Jäckering *et al*., 2019). This shows a clear indication that baobab products occupy a small market share characterized by low commercialization and low product awareness at the retail level. However, retailer awareness has majorly been associated with "brand awareness" (Allen *et al*., 2016; Dabija & Nicoleta, 2011), which is expressed as the extent to which consumers recognize or recall a particular retailer in a certain category (Pappu & Quester, 2006). Nevertheless, the ability of retailers to recognize and recall various baobab products has been neglected by research. Further, the performance of baobab candy enterprises remains unknown as there exists a dearth of empirical evidence regarding candy enterprise operations.

Over the years, there have been increased empirical studies on baobab in Kenya. However, there is a knowledge gap regarding baobab retailing, especially on awareness and technical efficiency of baobab retail enterprises, as the majority of the studies have focused on baobab processing (Muriungi *et al*., 2021), consumption (Kiprotich *et al*., 2019) and nutritional attributes of baobab (Muthai *et al*., 2017).

This research, therefore, addresses these gaps by identifying various clusters of baobab retailers, establishing their awareness levels towards various baobab products, and estimating technical efficiencies of baobab candy retail enterprises. Further, an evaluation of drivers of awareness and technical efficiency are also investigated. The study, therefore, attempts to extend the existing knowledge frontiers of the Baobab value chain.

1.3 Objectives

1.3.1 Main Objective

The overall objective of this study was to characterize baobab candy retailers, investigate their awareness levels towards various baobab products, and estimate the technical efficiency of candy retail enterprises in urban and rural township markets in Kenya.

1.3.2 Specific Objectives

The specific objectives of the study were:

i. To characterize various clusters of baobab candy retailers in terms of their social-economic, institutional, and business attributes in Kenya.
ii. To assess factors influencing awareness of retailers towards various baobab products in rural townships and urban markets in Kenya.
iii. To establish the determinants of technical efficiency among candy retailing enterprises in urban and rural townships markets in Kenya.

1.4 Study Hypothesis

The following hypothesis were tested:

i. There are no variations in the characteristics of baobab candy retailers in Kenya.
ii. Socioeconomic factors have no significant effect on the awareness level of retailers towards various baobab products in rural townships and urban markets.
iii. Socioeconomic factors have no significant influence on the technical efficiency of candy retail enterprises in urban and rural township markets.

1.5 Justification

Over the years, baobab products have gained special attention both locally and internationally as they contribute to food security, income generation, and raw material for food processing. Baobab grows in harsh climatic conditions characterized by unpredictable weather patterns and long periods of drought. Hence, its products can be used to supplement income and dietary for households in such regions. Despite, the potential of the baobab in livelihood strategies and welfare, the markets for its products remain informal with less developed value chains (Sidibe & Williams, 2002). Retailers are the main economic agents along the agricultural value chain (Záboj, 2008). However, in Kenya, baobab products remain rare and unknown among retailers who trade with relatively few products (Jäckering *et al*., 2019). Therefore, gaining insights on various clusters of baobab retailers and their awareness levels not only provides a basis for better decision-making regarding the improvement of efficiency and market share for baobab products but also informs policymakers on possible policy interventions that can govern baobab retail sub-sector and improve the awareness of baobab products among retailers. This will in turn promote market development of novel food products such as baobab.

It is the goal of any enterprise to attain maximum revenue with the least costs possible. This can be achieved only if an enterprise is technically efficient in its operations. Technical efficiency (TE) involves maximizing the revenue from a set of inputs at the

least cost or, minimizing the use and costs of inputs for a given level of revenue (Farrell, 1957). Therefore, gaining insights into the level and determinants of TE in candy retailing enterprises will enable retailers and other interested stakeholders to benchmark and select an appropriate input-output mix that yields maximum revenue. Besides, it will also promote enterprise development and competitiveness as the magnitudes and causes of inefficiencies will be identified, thus providing a basis for the improvement of such units and ultimately enhance commercialization of novel food products, particularly baobab. Further, this research adds to the limited body of literature on baobab value chain especially in SSA, hence providing a reference point for future studies in SSA.

1.6 Scope of the Study

The study characterized candy retailers, and assessed factors influencing the awareness of retailers toward baobab products. Similarly, technical efficiencies and their determinants in baobab candy retailing were also established. Due to the diverse and heterogeneous nature of baobab markets in Kenya, the markets were subdivided into two namely; rural township and urban to represent the markets where baobab retailing is common. The study targeted retailers who majorly trade with at least one baobab product (candy) to the final consumers in the local markets. The study adopted the description of the local market as defined by Shackleton et al. (2007), where local markets are known to exist and operate within cities, towns, neighboring villages, and on roadsides. Such markets are often run by retailers.

1.7 Definition of Terms

Baobab Candy- is a flavored and sweetened baobab seed coated with pulp. Locally known as ‘Mabuyu’ in the local language.

Retailer/retail enterprise- An individual or entity involved with at least one baobab product (candy) and sells the product in the local markets to the final consumer.

Local market- markets within cities, towns, neighboring villages, and on roadsides where forces of demand and supply operate freely.

1.8 Thesis Outline

This thesis covers five chapters. Chapter one presents the background information, problem statement, objectives, hypothesis, justification and scope of the study. Chapter two discusses the empirical literature on characterization, awareness, and technical efficiency. It begins with an overview of characterization, conceptual framework, and empirical literature on characterization. Similar steps explaining awareness and technical efficiency are also explained in the chapter. Chapter three covers the theoretical framework, econometric specification, and estimation procedures applied in the study. A detailed description of the study sites, research design, sampling techniques, data collection, and analysis procedure are also examined in the chapter. Chapter four focuses on the study results and discussion, while Chapter five presents the summary, conclusions, and policy recommendations from the research findings.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section reviews the relevant literature on the characterization, awareness, and efficiency. In section 2.2 the overview, conceptual framework, and empirical literature of characterization are discussed. Furthermore, the overview, conceptual framework, and empirical literature on awareness are examined in section 2.3 while section 2.4 presents a detailed overview, conceptual framework, and empirical literature review of technical efficiency.

2.2 Baobab Characterization

2.2.1 Overview of Characterization

Understanding the underlying variations of baobab retailers is a crucial step to formulating appropriate policy interventions targeted to a specific group of retailers with similar characteristics. Characterization provides a platform that helps in understanding different types of retailers in the baobab subsector. Characterizing baobab retailers in this context is referred to as the process of profiling various clusters of retailers in terms of their social-economic, institutional, and business attributes. These attributes yield various classes known as typologies whereby each typology exhibits unique attributes (Nyambo *et al*., 2019).

Typologies provide mechanisms for understanding each baobab retailer based on their heterogeneous attributes. Thus, forming a basis to develop appropriate recommendation domains. According to Chatterjee *et al*. (2015), the recommendation domain simplifies the heterogeneous nature of elements under similar conditions and circumstances to enable the formulation of suitable recommendations. Therefore, describing baobab retailers' typologies not only provide eligible recommendations and suitable policy

intervention but also reduces the complexity of the decision-making units regarding the improvement of their operations and thus, enhances the achievement of a favorable efficiency level in retailing activities.

2.2.2 Conceptual Framework of Characterization

For a successful characterization of any agricultural value chain player, various aspects in their operations and their attributes have to be considered. Moreover, the actor under consideration must be operating under a relatively similar condition, or circumstance (Kuivanen *et al*., 2016). In the current context retailers trading with baobab candy in the local markets. Factors influencing characterization of baobab retailers may include their social-economic aspects, access to services and business attributes etc. Using statistical approaches such as principal component analysis and cluster analysis, retailers with similar traits will be grouped under the same cluster. This will enhance the formulation of appropriate policy interventions and recommendation domains (Goswami *et al*., 2014; Kobrich *et al*., 2003).

In this study, candy retailers were hypothesized to be homogeneous in nature. However, this may not be true since each retailer was expected to have unique features. Therefore, typologies of baobab candy retailers may be as a result of their unique combination of socioeconomic features, institutional and business attributes. In terms of socioeconomic, candy retailers with relatively similar characteristics such as age, education, gender, household size etc. will be grouped under the same cluster, whereas, characterizing candy retailers in respect to their business operations, attributes such sales revenue, cost of retailing, business registration etc. will be considered. Furthermore, access to training, credit and group membership are among the institutional factors to be considered when classifying retailers. Hence, candy retailers will be grouped into clusters according to their similarities.

2.2.3 Empirical Literature on the Characterization of Agricultural Value Actors

Characterization of retailers in the baobab sub-sector is crucial to the development of appropriate policy interventions and recommendation domains. However, an in-depth review of the literature regarding characterization of baobab retailers yielded no results. Hence, the study reviewed the literature from other related studies.

Adam *et al*. (2024), conducted a study on the classification of livelihood strategies, baobab income and income inequality in Kordofan and Blue Nile states in Sudan. The study adopted random sampling to select 374 respondents. Principal component analysis (PCA) and cluster analysis (CA) were employed to identify various clusters of households based on their income sources. Three clusters from each state were identified. In Kordofan, the clusters identified include; 'livestock and baobab-based', 'livestock and crop-based', and 'business- based' while in Blue Nile, the clusters identified were; 'mixed', 'business-based', and 'crop-based. The clusters exhibited variations in asset endowments and wealth, with differences in access to land, savings, credit, and technology. Households classified under the livestock-baobab strategy (Kordofan) and the mixed strategy (Blue Nile) were found to have highest degree of poverty, lowest per capita income, and baobab contributed about 33% and 26% of total income, respectively. The study concluded that households adopt diverse livelihood strategies, with distinct patterns of income sources and asset endowments.

Muriungi *et al*. (2021), investigated the characterization and determinants of baobab processors in Kenya. The study employed descriptive statistics and multivariate analysis of PCA and CA with 303 baobab processors who were selected using multistage and snowballing sampling techniques. Descriptive statistics revealed that the majority of the baobab processors were female (92.4%) and about 90.8% of them processed baobab candies. PCA and CA results revealed that baobab processors can be classified into three clusters namely; high-quantity, average, and low-quantity processors. Years of processing, access to training, access to land, and processing costs were the key factors influencing the variation of baobab processors classification. The study recommended the

need to reform land policies and empower processors through training to increase land access and knowledge of baobab processing respectively. Further, the study recommended the need to reduce the maturity period of baobab trees through research to encourage more processors to grow baobab.

Otieno *et al*. (2021), conducted a study on the characterization, typologies, and determinants of smallholder dairy farming in Nakuru and Nyandarua counties in Kenya. The authors adopted stratified random sampling to select 380 dairy farmers. Principal component and cluster analysis were employed to determine the typologies of smallholder dairy farmers. PCA showed that land, income, infrastructure, and output were the main factors in characterizing smallholder dairy farmers. The results of CA observed three typologies of smallholder dairy farmers namely; low resource endowed and low market-oriented, moderate resource endowed and moderate market-oriented and high resource endowed, and high market-oriented. Land, labor, household income, farm assets, stock of dairy animals, years in dairy farming, dairy outputs, cost of production, and consumption level factors were found to have a significant influence on smallholder dairy farmers' characterization. The study recommended designing policies that focus on accessibility to land and financial resources as well as developing the infrastructure needed by smallholder dairy farmers. Further, the study recommended the need to address issues that hinder the growth of smallholder dairy farmers such as the high cost of production, fodder, and poor quality of milk. The researchers noted that appropriate research and extension services can be adopted to address these hindrances.

Taremwa *et al*. (2021), studied the characterization of smallholder rice and maize farmers in Eastern and Western provinces of Rwanda. The study used multistage and stratified sampling to select 422 smallholder farmers across the provinces. The researchers employed principal component analysis and cluster analysis with K-means to characterize smallholder farmers. Results from PCA and CA established four typologies (clusters) of smallholder rice and maize farmers. The first cluster was the largest with 67% of the sampled farmers. The cluster was comprised of farmers with; formal education, more than

five years in farming, off-farm income, cultivatable land not exceeding one hectare, household membership between 1-5, rented land of less than one acre and no dependant under five years. The study recommended the need for financial institutions to provide credit to farmers with the above characteristics and the re-evaluation of the assumption that farmers are high risk by credit institutions.

The reviewed literature has significantly shown that there is a paucity of information regarding baobab retailing as majority of the studies have focused on categorizing farmers and processors. Thus, characterizing baobab candy retailers will possibly reduce this knowledge gap and contribute to the limited body of literature concerning baobab retailing.

2.3 Awareness of Baobab Products

2.3.1 Overview of Baobab Product Awareness

The baobab (*Adansonia digitata L*) is an important multipurpose tree that occurs naturally in arid and semi-arid regions of sub-Saharan Africa (Kehlenbeck *et al*., 2015). Almost all parts of the tree are useful for various purposes (Omotesho *et al*., 2013; Buchmann *et al*., 2010). Thus, baobab products offer a great opportunity for income generation, particularly for poor households, processors, and retailers in SSA. In Kenya, baobab products are majorly traded by retailers to earn their livelihood. Baskets, seed oil, pulp on seed, ice pops, pulp, and candy are among the traded products in Kenyan markets. However, candy is the common preferred product by retailers (Jäckering *et al*., 2019). This indicates that products derived from baobab tree occupy a small market share and remains unknown among retailers who play a central role in distribution, production and consumption. This is possibly attributed to a lack of or low product awareness at the retail level.

Awareness exerts influence on the choice of the products market players trade with. Therefore, an increase in product awareness can possibly induce a positive change toward product retailing, thus improving the market share for baobab products in retail sector.

With proper product awareness, market development is usually guaranteed (Omotayo & Aremu, 2020). Additionally, awareness enables market actors to develop efficient marketing strategies and competitive advantage over the less aware and also acts as a driver to customer loyalty (Halliru *et al*., 2018). Hence, an increase in product awareness among retailers may possibly improve the portfolio of baobab products in their enterprises and thus enhance market development and commercialization of the products.

2.3.2 Conceptual Framework of Retailer Awareness

Awareness is an important feature in any business as it enables the owners to perform their tasks effectively and on time (Endsley & Garland, 2000). For instance, retailers' awareness of baobab products can improve their decision-making process regarding the products they retail with. This study focused on the individuals who were retailing with at least one baobab product, thus each retailer had to be aware of at least one baobab product i.e. candy. However, some retailers were expected to have in-depth knowledge regarding various baobab products compared to others. Thus, awareness of retailers with less knowledge can be improved through either direct observation, written articles, or verbal communication between stakeholders (Endsley, 2021). Personal attributes, environmental factors, training, and experience are among the key factors associated with awareness (Endsley, 2000; Endsley, 1995a). Hence, a situational awareness framework was adopted in the study.

Situational awareness (SA) takes into consideration variations of individuals' attributes and environmental factors over a period of time to make an appropriate decision for a future course of action. SA follows three steps: perception, comprehension, and projection (Endsley, 1995b). Perceptions of individuals are achieved by understanding the elements in the environment. This can be done by gathering the relevant information in the environment where individuals operate from. Comprehension involves combining, interpreting, and retaining the gathered information to provide meaningful insights in order to achieve an objective. Projection is based on anticipating the future course of

action (Endsley, 1988). Thus, SA is majorly used in the decision-making process (Gonzalez & Wimisberg, 2007).

The study employed the query-based technique of SA to establish the awareness levels of baobab products. Retailers were asked to list the number of baobab products they were aware of against a comprehensive list of products derived from baobab tree. This generated an awareness score. The awareness of retailers regarding baobab products was possibly drawn from fellow retailers, experience gained in retailing, formal training, direct observation, etc. The information gathered from various sources was interpreted and integrated by retailers to enable them make an informed decision regarding their future course of action.

2.3.3 Empirical Literature on the Determinants of Awareness

The level of awareness and knowledge of baobab products among retailers can possibly influence their choice of products to trade with. Therefore, understanding factors influencing their awareness can be used as a benchmark to improve the market share for baobab products in the retail sector. However, there exists a dearth of empirical evidence regarding retailers' awareness of baobab products. Hence, the reviewed literature focused on the awareness of other agricultural value chain actors. For instance,

Joshi *et al*. (2019) investigated the factors affecting the awareness of good agricultural practices (GAP) among banana farmers in Chitwan, Nepal. Stratified sampling technique was used to select 103 households. The binary logit regression model was employed to establish factors influencing the awareness of GAP among banana farmers. Education and training were found to have a significant influence on the awareness of GAP. The study recommended the need to develop training programs related to GAP to improve awareness of GAP among banana growers.

Pambo *et al*. (2014) investigated consumers' awareness and factors influencing awareness of fortified sugar in Kenya. 350 respondents were selected randomly in rural

and urban areas. Descriptive statistics and logit model was used to determine awareness levels of consumers towards fortified sugar and factors influencing awareness of fortified sugar respectively. Descriptive results revealed that about 55% of the respondents were aware of fortified sugar and the awareness levels in urban areas were high and significant compared to their counterparts in rural areas. The results from logit model showed that; age of the consumer, place of purchase, source of information (newspaper), and dwelling place (either rural or urban) influenced consumers' awareness significantly. The study recommended the development of preference-based sugar fortification and education programs that focus on public nutrition in order to maintain and improve awareness levels of sugar fortification.

Omotesho *et al*. (2013) investigated awareness of uses and determinants of usage of the baobab tree in Kwara state, Nigeria. The study employed descriptive statistics and a logit model with 200 respondents who were selected using multistage sampling. Descriptive statistics revealed that about 50% of the respondents were aware of the edibility of different parts of the baobab tree. Nonetheless, there was a low level of awareness (27.3%) about the specific uses of the tree. For instance, 16.2% of the respondents were aware of its use in cosmetics, 5.6% as a source of good oil, and only 24.2% were aware of its use in medicinal field. Additionally, about 32.3% of the respondent revealed that they use baobab as food, while 19.2% of them disclosed that they use baobab as fodder. About 11.1% and 12.1% of the respondents reported that they use baobab occasionally for medicinal and cosmetic purposes respectively. Awareness of baobab use and household income were the main factors influencing baobab usage. The study recommended that the only way to increase awareness levels on usage of baobab tree is through accessible extension services and research.

Rock *et al*. (2017) surveyed awareness levels and factors associated with the consumption of organic food products in the Trichy district, India. The survey adopted descriptive statistics where 300 consumers were selected systematically. Results revealed that about 76% of the consumers were aware of organic food products. Credibility and availability

influenced the consumption organic food products positively, whereas lack of knowledge and difficulty to identify organic products were found to have a negative effect on the consumption of the products. To improve consumption and awareness levels of organic food products, the survey recommended the need for consumers to own organic gardens as well as improve the product features such as packaging, certification, and freshness of organic products.

In conclusion, the reviewed literature has shown that there is a knowledge gap regarding determinants of awareness of baobab in product retailing. Therefore, the review enabled the researcher to hypothesize the possible factors that may have an influence on the awareness of retailers towards baobab products.

2.4 Efficiency of baobab retail enterprise

2.4.1 Overview of Efficiency in Agricultural Enterprises

Efficiency is the backbone to a successful business as it forms the basis for decision-making regarding resource use, output levels, and overall operationalization of activities within the business entity (Chorna *et al*., 2021). Generally, efficiency stems from production theory which explains the relationship between the prices of products and prices of productive factors i.e. prices of inputs. A firm is said to be efficient only if it's operating within the production frontier. The frontier represents the maximum output produced from each level of input used (Coelli *et al*., 2005). Hence, efficiency is a key determinant to the competitiveness and performance of a business entity (Vaz & Camanho, 2012; Barros, 2005).

The efficiency concept is used in myriad disciplines such as production, business operation, organizational management, etc. to assess the performance of entities. It is expressed in three terms namely; economic efficiency (EE), technical efficiency (TE), and allocative efficiency (AE). Economic efficiency is defined as the ability of a firm to allocate and distribute resources optimally to attain a maximum output while avoiding

resource wastage. EE measures the overall performance of a business (EE=TE+AE). TE is referred to as the ability of a firm to produce maximum outputs from a given set of inputs at the least cost or minimize the costs of inputs for a given output (revenue) (Emrouznejad & Cabanda, 2013).

Allocative efficiency (AE) involves a selection of a set of inputs to produce a maximum quantity of output given prevailing input prices (Coelli *et al*., 2005). AE ensures appropriate allocation of productive resources to ensure customer preferences are achieved. In competitive markets, AE is achieved when market prices equal the marginal cost of the products (Hendrani *et al*., 2022). Economic, technical, and allocative efficiency are used either jointly or independently to assess the performance of various entities (Tesema, 2021; Okello *et al*., 2019). However, TE is superior to EE and AE in the context of a business entity as it strives to show how an enterprise achieves optimal revenue with the least costs possible. Thus, the estimation of technical efficiency in candy retailing was more paramount.

2.4.2 Conceptual Framework of Technical Efficiency

Farrell (1957) defined technical efficiency as the ability of a decision-making unit (DMU) such as a firm, business entity, etc. to achieve maximum outputs from a given set of inputs at the least cost. A DMU is any entity that transforms multiple inputs into outputs and its performance can be estimated (Cooper *et al*., 2007). For instance, in production, a DMU is a farm (Emrouznejad & Cabanda, 2013), whereas, in retailing, DMU is a retail enterprise. The TE score is estimated as a ratio of single output to input or as the aggregate of multiple outputs and inputs simultaneously (Barros, 2005). TE is expressed either as an input-oriented or output-oriented approach. In the output approach, a business maximizes revenues from a given bundle of inputs, while in the input approach, the costs and use of input are minimized for a given level of revenue (Ndicu *et al*., 2016). However, an input-oriented approach is preferred if a DMU is a business entity. This is possibly attributed to the assertion that inputs are integral to the business and are within the control of the decision-maker, whereas in the output approach, outputs are dependent on

externalities such as government regulations and are outside the purview of the decision-maker (Pai *et al*., 2020).

Following the generalized work of Farrell (1957), various non-parametric measures of technical efficiency have been suggested. Charnes et al. (1978) proposed the use of the data envelopment analysis (DEA) model that assumes a constant return to scale (CRS) while Banker *et al*. (1984) suggested a DEA model that assumes a variable return to scale (VRS). The DEA CRS model estimates overall technical efficiency (OTE) and assumes a linear relationship between inputs and outputs (Cooper *et al*., 2011). Hence, the OTE scores generated from both approaches are similar (Kumar & Galati, 2008). However, the estimation of TE scores using the DEA VRS model is dependent on the type of orientation (Banker *et al*., 2004). The DEA VRS model is used to estimate the pure technical efficiency (PTE) of a DMU devoid of scale efficiency effects.

Agricultural value chain players use unique sets of inputs to attain desired outputs. The inputs and outputs are based on the type of actors. For instance, in agricultural production, farmers produce at a level where a set of inputs are at the least cost and yields are at the optimal level. These inputs may include labor, fertilizer, seedling, pesticides, etc. while the output is farm yield (Coelli *et al*., 2005). A similar concept can be applied in the retail enterprises (Vaz & Camanho, 2012). For example, in product retailing, outputs are measured in terms of, sales revenues, stock turnover, and gross margin, etc. (Higón *et al*., 2010; Keh, 2000), whereas inputs can be expressed as, hours of an employe, labor, inventory cost, taxes, and transport cost, etc. (Coelli *et al*., 2005; Kamakura *et al*., 1996). In this study, sales revenue was used as output while a set of costs with a direct link to baobab retailing were used as inputs. These costs include; goods sold, labor, municipal fees, transport, sachet, etc. The study adopted an input-oriented approach and a non-parametric model of DEA that assumes variable return to scale to establish the TE of candy retail enterprises.

Banker et al. (1984), demonstrated (Figure 2.1) a simple concept of estimating the technical efficiency of DMU_d using one input (X) to produce a single output (Y), under CRS and VRS assumptions.

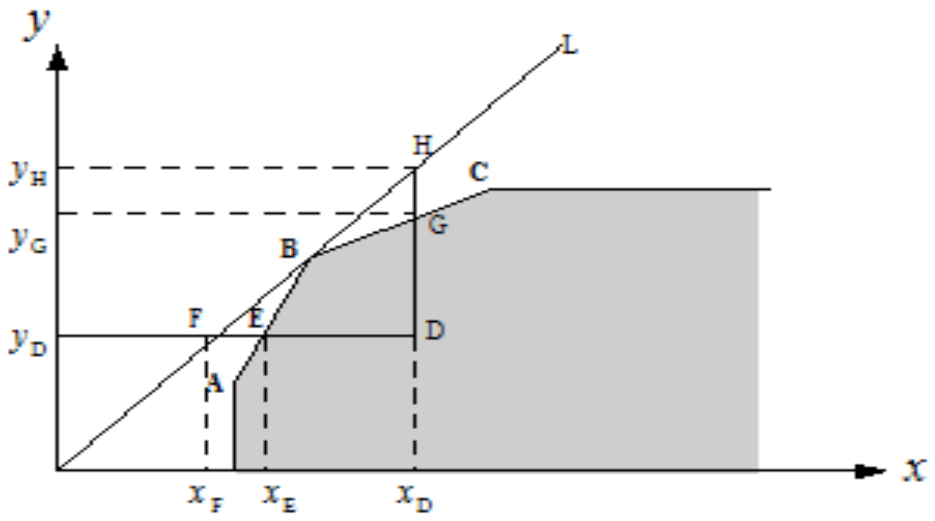

Figure 2.1: Composition of OTE, PTE, and SE

Source: Banker *et al*. (1984)

Figure 2.1 illustrates two efficiency frontiers; one under a constant return to scale (shown by line L) and the other under a variable return to scale assumption (represented by the segment line of ABC). In the input-oriented approach, DMU_d minimizes the use of input X, for a given level of output Y. Thus, the CRS efficiency frontier estimates the overall technical efficiency (OTE) and is defined by $\frac{X_F}{X_D}$. Notably, due to the nature of the CRS frontier slope (CRS=1), the output-oriented approach yields similar results $\left(\frac{Y_D}{Y_H}\right)$, such that $\frac{X_F}{X_D} = \frac{Y_D}{Y_H}$, thus, OTE scores generated from either of the orientation are similar.

The VRS efficiency frontier represented by ABC measures the pure technical efficiency (PTE) of a DMU_d. In the case of an input-oriented approach, PTE is estimated as $\frac{X_E}{X_D}$,

whereas, if the orientation is output based, the PTE is defined by $\frac{Y_D}{Y_G}$. Hence, the PTE scores generated from input or output approach differ significantly. The scale efficiency in input and output oriented is represented by $\frac{X_F}{X_E}$ and $\frac{Y_G}{Y_H}$ respectively.

2.4.3 Empirical Literature on Technical Efficiency in the Agricultural Sector

A business entity is required to perform at its best to ensure its survivability and competitiveness. Technical efficiency is among the key techniques used to assess the performance of enterprises (Ndicu *et al*., 2016). However, there is dearth of information regarding the performance of candy enterprises in Kenya. Therefore, this study reviewed literature on technical efficiency of other agricultural players along the value chain.

Miassi *et al*. (2023) established the level of technical efficiency and factors influencing TE in rice production in Benin. The survey adopted a simple random sampling technique to select 200 rice farmers. Multivariate analysis of the DEA and Tobit model were used to determine the level of technical efficiency and its determinants respectively. DEA result revealed an average technical efficiency of 0.51, indicating that rice farmers achieved efficiency level of about 51%. Age, household size, experience, input use and amount of agricultural credit were the significant factors influencing the TE in rice production. The study recommended development of agricultural policies targeted to determinants of technical efficiency in rice production.

Anang. (2021), estimated the technical efficiency and scale efficiency of groundnut farmers in Tolon district, Ghana. The study employed DEA and Tobit model to evaluate efficiency scores and determinants of efficiency respectively. A sample size of 158 respondents were selected randomly. DEA results revealed that farmers were 70% technically efficient under VRS assumption and 73% scale efficient. Gender, farming experience, household size, extension contact, participation in off-farm work, and pest and disease incidence influenced the TE of the farmers significantly, while scale efficiency was influenced by educational status, household size, group membership and

farm size. The study recommended formulation of policies that promotes efficiency at the farm level. The policies should focus on promotion of formal education in rural areas, incentivization of farmer groups to offer beneficial services to members and expansion of extension access to rural farmers.

Majiwa *et al*. (2018) evaluated the TE of rice processing in Kenya with a special focus on postharvest handling. The study adopted network DEA and fractional regression to estimate efficiency scores and their determinants respectively. The sample size of 150 rice millers were selected randomly with 27 of them engaging in drying and milling practices while the remaining 123 were involved in milling alone. The network DEA results showed a low-efficiency score as only three millers were technically efficient. Distance to the market and storage space influenced the drying TE; while age of the mill, experience in milling, and energy type used influenced milling TE. The study recommended the need to invest in drying technologies and storage facilities that can improve the efficiency of drying. Also, the study recommended development policies that can enhance investment in reliable energy sources and post-harvest handling in milling to reduce PH losses.

Perrigot & Barros (2008) investigated the technical efficiency of French retailers using panel data from eleven French grocery companies for the years 2000 to 2004. Data Envelopment Analysis (DEA) and bootstrapped Tobit model were used for analysis. DEA revealed a high level of efficiency among French retailers with an average of 0.987 in constant return to scale and 0.993 in variable return to scale. The Tobit model observed that quotation, group membership, and involvement in internationalization influenced technical efficiency significantly. The study concluded that the scale of operation is the major issue in measuring the performance of retailers.

The reviewed literature has shown that there exists a shortage of information regarding technical efficiency at the retail level of agricultural value chains and especially for IFTs products such as baobab. Therefore, these observations provide a basis to investigate the technical efficiency levels and their determinants in baobab candy retailing enterprises.

2.5 Conclusion

The reviewed literature has shown the existence of a knowledge gap regarding various aspects of baobab retailing in Kenya. First, the characterization and typologies of baobab retailers remain undocumented. Secondly, empirical evidence on retailers' awareness towards various baobab products remains scarce and unknown. Lastly, there exists a knowledge gap regarding the level of technical efficiency of candy retailing enterprises. Therefore, this study sought to fill in these knowledge gaps.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter discusses the research methodology applied in this study. It provides a theoretical framework, econometric models, and measurement of variables used in the study. It also describes the study sites, research design, and sampling. Additionally, this chapter provides an overview of the research tool used for data collection and data analysis procedures.

3.2 Retailers Characterization

3.2.1 Theoretical Framework of Characterization

The main goal of characterization is to determine various clusters of baobab candy retailers, whereby each cluster exhibits different attributes. It is a two-stepwise process. First, it involves identifying and describing factors responsible for variations between the retailers. This process simplifies the complex nature of retailers since they are unique and heterogeneous in their operations. Different factors contribute to the variations of value chain players. For instance, Otieno *et al*. (2021) revealed that smallholder dairy farmers differed due to household income, access to land, milk output, and access to infrastructure. Muriungi *et al*. (2021) noted that variations of baobab processors are as a result of their social-economic characteristics, inputs, income, and outputs. Retailers use varying quantities of resources during trading, marketing, repackaging, and holding stock. Hence, variations of baobab retailers can be as a result of their social-economic characteristics, sales volumes, costs of retailing, retailing revenues, etc.

The second step involves grouping baobab retailers with relatively similar characteristics under the same cluster/typology whereby each cluster exhibits a unique attribute. The grouping enables the formulation of appropriate policies for a specific cluster of retailers.

Also, characterization provides a suitable framework for the recommendation domain (Chatterjee *et al*., 2015). Thus, placing retailers in their respective clusters will help in formulating suitable recommendation domains and disseminating relevant information to improve their retailing activities.

3.2.2 Econometric Specification of Characterization

Characterization of baobab candy retailers was done using two sequential multivariate statistical techniques of principal component analysis (PCA) and cluster analysis (CA). PCA was used to reduce a large set of interdependent variables into a smaller set of independent variables while retaining most of the information from the original data set (Jollife & Cadima, 2016). The main aim of PCA is to reduce the dimensionality of the data set, so as to define the differences within the correlated variables in terms of a separate set of uncorrelated variables each being combined linearly (Rahman & Rahman, 2020). In the study, PCA was used to generate fewer uncorrelated variables called principal components (PCs) which are the linear amalgamation of the original variables. from baobab candy retailers/enterprises.

PCA assumes normality of data, sampling adequacy, and matrix factorability (Suhr, 2006). To ascertain these assumptions, data was subjected to Kaiser-Meyer Olkin (KMO) and Bartlett's Test of Sphericity (BTS) to assess sampling adequacy and matrix factorability respectively. KMO greater than 0.5 and BTS with a significant value of less than 0.05 are considered adequate (Field, 2005). The data was adequate for PCA as a KMO value of 0.839 and BTS of 2511.79 with a p-value of 0.000 was achieved. The identified PCs were rotated using an orthogonal varimax approach to obtain a simple structure and enhance the interpretation of the factor loadings. Based on the Kaiser rule, factors with eigenvalues greater than one were retained and used as inputs in cluster analysis. The PCs were arranged sequentially, starting with the one with the highest proportion of variance to the lowest.

The econometric procedure for PCA involves a data set with an observation p variable for each n individual. Hence, these values in the data set define p n-dimensional vectors. Assume x is a vector of random variable n and the transpose of x^T. Therefore,

$$x = [x_1, x_2, \dots, x_t]^T \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots 3.1$$

The first step will be to find the highest variance of element x from a linear function of $\alpha_1^T x$ where α_n is a vector of n constant $(\alpha_{11}, \alpha_{12}, \dots, \alpha_{1n})$ so that,

$$\alpha_1^T x = \alpha_{11}x_1 + \alpha_{12}x_2 + \cdots + \alpha_{1n}x_n = \sum_{j=1}^{n} \alpha_{1j}\, x_j \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots 3.2$$

Secondly, it is important to find a linear function of $\alpha_2^T x$ which is uncorrelated to $\alpha_1^T x$ and has the highest variance. Similarly, it is important to find a linear function of $\alpha_3^T x$ that is uncorrelated to $\alpha_2^T x$ and $\alpha_1^T x$. This process continues until the n^{th} linear function is formed, such that the k^{th} function is uncorrelated with $\alpha_1^T x, \alpha_2^T x \dots, \alpha_{k-1}^T$. Thus, a new n random variable called the principal component is formed (Jolliffe, 1986). The PCs in the study were derived as follows;

The first component was defined by a linear combination of x variables with the highest variance. M denoted a non-singular covariance and a positive matrix of random variable x with n dimensions, such that element (i, j) of matrix M expresses the covariance between x_i and x_j where $j \neq i$. This step involves finding vectors of α_1 that maximize the variance of $\alpha_1^T x$ and was expressed as;

$$Maximize\ var[\alpha_1^T x] = \alpha_1^T \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots 3.3$$

To fully achieve the maximum variance, the normalization constraint $(\alpha_1^T \alpha_1 = 1)$ with the Lagrange multiplier (λ) was imposed in equation 3.3. The constraint is given by equation 3.4

$$\alpha_1^T = \sum_{i=1}^{r} \alpha_{1i} x_i \quad \ldots 3.4$$

To maximize the variance ($\alpha_1^T x$) subject to constraint was given as;

$$Maximize\ \alpha_1^T \sum \alpha_1 - \lambda(\alpha_1^T \alpha_1 - 1) \quad \ldots 3.5$$

Differentiating equation 3.5 with respect to α_1, the results are as follows;

$$\sum \alpha_1 - \lambda \alpha_1 = 0 \quad \ldots 3.6$$

It can also be written as $(\Sigma - \lambda I_n)\alpha_1 = 0$ ... 3.7

WhereI_n, represents $(n \times n)$ identity matrix, α_1 eigenvector, and λ eigenvalue of Σ. The next step was achieved by selecting the eigenvectors that produced the highest value for the first PC. To achieve this, λ was expected to be the largest eigenvalue. Thus, α_1 was an eigenvector that corresponded to the largest eigenvalue.

$$\alpha_1^T \sum \alpha_1 = \alpha_1^T \lambda \alpha_1 = \lambda \alpha_1^T \alpha_1 = \lambda \quad \ldots 3.8$$

A similar process was adopted to find other principal components such that the k^{th} component of x is $\alpha_k^T x$ and its variance is λ_k. Therefore, λ_k is the k^{th} biggest eigenvalue whereas α_k is the corresponding eigenvector of Σ, where k =1, 2…, n (Jolliffe, 1986).

After identifying all the PCs, the study adopted cluster analysis (CA) to characterize candy retailers. The components were used as inputs in CA. This approach was preferred since there was no prior knowledge regarding baobab candy retailers. Further, CA establishes the variables in a data set that are unrelated to one another and are homogeneous within themselves. Therefore, baobab candy retailers with relatively similar attributes were grouped in the same cluster.

3.2.3 Estimation Procedure for Retailer Characterization

Characterization of retailers refers to a process of identifying and describing various categories of baobab candy retailers. The study adopted two sequential steps to characterize baobab retailers. In the first step, 12 socioeconomic variables describing candy retailers, and existing business attributes were used in PCA. The variables are presented in Table 3.1.

Table 3.1: Key Variables Used in Retailer Characterization

Variable	Variable description	Units of Measure
Age	Age of retailers	Years
Education level	Years in formal education	Number of years
Experience	Years in baobab retailing	Number of years
Market distant	Distant to the market	Kilometers
Business registration	Formal enterprise registration	Yes=1, No=0
Weekly revenue	Candy enterprise revenue	Ksh per week
Weekly cost	Candy retailing costs	Ksh per week
Business operation	Daily enterprise operation	Hours per day
Credit	Access to credit facility	Yes=1, No=0
Training	Access to formal training	Yes=1, No=0
Group Membership	Membership to a group	Yes=1, No=0
Retailer income	Income from other sources	Ksh per month

Ksh=Kenya Shilling

The correlated variables were condensed into a new set of uncorrelated variables called principal components. The new set of components was then rotated using an orthogonal varimax approach, and the highly correlated variables were placed under the same factor. This rotation was suitable since it assumes that all factors are uncorrelated to each other (Dean, 2009). The factors with an eigenvalue greater than one were retained, explained, and used as inputs in CA.

In the second stage, the retained factors from PCA were used in CA to identify various clusters of candy retailers. Retailers with similar attributes were grouped under the same

cluster. Agglomerative hierarchical and partitioning clustering were employed to establish the number of clusters in baobab candy retailing. Hierarchical clustering was used to form K-clusters by joining two clusters from K+1 while the partitioning method was used to separate the observations in the clusters. A dendrogram was used to identify the number of clusters. One-way Analysis of Variance (ANOVA) was used to determine the differences in variance between the clusters.

3.3 Retailer Awareness

3.3.1 Theoretical Framework of Retailer Awareness

Awareness is a key determinant of the decision-making process in product retailing. It enables retailers to answer questions such as; what product to trade with, why trade with a certain product over the other, and how much should be traded to achieve the desired goal. Awareness is based on the premise that an individual cannot know what they are not aware of. Therefore, awareness does not occur in a vacuum (Devanur & Fortnow, 2009). Nonetheless, awareness can be improved through understanding and interpreting factors associated with it. These factors may include, personal attributes, environmental factors, experience, training, etc. (Endsley, 2000). In this study, the targeted respondents were retailers who traded with baobab products. Therefore, they had to be aware of at least one baobab product. The study adopted a situational awareness (SA) framework to establish the retailer's awareness score and its determinants.

SA takes into account elements within an environment where individuals operate from. To achieve awareness, three steps of SA are considered. First, the perception status and attributes of an individual towards a situation or a product are key determinants of awareness. This can be achieved either through direct observation, verbal communication, or reading published articles. For instance, a retailer can improve his awareness level by observing the baobab products traded in the markets. Awareness can also be drawn from individuals with in-depth knowledge regarding various baobab products or from published articles on baobab. The second step involves comprehending the meaning of

the elements and integrating them to achieve a desired goal. For example, after gathering relevant information concerning various baobab products, retailers may draw conclusions on various products derived from baobab plant. Lastly, upon extracting and interpreting the meaning of retained information, the individual may project a future course of action (Endsley, 2021), which in this case, a retailer may decide to increase the number of baobab products they trade with to improve their revenues. Furthermore, SA represents human knowledge and the understanding of the present situation or a product (Endsley, 2000).

Various measurement techniques of SA are used to establish the awareness levels of individuals toward a product. They include physiological measures, subjective measures (self-rating, observation rating, and query-based), and performance measures (Endsley, 1995a). However, in the study, subjective query-based technique was adopted. This method was suitable since it enabled the researcher to evaluate the awareness level of retailers toward various baobab products against a comprehensive list of products drawn from the baobab tree, thus providing objective assessments. Additionally, the method provides empirical validity and reliability of elements since it does not suffer from the limitation of human memory and is not intrusive to subjective behavior (Endsley, 1995a). An exhaustive list of baobab products was compiled and used as a benchmark to assess the actual awareness level of retailers. A detailed list of questions regarding awareness of various products was administered to the respondents, allowing ample time for responses. After completion of the first question, the respondents were subjected to the other questions until the list was exhausted. This generated the awareness score. The score was regressed with various variables hypothesized to influence awareness of retailers toward baobab product using zero-truncated poison (ZTP) model.

3.3.2 Econometric Specification of Zero Truncated Poison Model

Various analytical models have been employed to investigate the determinants of awareness of various value chain actors. However, majority of the studies have adopted models with a binary variable as a dependent variable (Büyükkaragöz *et al*., 2014; Pambo et al., 2014), whereas, others have used descriptive statistics to assess factors associated

with awareness (Rock *et al*., 2017; Omotesho *et al*., 2013). Nonetheless, there exists a paucity of studies that adopted a non-negative variable as a dependent variable. Therefore, the study employed a zero-truncated poison (ZTP) model to establish the determinants of retailer awareness towards baobab products. The model was suitable since it uses count data above the truncation point of zero and assumes non-negative integers (Shanker, 2017). The targeted respondents were retailers who traded and specialized with at least one baobab product (candy). Hence, ZTP model was used as there was no possibility of zero occurrence.

The model used was presented as:

$$p\langle y_i/y_i \succ 0, x) = \frac{p\langle y_i/x)}{p\langle y_i \succ 0/x)} = \frac{\mathcal{u}^{\,y_i}\exp(-\mathcal{u})}{y_i\big(1-\exp(\mathcal{u})\big)}, y_i = 1,2,3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.9$$

Where$(y > 0)$ and is the dependent variable.

Derived log-likelihood for the above distribution function is;

$$LL(\mu; x) = y_i\, Log\ (\mu) - \mu - Log\Gamma\ (y_i + 1) - \log(1(e^{-\mu}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.10$$

Log-likelihood in equation (ii) is parameterized in terms of linear predictor x

Where $\mu = e^{\boldsymbol{x\beta}}$ which forms;

$$LL(\beta; x) = y_i\, x\beta\ -\ e^{x\beta} - log\ \Gamma(y_i + 1) - \log\big(1 -\ e^{(-\boldsymbol{e})}\big) * \beta \ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.11$$

According to Cameron & Trivedi (1999), robust standard errors are recommended for Poisson models. Therefore, differentiating equation 3.11 will give us a basis for the robust score and is calculated as;

$$y - \exp(x\beta) - \frac{\exp(\boldsymbol{x}\beta)\exp\big(-\exp(\boldsymbol{x}\beta)\big)}{1-\exp(-\exp(\mathrm{x}\beta))} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.12$$

Where; y = Number of baobab products the respondent is aware of.

x =Explanatory variables.

μ = Poisson distribution means.

β = linear predictor of random variable response.

The study adopted parametric tests that assumes normal distribution criteria for the parameters within the population distribution from which the sample is drawn (Uchechi, 2019). Variables used in the model were subjected to normal distribution tests such as skewness and kurtosis. Skewness and kurtosis with a *p*-value> 0.05, indicates that variables are normally distributed.

3.3.3 Estimation Procedure for Determinants of Retailer Awareness

Majority of the studies so far have linked retailer awareness to "brand awareness". However, in this study, retailer awareness was defined as the ability of the retailer to recognize or recall various products derived from baobab tree. Moreover, the reviewed literature on the determinants of retailer awareness revealed scanty references. Therefore, the variables used in the study were drawn from other related studies (Pambo *et al*., 2014; Omotesho *et al*., 2013). Retailers were asked to list the number of baobab products they were aware of. This generated an awareness score. The score was used as a dependent variable in the zero-truncated poison (ZTP) model.

A normal distribution test was conducted on all continuous variables used in the model. Years in baobab retailing, distance to the market, and income from other sources did not adhere to the criterion. Hence, they were transformed. Field (2005), suggested the use of natural logarithm i.e. $log\ (x_i)$ when transforming variables with non-zero value and $log(x_i + 1)$ if the variables have zero value. A key observation from the study was that some retailers had been involved in baobab retailing for a few months prior to the survey and had covered zero distance to the market as the products they traded with were delivered directly to their stores. Hence, $log(x_i + 1)$ method was used to transform the variables. In regard to income from other sources, all respondents had earned a monthly

income of more than Ksh 1000 from non-retailing activities. Therefore, $log\ (x_i)$ was used to transform the variable. The variables used in the model are presented in Table 3.2.

A diagnostic test for statistical problems such as multicollinearity was used to assess the suitability of the variables used in the model. Variance Inflation Factors (VIF) were computed for each variable to detect multicollinearity between independent variables. This involved estimating ordinary least squares regression between each retailer characteristic as the dependent variable with the rest set as independent variables (Otieno, 2013). The VIF for each variable was calculated as;

$$VIF_i = \frac{1}{1 - R_I^2} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad 3.13$$

Where R_I^2 is R^2 of the artificial regression with the i^{th} independent variable as a dependent variable. VIF <5 suggests the absence of significant multicollinearity (Becker et al., 2015).

The study findings observed that the mean VIF was 1.84, with individual VIF ranging from 1.22 to 2.58, thus indicating the absence of serious multicollinearity. Hence, the variables shown in Table 3.2 qualified for inclusion in the ZTP model.

Table 3.2: Description of Variables Hypothesized to Influence Retailer Awareness

Variable	Variable description and unit	Hypothesized Effect
Gender	1 = Male; 0 = Female	+, -
Age	Age of the retailer in years	+
Education level	Years spent by retailers in school	+
Market distance	Distance to the market in kilometers	-
Years in business	Number years in baobab retailing	+
Group Membership	1=; Member; 0 = Not a member	+
Retailer income	Monthly income (other sources); Ksh	+, -
Formal training	Access to training; 1=Yes; 0=No	+

3.4 Technical Efficiency

3.4.1 Theoretical Framework of Technical Efficiency

The theoretical foundation of technical efficiency is derived from production theory, which deals with the decision-making process regarding the quantity of the commodity to produce given a proportion of inputs (Coelli et al., 2005). Technical efficiency (TE) involves minimizing the use of inputs for a given level of outputs (input-oriented) or maximizing the outputs from given inputs (output-oriented). Hence, TE forms a basis for the decision-making units (DMUs) regarding the resource use. A DMU is any entity responsible for making decisions, for which performance can be estimated. In the current context, a DMU was a candy retailer/enterprise.

Technical efficiency can be estimated by either parametric or non-parametric measures. Parametric measures involves specifying stochastic cost/production frontiers, whereby outputs are assumed to be the function of inputs and random error (Linh, 2012). For non-parametric approaches such as data envelopment analysis (DEA), prior functional forms relating to outputs and inputs are ignored (Banker et al., 1984). Hence, the variables used in the DEA model are less prone to misspecification and can be quantified using different units of measure (Wang & Lan, 2011; Ayaz *et al*., 2010). Unlike stochastic frontier analysis (SFA), which estimates the overall technical efficiency (OTE), DEA decomposes OTE into pure technical efficiency (PTE) and scale efficiency (Bogetoft & Otto, 2011). Thus, DEA is more preferred compared to parametric approaches such as SFA when estimating the TE of DMUs. DEA also assumes that the weight for each variable is unconstrained, whereas the SFA hypothesis is vice versa (Barros, 2005). This is an important difference for DEA since all the variables with possible or unknown effects on technical efficiency can be included in the model (Cooper *et al*., 2011). Moreover, due to the dynamics of product retailing, various studies have recommended the application of the DEA model when evaluating the TE of retail enterprises (Perrigot & Barros, 2008; Thomas *et al*., 1998; Kamakura *et al*., 1996). Therefore, the choice of DEA in the current

context was driven by the intrinsic merits of the model over the other techniques used to measure relative efficiencies

3.4.2 Econometric Specification of DEA Model

The DEA model was employed to estimate the TE of candy retail enterprise by comparing its inputs and outputs with the inputs and outputs of all other homogeneous enterprises under consideration. The enterprise with the highest TE score (TE score $= 1$) is used as a basis for comparison (Donthu & Yoo, 1998). Various DEA models such as Charnes, Cooper, and Rhodes (CCR) (Charnes *et al*, 1978), Banker, Charnes, and Cooper (BCC) (Banker et al., 1984), multiplicative (Charnes *et al*., 1982), and additive (Charnes *et al*.,1985) are used to estimate TE. However, if the inputs and outputs of DMUs are positive integers, DEA CCR and BCC are commonly used (Dobos & Vörösmarty, 2020; Coelli *et al*., 2005).

The CCR model was originally suggested by Charnes *et al*. (1978) and was named CCR model after the developers i.e. Charnes, Cooper, and Rhodes (CCR). The model estimates the OTE of homogeneous DMUs operating at optimal scale and assumes a constant return to scale (Cooper *et al*., 2011). The CCR model estimates the TE as a ratio of outputs to inputs and assumes a linear relationship between outputs and inputs. Therefore, the TE scores from the CCR model are similar whether in an input or output-oriented approach (Kumar & Galati, 2008). According to Charnes *et al*. (1978), the CCR model can be illustrated as follows;

Assume a set of observed n DMUs (candy enterprises) such that DMUj $\{j = 1,2,3 \dots \dots n\}$ uses m inputs $\{x_{ij}; i = 1,2,3 \dots \dots . m\}$ to generate s outputs $\{y_{rj}; r = 1,2,3 \dots \dots \dots . s\}$. Thus, the efficiency score of jth DMU can be obtained as a maximum ratio of weighted outputs to weighted inputs for all the DMUs, subject to a constrain that the ratios of all the other DMUs are less than or, equal to one (Charnes *et al*., 1978). This results in a non-linear fractional programming (FP) model. Mathematically, the FP model is presented as;

$$(F.P) \quad \text{Max}_{U_i, V_i}\, \theta_{j0} = \frac{\sum_{r=1}^{s} u_r\, y_{rjo}}{\sum_{i=1}^{m} v_i\, x_{ij0}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.14$$

Subject to;

$$\frac{\sum_{r=1}^{s} u_r\, y_{rj}}{\sum_{i=1}^{m} v_i\, x_{ij}} \leq 1, \quad \text{j} = 1, 2, \ldots\ldots, j_0 \ldots\ldots \text{n}$$

$$u_{r,} \geq 0, v_i \geq 0\ , r = 1, 2, \ldots\ldots\ldots s, \quad and\ i = 1, 2, \ldots\ldots\ldots m$$

Where;

y_{rj0}= the amount of r^{th} output generated by candy retail enterprise j_0 (DMU_{j0})

x_{ij0}= the amount of i^{th} input used by retailer j_0 (DMU_{j0})

u_r= the weight chosen for r^{th} output (price of sales)

v_i= the weight given to i^{th} input (Cost of inputs)

n= number of baobab candy enterprises (352 enterprises)

s= number of output (sales)

m= number of inputs (6 inputs were used as indicated in Table 3.3).

To simplify the estimation of technical efficiency, FP (equation 3.14) is transformed into equivalent linear programming (LP) problem. The transformed LP can be illustrated as;

$$(L.P) = Max_{u_{i,}\, v_{i,}}\, \theta_{j0} = \sum_{r=1}^{s} u_r\, y_{rjo} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.15$$

Subject to,

$$\sum_{r=1}^{s} u_r\, y_{rj} - \sum_{i=1}^{m} v_i\ x_{ij} \quad \leq 0 \quad j = 1, 2, \ldots\ldots\ldots\ldots n$$

$$\sum_{i}^{m} v_i \; x_{ij0} = 1$$

$$u_{r,}, v_i \geq 0$$

The CCR model presented above (equation 3.15) is input-oriented, where the enterprise (DMU) minimizes the use and cost of inputs to attain desired revenue. The enterprise ($DMUj_0$) can only be fully efficient if $\theta^* = 1$ and there is at least one optimal(v^*, u^*), such that $v^* > 0$ and $u^* > 0$. Otherwise, the enterprise will be inefficient (Iqbal & Awan, 2015). Therefore, the CCR model is only suitable when estimating the overall technical efficiency (OTE) of an enterprise operating at an optimal scale (Barros & Perrigot, 2008). However, due to financial constraints, imperfect competition, scale of operation, and government regulation, an enterprise may not attain optimal scale. Thus, the estimated OTE may be confounded with scale inefficiencies (Kumar & Galati, 2008). To overcome this inadequacy, BCC model was proposed by Banker *et al*. (1984) as an alternative.

The BCC model named after Banker, Charnes, and Cooper is used to estimate pure technical efficiency (PTE) of an enterprise devoid of scale efficiency (SE) effects (Barros & Perrigot, 2008). The model assumes a variable return to scale (VRS) and is dependent on the type of orientation used (input or output), such that if a DMU adopts either of the orientation, the results of PTE scores are likely to be different (Banker *et al*., 2004). However, if a DMU is a business entity, an input-oriented approach is preferred. This is possibly attributed to the assertion that inputs are integral to the business and are within the control of the decision maker whereas, outputs are dependent on externalities such as government regulations and are outside the purview of the decision-maker (Pai *et al*., 2020; Akazili *et al*., 2008).

PTE involves a pure conversion of inputs into outputs, irrespective of whether an enterprise is operating at a constant return to scale (CRS), increasing return to scale (IRS), or decreasing return to scale (DRS). Thus, the PTE score estimates the extent to which a business reduces its inputs proportionately and still remains within the VRS frontier (Iqbal

& Awan, 2015). Under the BCC model, a candy enterprise is technically efficient only if it is operating within the VRS frontier.

Scale efficiency (SE) is used to measure the extent to which a business reduces its inputs at a fixed proportion until it reaches a beneficial return to scale frontier (Iqbal & Awan, 2015). The SE is expressed as a ratio of BCC and CCR scores. If $\text{BCC scores} \geq \text{CCR scores}$, then, $\text{the SE score} \leq 1$ (Iqbal & Awan, 2015). The study employed the input-oriented BCC model to estimate the PTE scores of candy retail enterprises. The model was modified from a CCR linear programming problem by introducing a convexity constraint $(\lambda = 1)$ (Banker et al., 1984). The linear program (LP) problem can be presented as;

$$(\text{LP}) \quad Min_{\theta_{j0},\lambda}\, \theta_{j0} \; - \varepsilon(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+), \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.17$$

Subject to,

$$\sum_{j}^{n} x_{ij}\lambda_j + s_i^- = \; \theta_j x_{ij0} \qquad\qquad i = 1, 2, 3, \ldots\ldots\ldots\ldots, m$$

$$\sum_{j}^{n} y_{rj}\lambda_j - s_r^+ = y_{rj0} \qquad r = 1, 2, 3, \ldots\ldots\ldots\ldots\ldots, s$$

$$\sum_{j}^{n} \lambda_j = 1$$

$$\lambda_j \geq 0, \quad s_r^+ \geq 0, \qquad s_i^- \geq 0$$

The notations used in the above equation are similar to those in equation 3.15. However, the few added represent;

ε= a positive non-Archimedean element defined as a smaller than any positive number ($\varepsilon > 0$).

s_i^- And s_i^-= non-negative slack variables (s_i^- & s_i^+ ≥ 0)

θ_{j0} = scalar

From equation 3.17, a dual form of BCC input-oriented model can be formulated as;

$$\text{Max z} = \sum_{r=1}^{s} u_r\, y_{rjo} - u_{j0}, \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots .3.18$$

Subject to;

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} - u_{j0} \leq 0, \qquad j = 1, 2, \ldots \ldots j_0, \ldots \ldots \ldots, n$$

$$\sum_{i}^{m} v_i x_{ij0} = 1,$$

$$v_i \geq \varepsilon, u_r \geq \varepsilon, and \;\; u_{j0} \; is \; free \; in \; sign$$

Where z and u_{j0} are scalars. The u_{j0} value is unconstrained in sign. i.e. It may be positive, negative, or zero. Based on the BCC model (equation 3.18), IRS and DRS for enterprise j_0 will prevail only if $u_{j0} < 0$, and $u_{j0} > 0$ respectively for all optimal solutions while CRS prevails only if $u_{j0} = 0$ for at least one optimal solution (Banker et al., 1984).

3.4.3 Estimation Procedure for Technical Efficiency

The estimation of technical efficiency is fundamental to product retailing since it measures the rate at which an enterprise converts its inputs into outputs. The conversion is either through minimizing the use and costs of inputs for a given level of revenue or

maximizing the revenues from a given set of inputs (Ayaz *et al*., 2010). Various DEA models are used to estimate TE in product retailing. However, the study adopted an input-oriented BCC model. The model was suitable since it estimates pure technical efficiency, irrespective of whether an enterprise is operating at CRS, IRS, or DRS. Additionally, BCC provides better results of technical efficiency compared to other DEA models (Fatimah & Mahmudah, 2017).

DEA requires the identification of inputs and outputs. However, due to the scarcity of existing literature regarding candy enterprises, variables used in the model were drawn from other related studies (Yoko & Yoshihiko, 2016; Gandhi & Shankar, 2014; Perrigot & Barros, 2008). Output was measured in terms of sales revenue while inputs were expressed in terms of cost of sales, labor, packaging, transport, municipal fees, and total number of hours involved in operating candy enterprises. Weekly recall period was adopted in the study. This recall proved to be more effective since the respondents were able to remember correctly the cost of inputs and revenues on weekly terms compared to monthly or annual basis. The variables used in the model are presented in Table 3.3.

Table 3.3: Description of Variables Used to Estimate Technical Efficiency

Variable	Variable description	Unit of measure
Sales	Revenue from baobab candies	Ksh
Cost of sales	Cost of goods sold	Ksh
Labor	Cost of labor	Ksh
Packaging cost	Cost of sachets	Ksh
Municipal levy	Municipal fee	Ksh
Transport	Cost of transport	Ksh
Business operation	Number of hours in operating candy enterprise	Hours per week

Ksh=Kenyan Shillings.

Further, the general rule of thumb of DEA was applied in the study. The rule stipulates that the minimum number of DMUs should be greater than three times the number of inputs plus outputs (Gandhi & Shankar, 2014). In the study, the number of inputs plus output was seven and its three times value is 21. Thus, the rule was adhered to since the number DMUs were more than 21.

3.3.4 Econometric Specification of Tobit Model

Given the bounded nature of technical efficiency (ranging between 0 and 1), the TE scores obtained from the BCC model were regressed with explanatory variables using Tobit model. Tobit model was suitable since it describes the relationship between a continuous non-negative dependent variable with independent variables (Tobin, 1958). In addition, when compared to ordinary least square (OLS) models, Tobit model is more superior as it censors out the observations with lower limit scores (Wilson & Tisdell, 2002). Further, unlike OLS which assumes a normal distribution of the data and homoscedasticity of the disturbance, Tobit is nonlinear and the expected errors are usually not equal (Ismail, 2015; Weiss, 1993). Hence, the estimated parameters using Tobit model are free from bias.

The DEA model is a non-parametric measure. Therefore, the scores generated from the BCC model are relative rather than absolute, and thus they may be correlated with explanatory variables. This implies that if the scores are used directly in the standard Tobit model, the coefficients of the estimated parameters may be inconsistent or biased (Perrigot & Barros, 2008). To overcome this statistical problem, Tobit model was bootstrapped to provide consistent and reliable estimates. Bootstrapping procedure substitutes the Tobit estimators with bootstrap estimators to allow the calculation of standard errors in the estimates (Atkinson & Wilson, 1995).

Determining factors influencing technical efficiency in baobab candy retailing is paramount to the performance and survivability of the candy enterprises. This is because the units responsible for inefficiencies and wastage of resources can be identified and thus, provide a basis for improvement of such units. Despite the outstanding use of technical efficiency in measuring the performance of business entities, there exists an empirical knowledge gap regarding determinants of TE in baobab candy retailing. Thus,

the variables used in the Tobit model were drawn from other related studies (Ayaz et al., 2010; Perrigot & Barros, 2008; Crespi & Alvarez, 2003).

The general form for the Tobit model can be expressed as follows;

$$y^{*}i = \beta' x_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .3.19$$

Where $y^{*}i =$ is the latent dependent variable with limited values between 0 and 1 i.e., technical efficiency scores obtained from BCC model. $i =$ the number of observations.

β'= a vector of unknown coefficients to be estimated

x_i= a vector of the explanatory variables that influence the level of technical efficiency.

ε_i= error term assumed to be normally distributed with a zero mean and constant variance

The censoring problem is denoted by y and can be defined as;

$$y = y^{*} if\ y^{*} > y_0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.20$$

$$y = 0\ if\ y^{*} \leq y_0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.21$$

For a sample of N independent observation, the Tobit model is estimated using a maximum likelihood estimate (MLE). Therefore, the log-likelihood of the Tobit model can be presented as;

$$\ln L_N(\theta) = \sum_{i=1}^{N} \left\{ d_i \ln f^{*}(y_i /\ x_i, \theta) + (1 - d_i) \ln F^{*}(L_i /\ x_i . \theta) \right\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.22$$

From equation 3.22, three conditional expectations in the Tobit model can be drawn i.e. condition underlying the latent variable y^{*}, the condition of the observed dependent

variable (y), and the condition of an unobserved variable $y/y \succ 0$. Ward's chi-square test was used to assess the goodness of fit of the Tobit model. The variables used are presented in Table 3.4 below.

Table 3.4: Description of Variables Used in the Tobit Model

Variable	Variable description and units	Expected Effect
Gender	1 = Male; 0 = Female	+, -
Age	Years attained by the retailer	+, -
Household size	Number of household members	+
Experience	Years of candy retailing	+
Credit	Access to credit; 1 = Yes; 0 = No	+
Group membership	1 = Member; 0 = Not a member	+
Business registration	1 = Yes; 0 = No	+
Market distance	Distant to the market in Kilometers	-
Other income	Monthly income from other sources	+, -
Formal training	Access to training; 1 = Yes; 0 = No	+

Ksh= Kenyan Shilling

3.5 Data Sources and Collection

3.5.1 Description of Study Sites

The study was conducted in various counties in Kenya. Kitui, Garissa, Makueni, Kilifi, Wajir, Marsabit, Taita Taveta, and Lamu counties were selected purposively to represent rural township markets while Mombasa represented urban markets. Apart from Mombasa County, whose markets operate on a daily basis, the main markets in Makueni, Kilifi, Kitui, Lamu, and Taita Taveta were selected to represent the rural township markets as they fall within the baobab-growing belt (Fischer *et al*., 2020; Kiprotich *et al*., 2019) and their operations were limited to a specific day of the week. Moreover, Garissa, Wajir, and Marsabit counties fall outside the belt. However, the markets from the counties were

selected to represent rural townships as they host majority of baobab retailers, consumers and their markets operate on a specific day of the week.

Kitui county lies between latitudes $0^0$3.7' and 3°00' south, and longitudes $37^0$45' and $39^0$00'. It is characterized by a rapidly growing population of 1,136,187 with falling food production and falling resilience to climate change (KNBS, 2019) and with about 60% of the population living below the poverty line. Kalundu is the main market in Kitui County and was preferred in the study due to its centrality and availability of baobab retailers. The market operates only on Mondays and Thursdays. Thus, the market represented rural townships.

Makueni is a semi-arid County located between latitude $1^0$35' S and longitude $37^0$10'E. The main economic activities include; subsistent crop production, dairy farming, and bee-keeping (County Government of Makueni, 2020). Baobab is among the leading IFTs that grows naturally in the County and its products are traded across the markets. In the study, Makindu, Kibwezi, and Mtindo Andei were sampled due to the high presence of baobab retailers. Each market is operational on a specific day of the week. Taita Taveta county was selected since it lies within the inland baobab growing belt (Fischer *et al*., 2020). Voi and Taveta markets within the county were chosen purposively to represent rural township markets as they host majority of baobab retailers and their operations are limited to a specific day of the week.

Garissa is a semi-arid County which lies between latitudes 1^0 58'N and 2^0 1' S longitude 38^0 34'E and 41^0 32'E with an average rainfall of about 275mm annually (Kenya, 2018). The county has about 841,353 population, the majority of whom are Muslims and baobab consumers (KNBS, 2019). Given the arid nature of the County and high presence of baobab consumers, baobab products are traded in the markets to meet the growing demand. Soko-Muqdi is the centralized and main market for agricultural products in the County and is majorly operational on Tuesdays and Fridays. Thus, the market was selected to represent the rural township.

Baobab trade also thrives in Wajir and Marsabit Counties. This can be attributed to Swahili culture, where the consumption of baobab candy is remarkable. The Counties are characterized by semi-arid climatic conditions accompanied by long periods of drought and famine. Therefore, baobab products can be used to supplement income for poor households in the Counties. In the study, Wajir modern market located in Wajir town was selected due to its central position and availability of baobab retailers. The market is operational mainly on Fridays. In Marsabit County, Moyale market located near the border with Ethiopia and Kenya was chosen due to the high presence of baobab traders. The market is mainly operational on Wednesdays and Mondays.

Kilifi and Lamu Counties harbors the Coastal baobab belt of Kenya. Kilifi lies between the latitude of $2^0 20'$ and $4^0 20'$ S, and longitude between $39^0 05'$ and $40^0 14'$ E (County Government of Kilifi, 2013). The County has a population of about 1,453,787 of whom the majority are involved in crop production, livestock production, apiculture, and fishing as their core income-generating activity (KNBS, 2019). However, more than half of the land in the County is arable with a high population of baobab trees. The baobab products are traded in various markets of the County. In Kilifi, the study sampled baobab retailers from old market (Malindi), Charo-Wamae, (Kilifi town), and Mbuzi- wengi (Mtwapa) to represent rural township markets. Each market is open on a specific day. In Lamu, Hindi and Mokowe markets were selected to represent rural markets as they host majority of candy retailers and they operate on a specific day of the week.

In Mombasa County, the study was conducted in Marikiti and Mwembe Tayari due to their well-developed markets for agricultural products. The markets are operational on daily basis. Besides, Mombasa is among the final urban markets where processed and unprocessed baobab products are sold (Kiprotich et al., 2019). Additionally, the county is the home of about 1,208, 333 people of whom a majority are of Mijikenda, Swahili, and Indian descent. These communities are known to form a good proportion of baobab candy consumers. Therefore, Mombasa was selected to represent urban market as it hosts the majority of baobab traders, consumers and processors (Muriungi et al., 2021). Figure

3.1 shows a map of baobab retailing counties and their respective retail market locations in Kenya.

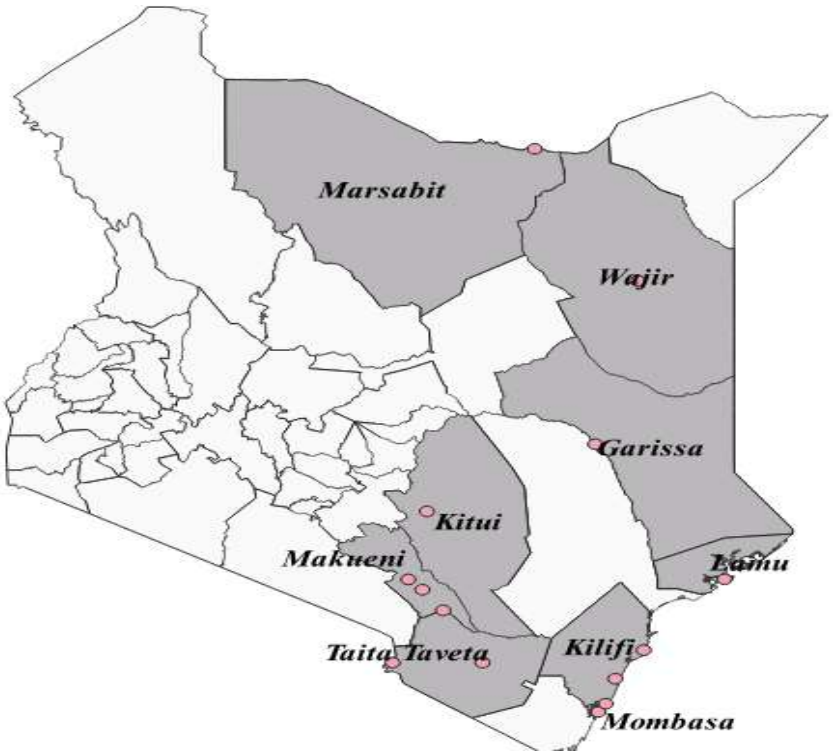

Figure 3.1: Map Showing Baobab-Retailing Counties and Their Market Locations in Kenya

3.5.2 Research Design

The study adopted a cross-sectional survey design. The design was preferred since it allows the researcher to collect sample data to represent the whole population at a given a period while maintaining data confidentiality. Besides, the design provides accurate responses to the question asked. The data was collected between August 2020 and May 2021 after obtaining a research permit from National Commission for Science, Technology, and Innovation.

3.5.3 Sampling

The study adopted purposive and cluster sampling techniques. Purposive sampling was used to identify and select markets where baobab retailing is common while cluster sampling was used to subdivide the markets into two clusters, namely rural townships and urban markets. The target population was retailers who traded with at least one baobab product and sold their products directly to consumers in the local markets. The study adopted the description of the local market as defined by Shackleton et al. (2007), where local markets are known to exist and operate within cities, towns, neighboring villages, and on roadsides. Such markets are often run by retailers.

Cochran's (1977) formula was used to determine the sample size for the study.

$$n = \frac{z^2 * p(1-p)}{e^2}$$

$$n = \frac{1.96^2 * 0.5(1-0.5)}{0.05^2} = 385$$

Where;

n = Target sample size

p = proportion of the population containing the major interest (0.5),

z = confidence level (1.96).

e = marginal error (0.05).

The target sample of 385 was not attained due to the outbreak of COVID-19. However, a total of 352 baobab retailers were drawn randomly across the baobab markets. 187 from rural township markets and 165 from urban markets. This represented about 91.43% of the targeted sample.

3.5.4 Data Collection

The survey employed a structured questionnaire (appendix I) as the main tool of data collection. The questionnaire captured information regarding retailers' socioeconomic attributes, awareness of various baobab products, and overall baobab retail activities. The tool was pre-tested to establish its validity, relevance, and consistency to the study. After establishing the suitability and accuracy of the questionnaire, it was administered to the retailers by trained enumerators. Lastly, the data was cleaned, coded, and entered into statistical tools such as SPSS version 25, STATA, and DEAP version 2.1 for analysis.

3.5.5 Data Analysis

The study employed descriptive statistics and econometric models to analyze the relationship between various variables. Descriptive statistics such as mean and percentages were used to present summaries of socio-economic characteristics, business attributes, awareness levels, and TE of candy enterprise. The independent t-test and chi-square test were carried out to allow a comparison of various attributes of retailers in rural townships and urban markets. PCA and CA was used to characterize baobab candy retailers. Econometric models such as zero truncated poison and Tobit were employed to assess the determinants of awareness and TE respectively. The results of the study are presented in the following chapter.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents statistical summaries of descriptive statistics and econometric models used in the study. Descriptive results include socioeconomic characteristics, business attributes, awareness levels of various baobab products, and technical efficiency scores of candy retail enterprises. The econometric results of ZTP and Tobit models are also presented.

4.2 Summary of Socio-Economic Characteristics of Baobab Candy Retailers

Table 4.1 presents the results of a two-tailed t-test for continuous socio-economic characteristics of baobab candy retailers in rural township and urban markets. The results showed that baobab retailers in urban and rural township markets were relatively similar in age, years of baobab retailing, and income from other sources. However, they differed statistically in terms of education level, household membership, distance to the market, and product awareness.

Candy retailers in rural township markets had a higher number of household members (5) compared to their counterparts in urban markets (4). Additionally, urban retailers were more educated, with 7 years of schooling compared to 6 years for rural retailers. This was partially due to a higher number of schools in urban areas compared to rural areas. Hence, retailers in urban markets seem to have easier access to education. Similarly, product awareness differed statistically across the two markets. Urban retailers were more aware of various baobab products (11) than their rural counterparts (9).

Table 4.1: Descriptive Statistics for Continuous Variables

Continuous variables	Mean				
	Pooled (n=352)	**Rural (n=187)**	**Urban (n=165)**	**t-ratio**	**P-value**
Age	36.11	36.51	35.65	0.71	.481
Household size	5.0	5.0	4.0	2.82***	.005
Education level	6.47	6.0	7.0	-1.85*	.065
Years in business	4.48	4.32	4.66	-0.73	.465
Income from other sources	19,317	19,948	18,601	0.74	.455
Distant to the market	98.00	144.00	46.00	4.90***	.000
Product awareness	10.0	9.0	11.0	-4.3***	.000

Note: *, **, *** indicate significance levels at 10%, 5% and 1% respectively. 1$ = 105

On average, the distance to the market differed significantly across market segments. Urban retailers covered a shorter average distance (46km) than rural retailers (144km). This was possible since majority of retailers in the urban market were more concentrated and resided near the markets, whereas, markets in rural areas are sparsely distributed. Hence, retailers in rural markets had to cover a wider distance to access the markets for their products.

Table 4.2 presents the results of χ^2 analysis for categorical socio-economic characteristics of baobab retailers in rural township and urban markets. Marital status, access to formal training, and business registration were relatively similar across the market segments. Nevertheless, gender, access to credit, and group membership differed significantly between the urban and rural township markets.

Overall, women were more involved in baobab retailing (65%) compared to men (35%). This finding corroborated with those from Muriungi et al. (2021), which showed that baobab activities such as processing are majorly undertaken by women. Moreover, rural markets recorded a higher involvement of women (77%) compared to urban markets (52%). This can be attributed to the fact that many women in rural areas earn their income from gathering and selling non-timber forest products (Nemarundwe et al., 2008).

Table 4.2: Descriptive Statistics for Categorical Variables

	Percentage				
Categorical variable	**Pooled (n=352)**	**Rural (n=187)**	**Urban (n=165)**	**χ^2-ratio**	**P-value**
Gender					
Female	65.0	77.0	52.0	23.92***	.000
Marital status					
Married	65.0	62.0	67.0	1.05	.305
Access to training					
Yes	24.7	24.1	25.5	0.91	.763
Access to credit					
Yes	43.0	38.0	49.0	4.42**	.036
Business registration					
Yes	4.0	3.2	4.8	0.617	.432

*, **, *** denotes significance levels at 10%, 5% and 1% respectively.

The results further showed that the urban market segment had a relatively higher number of retailers (49%) with access to credit facilities compared to their rural counterpart (38%). This was partially due to the existence of more credit providers in urban areas than in rural areas. In terms of group membership, over 60% of baobab retailers belonged to a group, with about 68.4% and 60% of them belonging to the group in rural and urban markets respectively.

Table 4.3 presents the summary of candy enterprise attributes. Operational costs, revenue, cost of sales, and volume of sales were relatively similar across the retail markets. However, the total number of hours involved in operating candy enterprises differed statistically across the markets. Candy retailers in urban markets operated their enterprises for more extended hours (10.56) than rural retailers (9.08). This finding was partly due to electricity connectivity inside the urban markets; whereas, in rural markets, retailers majorly relied on traditional methods for lighting, such as paraffin lumps. Electricity is a reliable source of energy compared to traditional methods. Thus, the urban retailers continued to operate their enterprises for extended hours, especially in the evening.

Table 4.3: Descriptive Statistics for Variables Characterizing Candy Enterprises

Continuous variable	Mean				
	Pooled (n=352)	Rural (n=187)	Urban (n=165)	t-ratio	P-Value
Operational costs (Ksh)	1,151	1,064	1,137	0.228	.820
Sales revenue (Ksh)	9,114	9,354	8,841	0.397	.692
Cost of sales (Ksh)	2,719	2,690	2,753	-0.199	.843
Quantity of sales (sachets)	213	227	197	0.927	.355
Business operation (hours)	9.54	9.08	10.06	-2.8***	.005

Note: *** denotes significance level at 1%. 1$ = Ksh 105 at the time of survey.

4.3 Principal Component Analysis results

Prior to principal component analysis (PCA), Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity (BTS) were undertaken to assess the sampling adequacy and suitability of the model. The results revealed a KMO value of 0.839, and a BTS of 2511.79 with a p-value of 0.000, indicating the sufficiency of the data for PCA. The results of the tests are presented in Table 4.4.

Table 4.4: KMO and Bartlett's Test of Sphericity of Principal Components

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.839
Bartlett's Test of Sphericity	2511.79
DF	66
P-Value	0.000

Source: Authors' computation based on baobab retail survey, 2021

Furthermore, the Kaiser rule of eigenvalue was employed to determine the number of factors to be retained. Usually, the eigenvalue greater than one is used to ascertain the optimal number of components to be retained in PCA. The results showed that only three components adhered to the criterion as shown by the scree plot in Figure 4.1. The

eigenvalues for the retained components were; 5.454, 1.390, and 1.135 respectively and are presented in Table 4.5.

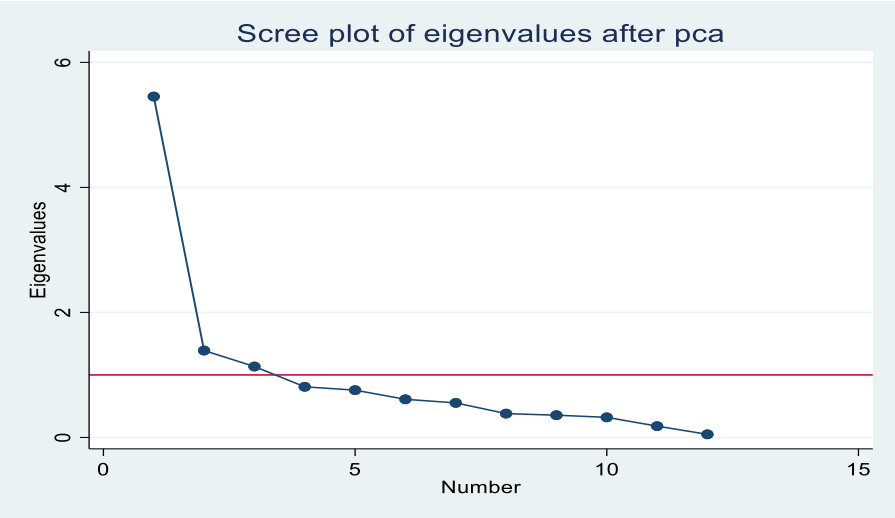

Figure 4.1: Scree plot for Eigen Values

Table 4.5: Components and Total Variance Explained

Component	Eigenvalue	Proportion	Cumulative	variance
Comp1	5.454	0.455	0.455	4.063
Comp2	1.390	0.116	0.571	0.256
Comp3	1.135	0.095	0.666	0.324
Comp4	.810	0.068	0.734	0.053
Comp5	.757	0.063	0.797	0.147
Comp6	.610	0.051	0.848	0.057
Comp7	.553	0.046	0.894	0.171
Comp8	.382	0.032	0.926	0.025
Comp9	.357	0.030	0.956	0.035
Comp10	.321	0.026	0.982	0.141
Comp11	.181	0.014	0.996	
Comp12	.050	0.004	1.000	

Source: Authors' computation based on baobab retail survey, 2021

The selected and retained components accounted for 66.5% of the total variance explained as shown in Table 4.6. The first component accounted for 30.1% of the total variation and was named "revenue and costs" since it had items concerning the baobab revenue (0.5175) and costs of retailing (0.5161).

The second retained component was labelled "access to physical infrastructure and education". It incorporated two elements focusing on the years retailers attended a formal institution of education (0.5489) and the distance they covered to ensure their products reached the targeted markets on time. Notably, distance to the market had a negative coefficient (-0.5141). The distance to the market is expected to have an inverse relation to sales revenue, such that if the distance to the market is too long, there is a high likelihood that sales revenue will be low and vice versa.

Table 4.6: The Principal Components Factor Loadings

Factor and item description	Factor loading	% Variance explained
Factor1: Revenue and cost		
Baobab revenue	0.5175	
Baobab retailing costs	0.5161	30.1
Factor 2: Access to physical infrastructure and education		
Years of schooling	0.5489	
Distant to the market	-0.5141	19.6
Factor 3: socioeconomic characteristics		
Age of the retailer	0.6922	
Years of baobab retailing	0.4877	16.8
Total variance explained		**66.5**

Source: Authors' computation based on baobab retail survey, 2021

The two variables concerning socioeconomic attributes were loaded into the third component. The component was termed "socio-economic characteristics" since it had retailers' attributes such as age (0.6922) and years in baobab retailing (0.4877). The component accounted for about 16.8% of the total variance explained. This finding was in tandem with the study conducted by Muriungi et al. (2021), which revealed that the variation of baobab processors was as a result of their socioeconomic attributes.

4.4 Cluster Analysis Results

The retained variables from PCA were used as inputs in cluster analysis (CA) to characterize and identify various typologies (clusters) of baobab candy retailers. The CA grouped the retailers into three clusters as shown by the dendrogram in Figure 4.2.

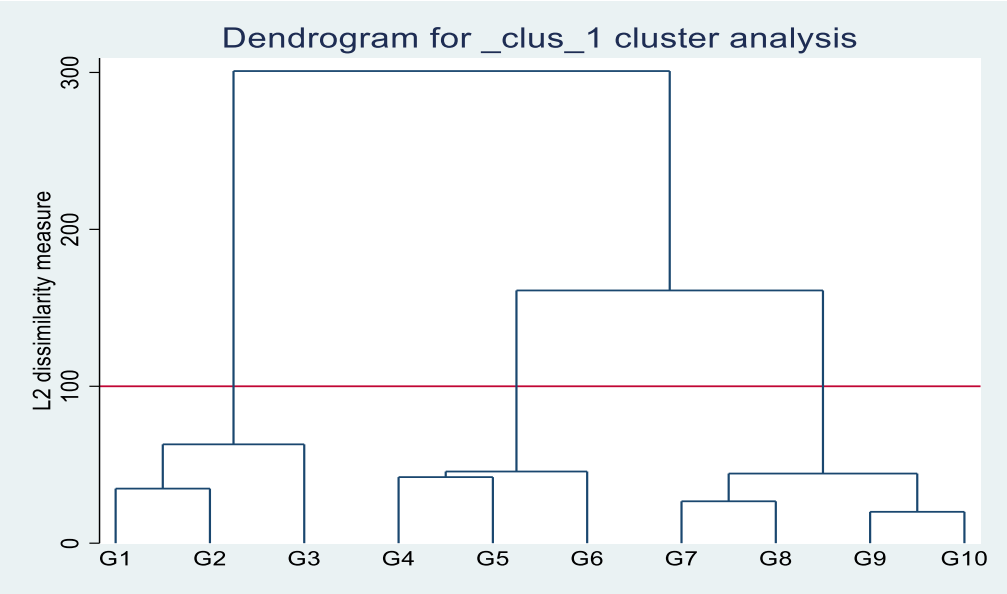

Figure 4.2: Dendrogram

4.3.1 Baobab retailer typologies

Table 4.7 presents the results of CA for the baobab candy retailers in Kenya. Based on the results, candy retailers are heterogeneous in nature and differ statistically based on various socioeconomic and business characteristics. The ANOVA analysis indicated the existence of three distinct clusters of candy retailers, namely cluster 1, 2 and 3. This finding formed the basis to identify various typologies in baobab candy retailing.

Typology 1: Low-volume retailers

Cluster 1 was composed of 124 candy retailers, representing 35.2% of the sample, and was classified as Typology 1. Retailers in this typology were characterized by a low sales

volume and relatively low revenue. They traded with 45 sachets of candies on a weekly basis and attained a weekly revenue of Ksh 2,169. Consequently, retailers in this typology were much younger, had fewer members in their households and were relatively illiterate compared to those in typology 2 and 3. Similarly, retailers in the cluster operated their candy enterprises for a limited period of 6 hours daily and incurred low weekly retailing costs of Ksh 1,695 to generate a weekly revenue of Ksh 2,169. Likewise, retailers in this typology were less experienced in baobab retailing since they had been in the candy business for about 1.06 years. Notably, the retailers covered a wider distance to access the markets for their products (243km) and generated a monthly income of Ksh 6,136 from other sources.

Table 4.7: Characteristics of the Clusters Based on Means

Variables	Cluster 1	Cluster 2	Cluster 3	F value	P-value
Socio-economic					
Gender (1=male)	.27	.31	.56	1.52	.125
Age	29	38	48	64.38	.000
Years of schooling	4.0	7.0	10.0	62.14	.000
Household size (no)	4	5	6	1.87	.192
Access to credit (Yes=1)	.02	.52	.92	60.80	.000
Access to training (Yes=1)	.01	.14	.83	7.94	.002
Group membership	.56	.67	.72	1.69	.187
Distance to the market (Km)	243.01	25.34	8.00	77.38	.000
Income from other sources	6,136	18,561	41,724	271.85	.000
Sales volume (sachets)	45	161	580	138.26	.000
Sales revenue (Ksh)	2,169	7,284	23,671	141.95	.000
Retailing costs (Ksh)	1,695	3,417	7,960	104.71	.000
Business operation (hours)	6	11	13	86.38	.000
Years in baobab retailing	1.06	4.75	9.40	90.55	.000
Cluster frequency (No)	***124***	***150***	***78***		
Cluster distribution (%)	***35.2%***	***42.6%***	***22.2%***		

Source: Authors' computation based on baobab retail survey, 2021. 1$=Ksh 105 at the time of the survey.

Typology 2: Average-Volume Retailers

Cluster 2 was comprised of 150 candy retailers representing 42.6% of the sample. The study categorized this cluster as Typology 2. In the typology, retailers achieved an average revenue of Ksh 7,284 with a sales volume of 161 sachets weekly. Similarly, age, household membership, and years in formal education among baobab retailers were found to be average. In addition, retailers in this typology operated their candy enterprises for about 11 hours and were moderately experienced with 4.75 years in baobab retailing. In terms of retailing costs, the retailers in this typology incurred an average weekly cost of Ksh 3,417. Further, candy retailers in this typology covered a relatively wide distance to the market of about 25km and earned an average monthly income of Ksh 18,561 from other sources. This finding suggests that the majority of the candy retailers (42.6%) covered a long distance to access the markets for their product and had diversified their income streams.

Typology 3: High-Volume Retailers

Cluster 3 was composed of 78 candy retailers representing 22.2% of the study sample. The cluster was categorized as Typology 3. Retailers in this typology generated a high weekly revenue of about Ksh 23,671 from their candy enterprises. They traded with high volumes of candies (580 sachets) on weekly basis. They were also more educated with a post-primary education level of over 10 years. Similarly, their age and household size were 43 and 6 respectively. This indicates that, retailers in this typology were much older and had a high household membership compared to those in other typologies. They also incurred a relatively high weekly cost of about Ksh 7,960 and operated their enterprises for more hours (13) compared to those in clusters 1 and 2. The mean monthly income from other sources was about Ksh 41,724. This implies that retailers in this category were more diversified and engaged in other income-generating activities apart from baobab retailing. Additionally, the respondents in this cluster covered the least distance to the market. Distance to market is known to have an inverse relation with revenues. Hence, retailers in this category attained higher revenue levels compared to their counterparts in

typology 1 and 2 as they covered a shorter distance to ensure the access and availability of baobab candies in the markets.

4.3.2 Determinants of Baobab Retailers' Typologies

Tables 4.6 and 4.7 presented the results of PCA and CA respectively. Based on the findings, various factors responsible for variations in baobab candy retailing were identified. These factors include; age, years of schooling, years in baobab retailing, sales revenue, retailing cost, sales volume, distance to the market, access to credit, hours of enterprise operation, access to formal training, and income from other sources. Notably, all these factors varied significantly ($p<0.01$) between retailers' typologies.

Age and years of product retailing varied significantly ($p<0.01$) between retailer typologies. Retailers in cluster 3 were much older and more experienced in baobab retailing compared to those in clusters 1 and 2. Experience enables the retailers to manage their retailing activities such as the acquisition of quality products and resource use more effectively compared to less experienced. Additionally, highly experienced retailers have broader information concerning the products they trade with, markets, and their targeted customers. Thus, such retailers are better placed in selling high volumes of baobab products. Cluster 1 had the youngest and least experienced retailers.

Access to credit and training facilities varied significantly ($p<0.01$) across the Clusters. Retailers in cluster 3 accessed formal training and credit facility more compared to those in Clusters 1 and 2. Credit access and training are key factors in business operations. Credit facility provides security to enterprises in case of market shocks and unfavorable regulations such as taxes as it facilitates the continuity and expansion of the business investment to meet the growing demand of the products. Likewise, training equips retailers with the necessary skills, knowledge and information on how to run a profitable business. Thus, training forms a basis for better decision-making regarding the effective use of resources to attain optimal revenue. This finding corroborates with those of

Muriungi et al. (2021) which showed that training enabled baobab processors to make an informed decision regarding the resource use.

Retailers' income from other sources differed significantly ($p<0.01$) across the clusters. Cluster 1 registered the lowest amount of income from other sources while cluster 3 recorded the highest. Often, income from other sources determines the ability of a retailer to invest in product retailing or non-retailing activities. Therefore, in the current context, income from other sources can be used to purchase retailing inputs. This can facilitate investment into the business through adoption of technology. This finding was in tandem with those of Musyoka et al. (2020), who revealed that off-farm income increases the monetary power of farmers to acquire processing equipments. Simlarly, Muriungi *et al*. (2021) also, found that baobab processors can be classified based on the income earned from other sources.

Distance to the market varied statistically ($p<0.01$) among the clusters. Retailers in cluster 3 covered the least distance to the market while Cluster 1 retailers covered the longest distance. Distance to the market is a crucial factor in product trading since it may influence the sales revenues of an enterprise either positively or negatively. For instance, if the distance to the market is long, the cost of transport is expected to be high, thus leading to low revenue and vice versa. Also, the distance to the market partly determines the availability of the products in the markets. Therefore, if a retailer covers a long distance to the market, the availability and access of the products by the customers in the markets may be constrained.

Further, the study revealed statistical variation ($p<0.01$) between the clusters in terms of years in formal education. Education is an important feature to a successful business. This is because education exposes individuals to a wider scope of information regarding business operation and management. Hence, educated retailers have the ability to assess product quality, pricing, and marketing strategies to ensure maximum returns from their investment. Retailers in Cluster 3 were more educated compared to their counterparts in Clusters 1 and 2.

The quantity of candies traded, operational costs, and daily business operations exhibited statistical variation (p<0.01) between the Clusters. Retailers in Cluster 3 traded with the highest volume of candy products on weekly basis (580 sachets), incurred relatively higher weekly costs (Ksh 7,960) and operated their businesses for more extended hours (13 hours) compared to their counterparts in clusters 1 and 2. The quantity of candy traded can also be constrained by the hours involved in the business operation, such that if more hours are allocated in baobab retailing, the sales volume are likely to be high and vice versa.

Weekly revenues also influenced retailer typologies significantly (p<0.01). The highest revenue was registered by retailers in cluster 3 while the lowest was recorded by their counterparts in Cluster 1. The highest revenue realized by retailers was partially due to seasonality nature of baobab where the supply of baobab input is high during peak season for processors, thus leading to low cost of product sold by retailers. Additionally, festive celebrations such as 'Eid al-Fitr, 'Eid al-Adha, and Charismas may have also influenced the revenue levels in baobab retailing as the demand for candies during such periods is usually high. This result corroborated those of Muriungi *et al*. (2021) which showed that peak and festive seasons have an influence on baobab processing revenue. Also, Jackering *et al*. (2019), revealed that the revenue levels from baobab trade may be limited due to inadequate inputs and markets for baobab products. Retailers in Cluster 3 recorded high revenue compared to other clusters as they traded with higher volumes of the candies, thus they attained economies of scale in their operations.

4.5 Retailer Awareness

4.5.1 Descriptive Analysis for Retailers' Awareness towards Baobab Products

Table 4.8 presents the results of χ^2 analysis of retailer's awareness levels towards various baobab products. Generally, the study revealed a relatively low product awareness across the markets. Out of the 28 baobab products presented to retailers, only ten (10) were well-known by retailers. Further, the results indicate that retailers in urban markets were

relatively more aware of various baobab products compared to their counterparts in rural township markets. Retailers in urban markets were aware of about eleven (11) baobab products while their counterparts in rural markets were only aware of about nine (9) products.

Further, the study revealed that retailers had a low awareness level of fruit-based products across the markets. However, baobab porridge, juice, candy, processed pulp, and pulp on seed were well-known by retailers across the markets. It was also observed that urban retailers were more aware of all fruit-based products compared to their counterparts in rural markets, except for baobab sweets and yogurt. Baobab porridge, ice cream, juice, sweets, processed pulp, cooking oil, and massage oil were the only fruit-based products that showed significant differences in awareness levels between the retailers in the two markets.

Firewood and bowls from shells were well-known waste-related product across the markets. Retailers in urban markets were more aware of waste-related baobab products than their rural counterparts. Firewood, bowls from shell, and decoration products were the only waste-related products that showed significant differences between retailers in the two market.

Further, more than half of the retailers were aware of other products from baobab tree such as ropes, baskets, and herbal products. All the products under this category revealed a statistical difference between the two markets.

The study concluded that the most well-known baobab products by retailers across the markets were baobab candy (100%), pulp on seed (99.4%), processed pulp (96.6%), and baobab juice (78.4%) while baobab soda (2%), rat trap (1.4%), chutney (0.9%), chocolate (0.6%), and baobab energy bars (0.3%) were the least-known products across the baobab retail markets in Kenya.

Table 4.8: Awareness Levels of Retailers towards Various Baobab Products

Baobab products	Pooled (n=352)		Rural (n=187)		Urban (165)		
	No Aware	(%)	No Aware	(%)	No Aware	(%)	χ^2
(a) Fruit products							
Baobab biscuits	19	5.4	9	4.8	10	6.1	0.267
Baobab porridge	242	68.8	113	60.4	129	78.2	12.860***
Baobab cake	13	3.7	4	2.1	9	5.5	2.709
Baobab yogurt	94	26.7	54	28.9	40	24.2	0.962
Ice cream	53	15.1	20	10.5	33	20.0	5.934***
Baobab chocolate	2	0.6	0	0.0	2	1.2	2.280
Baobab sweets	12	3.4	11	5.9	1	0.6	7.411***
Baobab juice	276	78.4	139	74.3	137	83	3.918**
Baobab cosmetic	28	8.0	13	7.0	15	9.1	0.548
Baobab soda	7	2.0	2	1.1	5	3.0	1.729
Baobab pharmaceuticals	10	2.8	3	1.6	7	4.2	2.210
Alcoholic product	44	12.5	20	10.7	24	14.5	1.188
Baobab chutney	3	0.9	1	0.5	2	1.2	0.476
Sauce	125	35.5	59	31.6	66	40.0	2.733
Energy bar	1	0.3	0	0.0	1	0.6	1.137
Candy (Mabuyu)	352	100.0	187	100.0	165	100	
Processed pulp	340	96.6	176	94.1	164	99.4	7.441***
Unprocessed pulp on Seed	350	99.4	186	99.5	164	99.4	0.008
Baobab cooking oil (seed)	154	43.8	66	35.3	88	53.3	11.591***
Baobab massage (seed)	65	18.5	22	11.8	43	26.1	11.899***
(b)Waste-related product							
Firewood from shell	264	75.0	124	66.3	140	84.8	16.067***
Bowls from shell	176	50.0	85	45.5	91	55.2	3.297*
Decoration	29	8.2	11	5.9	18	10.9	2.930*
Rat Traps	5	1.4	3	1.6	2	1.2	0.096
(c) Other products							
Baobab ropes	194	51.1	89	47.6	105	63.6	9.119***
Baobab basket	178	50.6	82	43.9	96	58.2	7.203***
Baobab herbal	197	56.0	87	46.5	110	66.7	14.431***
Leaves as vegetables	113	32.1	32	17.1	81	49.1	41.12***
Mean awareness score	**10.0**		**9.0**		**11.0**		

Source: Authors' computation based on baobab retail survey, 2021.

4.5.2 Determinants of Retailer Awareness Level towards Baobab Products

Table 4.9 presents the empirical findings of the zero truncated poison model on the determinants of retailer awareness on various baobab products. The dependent variable was awareness score.

The log-likelihood across the markets was found to be negative, indicating that the coefficients in the predictor variables conformed to the nested test model. Hence, the estimates obtained are statistically significant and can be relied on. The coefficients were the estimates of the marginal change in the likelihood of being aware of baobab products when the explanatory variables were marginally altered.

The study revealed that gender, age, education level, years in baobab retailing, group membership, distance to the market, and income from other sources were significant factors influencing retailer awareness of baobab products across the market segments.

Table 4.9: Determinants of Retailer Awareness toward Various Baobab Products

	Pooled		**Rural township**		**Urban**	
Variables	**Coef**	**P-value**	**Coef**	**P-value**	**Coef**	**P-value**
Gender	.067**	.011	.014	.758	.069**	.041
Age	.006***	.000	.007***	.002	.006***	.001
Education level	.082***	.000	.098***	.000	.021***	.005
Years in business	.217***	.000	.206***	.000	.230***	.000
Access to training	-.018	.559	-.022	.644	-.030	.911
Group membership	.218***	.000	.311***	.000	.169***	.000
Distance to market	-.087***	.000	-.08***	.000	-.061***	.000
Income from other source	-.073***	.001	-.063**	.047	-.070*	.084
Constant	2.136	.000	1.863	.000	2.148	.000
	No. of Obs = 352		No. of Obs = 187		No. of Obs = 165	
	Ward chi^2 = 1165.33		Ward chi^2 = 905.12		Ward chi^2 = 423.41	
	Prob > chi2 = .000		Prob > chi2 = .000		Prob > chi2 = .000	
	Log-likelihood=-786		Log-likelihood= -407		Log-likelihood=-374	

Note: *, **, ***, Denotes significance levels at 10%, 5% and 1% respectively.

The gender of the retailers had a positive and significant effect ($p<0.05$) on awareness across the markets. It had a positive and significant influence in urban markets but was insignificant in rural markets. This finding was possibly due to male dominance in baobab retailing in the urban market (48%) compared to rural markets (23%). Overall, the study revealed that male respondents were comparatively more knowledgeable and aware of various baobab products than female retailers. The age of the retailer was also found to have a significant and positive effect ($p<0.01$) on awareness levels across the markets. Older retailers were more likely to be aware of various baobab products than young retailers. Older individuals are known to have a high tendency to retain traditional knowledge that has been accumulated over time.

Education levels across the markets had a positive significant ($p<0.01$) influence on awareness levels of retailers. This suggests that more educated retailers in the study markets were more likely to be aware of the various baobab products than less educated retailers. This result was expected since more educated retailers are exposed to a broader scope of information, especially on the products they trade with. Therefore, education increases the awareness level of various products among retailers.

Years in baobab retailing were found to have a positive and significant relation ($p<0.01$) with awareness across the markets. This finding showed that with an increase of one year in baobab retailing, ceteris paribus, the awareness level of baobab products among retailers improved by about 21.7%. This was possibly attributed to the wide knowledge and experience acquired during baobab retailing. Hence, retailers with more years in baobab retailing were more likely to be aware of various baobab products compared to less knowledgeable and less experienced. Similarly, group membership influenced the awareness level of retailers positively ($p<0.01$) across the markets. Retailers belonging to a group were more likely to be aware of various baobab products than those who did not belong to any group. This finding was possible since groups provide wide access to information concerning various products. Hence, retailers with low awareness levels within the group can benefit greatly from those with in-depth knowledge regarding

various baobab products. Thus, improving the awareness level of baobab products amongst members of the group.

Furthermore, the study revealed that distance to the market had a negative and significant influence ($p<0.01$) on the product awareness of retailers across the two markets. The distance to the market constraint was found to have a negative effect on awareness, such that if the market was far apart by one Kilometer, ceteris paribus, the awareness level of retailers declined by 8.7%. Likewise, income from other sources was found to be negatively significant ($p<0.01$) across the market segments. This implies that as retailers increased their income from sources, their awareness level of baobab products decreased, and vice versa. This is possibly attributed to the assertion that retailers with higher income from other sources will tend to ignore and neglect baobab retailing and concentrate on those other income opportunities that earn them more.

4.6 Technical Efficiency

4.6.1 Descriptive Analysis of Technical Efficiency in Baobab Candy Retailing

The BCC model was used to estimate the technical efficiency scores of candy retail enterprises in urban and rural township markets. The results are presented in Table 4.10.

The results show that the average technical efficiency (TE) was 0.85, indicating that, a good proportion of candy enterprises attained a high TE of 85% across the market segments. This finding suggests that in the short run, candy enterprises can improve their level of TE by 15% through better use of existing resources or technology. Additionally, candy enterprises displayed variability in technical efficiency ranging from 63% to 100% in urban markets and 56% to 100% in rural township markets.

Table 4.10: Descriptive Summary of Technical Efficiency Scores Based on BCC Model

	Pooled	Rural	Urban	t-test	*sig*
Mean technical efficiency	0.85	0.85	0.86	1.095	.274
Minimum	.56	.56	0.63		
Maximum	1.00	1.00	1.00		
Std. deviation	.109	.115	.101		

Source: Authors' computation based on baobab retail survey, 2021.

Further, the level of technical efficiency in rural townships and urban markets was relatively similar, with an average TE score of 85% and 86% respectively. This result indicates that an average rural and urban enterprises were retailing at about 15% and 14% below the VRS frontier respectively. Since there were no significant differences between the TE scores of candy enterprises in rural townships and urban markets, the study sought to establish the distribution of TE scores of candy retail enterprises across the markets (pooled data). Input-oriented BCC and CCR models were adopted and results are presented in Table 4.11.

The distributions of TE scores in the CCR model showed that 15.6% of the candy enterprises attained TE level of below 49%, while in the BCC model, all the enterprises achieved an average TE level of above 50%. This finding suggests that some enterprises were likely to be efficient in the BCC model but inefficient in CCR model. Besides, about 79.6% and 40.9% of candy enterprises achieved TE level of above 75% in BCC and CCR model respectively.

Notably, all technically efficient enterprises in CCR were also efficient in BCC model, with only 14.5% and 4.8% of them attaining full technical efficiency (100%) respectively. This result indicates that majority of candy enterprises in the study were technically inefficient. Hence, there exists an opportunity for such enterprises to improve their level of TE.

Table 4.11: Frequency Distribution of Technical Efficiency Scores

Efficiency scores	BCC		CCR	
	Frequency	**Percentage (%)**	**Freq**	**Percentage (%)**
0.24-0.49	0	0.00	55	15.62
0.50-0.74	72	20.45	153	43.47
0.75-0.99	229	65.06	127	36.08
1.00	51	14.49	17	4.83
Total	**352**	**100.00**	**352**	**100.00**
Mean	0.85		0.69	
Standard deviation	0.11		0.17	
Minimum	0.56		0.38	
Maximum	1.00		1.00	
Constant return to scale	17	4.83		
Decreasing return to scale	4	1.14		
Increasing return to scale	331	94.03		

Source: Authors' computation based on baobab retail survey, 2021

Furthermore, the majority of candy enterprises in the study markets achieved a relatively high TE score of about 0.85 in BCC model and a moderate TE score of 0.69 in CCR model. These findings suggest that BCC model provides a better measurement of TE in product retailing. First, BCC model is devoid of scale efficiency (SE) effects whereby, scale inefficient enterprises operate at either increasing return to scale (IRS), or decreasing return to scale (DRS) while, in CCR model, scale effects are ignored as it estimates the TE of an enterprise operating at the optimal level and assumes constant return to scale (Perrigot & Barros, 2008). Second, CCR model is used to identify the overall inefficiencies in product retailing, whereas the BCC model differentiates between TE and SE (Golany & Roll, 1989). This is achieved by estimating the ratio of BCC and CCR scores to obtain scale inefficiency.

The study also revealed that about 4.8% of the candy enterprises were technically efficient under constant return to scale (CRS), suggesting that the proportionate increase of inputs increased the revenue by the same margin. Moreover, a small proportion of candy enterprises (1.14%) exhibited decreasing return to scale (DRS), implying that the

proportionate increase of inputs, increased the revenue by a lesser margin, such that, if the inputs were increased by 50%, the revenue generated was expected to increase by less than 50%. This indicates that an enterprise operating at DRS is too large and may be experiencing economic downturn.

The majority of candy retail enterprises (94.03%) in the study markets operated at an increasing return to scale (IRS), whereby an increase in inputs, increased the revenue by a larger margin. For instance, if the inputs were increased by 1%, the revenue was expected to increase by more than 1%. This finding reveals that the revenues from candy retailing yielded a higher value than inputs. Hence, such enterprises were more likely to be efficient compared to those operating at CRS or DRS, implying that they can increase their size to reach optimal scale.

4.6.2 Determinants of Technical Efficiency in Baobab Candy Retailing

The technical efficiency scores generated from the BCC model were used as the dependent variable in the Tobit model to determine factors influencing TE of candy retail enterprises. Since DEA is a non-parametric model, there was a possibility of a serious correlation between BCC scores and explanatory variables. Thus, leading to incorrect or biased estimates (Perrigot & Barros, 2008). Tobit model was bootstrapped to address this statistical problem and provide reliable estimates (Davidson & MacKinnon, 1999). Table 4.12 presents the results from bootstrapped Tobit model.

The results revealed that gender, access to formal training, business registration, income from other sources, and distance to the market were the significant factors influencing technical efficiency of candy retailing enterprises. Gender had a negative and significant ($p<0.1$) effect on the level of technical efficiency in baobab candy retailing, suggesting that female-owned enterprises were more likely to be technically efficient compared to male-owned enterprises.

Table 4.122: Determinants of Technical Efficiency in Baobab Candy Retailing

Variables	Parameter Estimate	Std. Error	z-score	P-value
Gender	-.023*	.012	-1.90	.058
Age	.002	.001	0.47	.638
Household size	.001	.002	0.44	.659
Experience	.002	.002	0.80	.424
Access to credit	-.006	.014	-0.46	.647
Group membership	-.017	0.013	-1.36	.175
Access to formal training	.077***	.016	4.73	.000
Business registration	.041***	.015	2.68	.007
Income from other sources	-.025**	.010	-2.38	.017
Distant to the market	-.013***	.003	-3.90	.000
Constant	1.094	.097	11.26	.000
No. Obs (bootstrap)	1,000			
Wald chi^2 (10)	69.84			
Prob>chi^2	.0000			

Note: *, **, *** indicate significance levels at 10%, 5% and 1%* respectively

Access to formal training was found to have a positive and significant effect (p<0.01) on the level of technical efficiency. This finding implies that trained retailers were more likely to be technically efficient in their operations compared to less-trained retailers. This result was expected since trained individuals are exposed to a wider scope of information regarding resource use, allocation and target customers. Thus, enhancing their ability to select the appropriate input-output mix. The finding was consistent with those of Weldegebriel (2014), which revealed that formal training improved TE in maize production.

Similarly, business registration was positively correlated with technical efficiency of candy enterprises (p<0.01), implying that formality of an enterprise improves its performance. This result was in tandem with those of Kabubo-Mariara *et al*. (2023), which showed formal firms are more productive compared to informal firms. Business registration provides legitimacy and enhances credit access, customer loyalty, and

traceability of products. As a result, such enterprises tend to trade with high volume of sales, and ultimately achieve high TE levels and economies of scale. Hence, a registered enterprise is more likely to be efficient compared to unregistered one.

Distance to the market was found to have a negative and significant effect ($p<0.01$) on the technical efficiency of candy retail enterprises. This was possibly attributed to the constraint that, if the distance to the market is too wide, the cost of transport is likely to be high, thus the revenues generated from the product is expected to be low, which in turn leads to a decline in enterprise technical efficiency. This finding collaborated with those from Sibiko *et al*. (2013), who revealed that distance to the market had a negative effect on the technical efficiency of smallholder bean farmers in Uganda.

Income from other sources influenced technical efficiency of candy enterprises negatively ($p<0.05$). This implies that as income from non-retailing activities increased, the level of technical efficiency declined, and vice versa. Thus, retailers with a high income from other sources tend to ignore and neglect baobab retailing and concentrate on those other income opportunities. This results was in consistent with those of Weldegebriel (2014), who noted that off-farm income decreases the technical efficiency of maize and sorghum production. Similarly, Nkegbe. (2018) observed that household income from off-farm activities influences the technical efficiency of crop production negatively.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents a summary, conclusions and recommendations of the study. The first section provides a summary of the study. The second and third sections draw conclusions and recommendations based on the study findings.

5.2 Summary

Baobab is a multifunctional plant with extensive benefits ranging from a source of nutritious food, medicine, fodder, clothing, and raw material for processing (Rahul et al., 2015). It grows in harsh climatic regions where crop and animal production are difficult. Therefore, it offers income-generating opportunities for poor households, marginalized communities, and other value chain actors. Despite, the outstanding contribution of baobab to livelihoods, the tree remains underutilized and under-commercialized. In Kenya, baobab products remain rare and unknown among value chain players, particularly retailers who trade with relatively few informally processed products. Retail markets are the main gateway to consumption and production. Nevertheless, the number of baobab products in the retail markets remains few. Baobab candy is a commonly traded product by retailers in Kenya (Jäckering et al., 2019). Therefore, this study sought to characterize baobab candy retailers, establish their awareness level and factors influencing awareness of baobab products and estimate the level of technical efficiency and its determinants among baobab candy retailing enterprises.

The study adopted a cross-sectional survey design. Purposive and cluster sampling designs were employed to select 352 candy retailers in rural and urban markets. A structured questionnaire was used for data collection. Descriptive statistics were used to provide an understanding of retailers' socio-economic characteristics, candy enterprise attributes, and awareness levels of baobab products. Multivariate statistical technique of

principal component analysis (PCA) and cluster analysis (CA) was used to characterize baobab candy retailers, while zero-truncated poison model was used to assess the determinants of retailer awareness. Data envelopment analysis (DEA) and Tobit model were employed to establish the level of TE and factors influencing TE of candy retail enterprises respectively.

5.3 Conclusions

Descriptive statistics revealed that women were predominantly involved in baobab retailing (65%). Additionally, the majority of candy enterprises were not formally registered (96%). Based on various socioeconomic characteristics, candy retailers in rural townships and urban markets differed statistically in terms of household membership, education level, distance to the market, product awareness, gender, access to credit, group membership and hours involved in operating candy enterprise.

PCA and CA identified three distinct clusters of candy retailers namely, low-volume, average-volume, and high-volume. The clusters accounted for 35.2%, 42.6% and 22.2% respectively. Retailing revenue and costs, socioeconomic characteristics and access to physical infrastructure were the main components that explained the variations between the clusters. Hence, the study concluded that candy retailers are heterogeneous in nature and they vary due to their; age, education level, years of retailing, sales volume, revenues, costs, access to credit and formal training, distance to the market, and income from other sources.

In terms of awareness, the study concluded that there was a low product awareness among retailers across the markets. This implies that baobab is still underutilized and its potential remains untapped in Kenya. In comparison to markets, urban retailers had a relatively higher product awareness (11) compared to their counterparts in rural markets (9). Baobab candy (100%), pulp on seed (99.4%), and processed pulp (96.6%) were the most well-known products among retailers, while baobab chutney (0.9%), chocolate (0.6%), and energy bars (0.3%) were the least-known products across the baobab retail markets in

Kenya. Gender, age, education, years in baobab retailing, and group membership had a positive significant influence on awareness while income from other sources and distance to the market influenced the awareness of retailers towards baobab products negatively.

Further, it was observed that a good proportion of candy retail enterprises attained a relatively high TE score of about 85% in variable return to scale and operated at an IRS (94%). This implies that there exists a room for improvement among inefficient enterprises. Business registration and access to formal training were found to have a positive significant influence on the technical efficiency of candy enterprises, while gender, income from other sources, and distance to the markets influenced TE of candy retail enterprises negatively.

5. 4 Recommendations of the Study

Grounded on the major findings of the study, various recommendations emerge. First, gender-related issues need to be addressed to bridge the gender disparity in baobab retailing. Baobab retailing is female-dominated. Women retailers were more efficient than their male counterparts. Nonetheless, they were less aware of various baobab products compared to male retailers. Therefore, addressing gender-related issues in baobab retailing will not only improve the awareness levels of baobab products and TE but will also provide possible policy interventions that can govern baobab retail sub-sector. Second, majority of candy enterprises are not formally registered. Hence, there informal status may act as a barrier to access services such as credit, training etc., provided by the governments, and other stakeholders. Registered enterprises were more efficient compared to unregistered ones. This calls for greater attention to policymakers and other relevant stakeholders to develop appropriate policies that can ease procedural requirements and costs of registering a business. Hence, fostering the formalization of baobab enterprises.

Third, it would be prudent to encourage baobab retailers to form or join existing trade groups, cooperative or nutritional groups to improve their awareness level. Groups

provide wide access to diversified information regarding products, markets, and business opportunities. Similarly, capacity-building initiatives such as strengthening trade groups should be encouraged to improve the awareness of baobab products in the retail sector. Age was found to be an influential factor in shaping retailers' awareness of baobab products. Hence, there is a need to develop sensitization and information dissemination programs that target young traders in the baobab sub-sector. The programs should focus on income opportunities and nutritional attributes of baobab. Modern communication channels such as Facebook, Twitter, or Instagram should be employed to ensure the targeted audience is reached. This will ultimately improve the awareness level of baobab products and thus enhance market development and commercialization of novel food products such as baobab.

An efficient transportation system reduces the cost of goods and enhances the mobility of goods to the markets. Therefore, it is prudent for county and national governments to invest in road and market infrastructures to enhance access and availability of baobab products in the markets. This will ultimately improve the level of awareness and technical efficiency in the baobab retail sub-sector. Further, stakeholders in baobab retailing should invest in human capital through educational and training programs. The programs should be designed in way that improves the awareness levels of baobab products among baobab value chain actors and technical efficiency of baobab candy enterprises. The programs should be accessible to retailers and those interested in baobab trading.

Lastly, the majority of candy enterprises operate at an increasing return to scale (IRS), suggesting that revenues from candy retailing yields a higher value than inputs and the proportionate increase of inputs, increases the revenue by a larger margin. Therefore, such enterprises may be too small in their retailing activities. Therefore, the study recommends an increase in investment into the enterprises through an efficient use of existing resources, or the adoption of technological changes.

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APPENDICES

Appendix I: Baobab Retailer Questionnaire

We are a team of researchers from Jomo Kenyatta University of agriculture and technology (JKUAT), undertaking Baobab research in collaboration with Humboldt University of Berlin, Germany. The study seeks to develop an understanding of the baobab retail business in Kenya. As part of the research, you have been identified as one of the respondents. Your participation is entirely voluntary, and all the information will remain confidential if you agree to participate in the interview. You can decide to withdraw at any moment without providing a reason. The data collected will be used for academic purposes only.

I now request your permission to begin the interview.

Is permission given?

YES=1[ ] NO[ ] (*if yes proceed to next question)*

SECTION A: GENERAL IDENTIFICATION: To be filled by the enumerator

Item	Response	Item
A1Name of the Enumerator		A7 Sub-county
A2 Name of the retailer/respondent		A8 Ward
A3 Phone number of respondent		A9 Market
A4 Date of interview		A10GPRS: Longitude
A5 Place of interview/LM		: Latitude
A6 County		A11 Altitude

County codes: 1 Nairobi, 2 Mombasa, 3 Kilifi, 4 Taita Taveta, 5 Garissa, 6 Makueni, 7 Kitui, 8 Morsabit, 9

Market Codes: 1 Eastleigh, 2 Jamia Mosque, 3 Karen, 4 Marikiti, 5 Mwebe Tayari, 6 Ujamaaa-Likoni,, 7 New mkt –Malindi, 9 Old mkt-Malindi, 10 Mbuzi wengi-Mtwapa,11 Soko Muqdi-Garissa, 12 Madongo-Tar Kalundu-Kitui, 16 Mwingi-Kitui 17 Moyale- Morsabit, 18Kalundu Kitui, 19 Mwingi- Kitui 20.Kibwezi- Mak

SECTION B: Respondent profile (Demographic characteristic)

B1 Gender	B2 age in years	B3 Highest level of education	B4 Marital status	B5.Household size	B6 Position in household	B7 What is the relation to the household head	B8main occupation of thehousehold head
1. Male 0.Female		1.None 2.Primary 3.Secondary	1.married 2.divorces/separated 3.widowed 4.Never married		1.Household head 2.spouse, 3.child	1.household head 2.spouse, 3.child, 4.sister/brother 5.grandch	1.formal employment 2.self-employed

		4.Vocational 5.Tertiary 6.University			4. helper 5.Relative 6.Other	ild 6.Father/ mother 7.non relative	(business) 3.farming 4.casual employee

B9: Are you the Retailer/owner/manager/ CEO of the business YES=1, N0=0 *(If the respondent is the owner of the business proceed to **B16**)*	
B10 if NO, What is your relationship with the Retailer/owner/manager/CEO Codes: 1. Employee, 2. Partner, 3. Friend, 4.Relative, 5. Other specify. *(If the respondent is the owner of the business proceed to **B16**)*	
B11: Gender of retailer/ owner 1= male 2= Female	
B12: Age of the retailer /Owner in years	
B13: Marital status of the retailer/owner 1= married 2= single 3=Divorced 4=Widowed 5=Never married	
B14: Household size of the retailer/owner	
B15: Highest level of education of retailer/ owner 1= none 2= primary 3=secondary 4=Vocational 5= Tertiary 6=university	
B16 Number of years of schooling of the retailer	
B17: Employment status of the spouse 1= Unemployed 2= Casual employee 3=Self-employed 4=Formal employment, N/A=889	
Notes	

SECTION C: Retailer awareness and knowledge

. Kindly indicate the number of baobab products you are aware of. Please indicate the ones you have ever sold.

	Baobab products	Aware of the product	Sells the product
1.	**Bark related products**		
a)	Ropes	Yes = 1, [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
b)	Baskets	Yes = 1, [ ] No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
c)	Medicine/Herbal	Yes = 1, [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
2.	**Leaves related products**		
a)	Vegetables	Yes = 1, [ ]No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
3.	**Seed related products**		
a)	Cooking oil	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
b)	Massage oil	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
4.	**Pulp related products**		
a)	Biscuits,	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
b)	Porridge	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
c)	Cakes	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]

d)	Yoghurt	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
e)	Chocolate,	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
f)	Sweets (tablets)	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
g)	Juices,	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
h)	Ice-creams	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
i)	Pharmaceutical products/tablets	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
j)	Cosmetics	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
k)	Sodas	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
l)	Alcoholic drinks,	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
m)	Chutneys,	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
n)	Sauces	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
o)	Energy bars	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
p)	Mabuyu "candies"	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
q)	Pulp " Processed pulp"	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
r)	Unprocessed pulp on seed	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
s)	Other(specify)	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
5.	**Waste related products**		
a)	Firewood from shells	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
b)	Bowls from shells	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
c)	Decorations(beads, necklaces) etc	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
d)	Others, specify	Yes = 1 [ ], No = 0 [ ]	Yes = 1 [ ], No = 0 [ ]
e)	Rat traps	Yes =1 [ ], No = 0 [ ]	
	Total awareness score	.....	.....

SECTION D: RETAILER KNOWLEDGE (knowledge on the product is an important aspect since it enables retailers to convince customers to purchase the products thus improving the sales) *To what extent do you agree with t following statements*. **Codes:** SA=5, A=4, N=3, D=2, SD=1

	YES=1 NO=0	**EXTENT Of AGREE MENT**				
		5=SA	**4=A**	**3=N**	**2=D**	**1=SD**
D1. Do you agree that baobab produc are nutritious						
D2. Do you agree that baobab produc are used as medicine						
D3.Do you agree that you can survive with income from baobab products alone?						
Notes						

SECTION E: What factors MOTIVATES you to sell baobab products Codes: SA=5, A=4, N=3, D=2, SD=1

Factors	**YES=1 NO=0**	**LEVEL OF AGREEMENT**				
		5=SA	**4=A**	**3=N**	**2=DA**	**1=SD**
E1. Availability baobab products						

E2. Demand for baobab products						
E3. Knowledge about the baobab products						
E4. High profits of the products						
E5.Low capital to start required f the products						
E6. Few retailers involved with th products so there is little competition						
E7. Market information on the prices of baobab products						
E8. Favourable location of the business						
E9. Limited skill required to run t business						
E10. Less barrier to enter the business						
E11. Nutritional aspect of the products						
E12. Influenced by other retailers/friends/relatives						
E13. Baobab products have long shelf-life						
Notes: (specify any other factors)						

SECTION F: BAOBAB RETAIL BUSINESS

F1 How long have you been involved in the baobab business	*(mention the period in years)*	
F2 What baobab products do you sell?	1. Mabuyu, 2. Pulp on seed, 3. Pulp 4. Other (specify)	
F3 Who made the decision to venture into the baobab business?	1. Husband, 2. Wife, 3. Both, 4.Children 5. Male, 6.Female	
F4 Is your business formally registered?	1=YES, NO =0	
F5 What is the form of your business?	1. Sole proprietorship, 2.Partnership 3. Other(specify)	
F6 Where is the location of your business?	1. Rural town, 2. Urban town 3. Home,4.Other (specify)	
F7What is the type of your business premise?	1. Umbrella shops 2.Open market stall 3.Open air space (**With No structure),** 4. Kiosk, 5.other(specify)	
F8 What is the form of ownership of the premise?	1 Rent, 2 Owned, 889=N/A	

F9 Suppose, you don't have baobab products available to sell, what other common products do you **SUBSTITUTE** with? (mention at least 3 and their prices) Codes for Units: 1. Sachets, 2.Pieces, 3. Kg 4. Plastic Tins, 5.Other (specify)

SUBSTITUTE	**Units**	**Number of Units**	**Price per Unit**	**Total weekly Sales**
1.				

2.				
3.				

F10 What are the common products that you sell together with baobab products? (**COMPLEMENT)** mention at least 3 and there prices

COMPLEMENT	**Units**	**Number of Units**	**Price per Units**	**Total weekly Sales**
1.				
2.				
3.				

F11 What are other products that are **AVAILABLE** during the same season as baobab but are bought by other buyers who do not buy baobab (mention at least 3 with their prices)

Products	**Units**	**Number of Units**	**Price per Unit**	**Total weekly sales**
1.				
2.				
3.				

SECTION G: BAOBAB RETAIL COSTS AND INPUTS

G1What are the Costs and inputs you have incurred in your baobab business for the last one Week (probe for all the costs that the business incurs Weekly). (***Kindly record all the baobab products the retailer sells)***

	Unit of Measure	**No of units**	**Price/ unit**	**Total Cost/ Unit**	**Total Weekly Cost**
Cost of the products					
1.Baobab Candy (Mabuyu)					
2.Pulp on Seed					
3.Pulp					
Other(specify)					
In case the retailer is also a processor					
Cost of inputs					
Pulp on seed					
Pulp					
Sugar					
Colour					
Flavour					
Other cost (specify)					
Other Variable Cost					
Cost of transport (product)					
Storage cost (percentage)					
Cost of Sachets					
Cost of Plastic Tins					
Rent cost (percentage)					

Cost of labour				
Advertising charge				
Electricity cost/Source of Energy				
Other costs (specify)				
Market charges				
License fees/municipal fee				
Taxes				
Bribes (police)				
Retail entry fee				
Business registration fee (monthly or annually)				
Security cost				
Other market costs (Specify)				

Codes UNITS: 1.20g Sachet (ksh5), 2.55g Sachet (ksh10), 3.80g Sachet (ksh20), 4. 170g Sachet (ksh50), 5.340g Sachet (ksh100) 6.80g plastic Tins (ksh20), 7.170g Plastic tin (ksh50), 8.340g Plastic tin(ksh100), 9.Kg, 10.Basin (14kg), 11.Sack (90kg), 12.Ksh, 13. Per day, 14.Other (specify**)**

G2 WHERE do you buy your baobab products? **Codes**: 1.Collectors, 2.Assemblers, 3.Rural wholesalers, 4. Urban wholesalers, 5. Processors 6. Fellow retailers 7.Other specify)	
G3 When buying baobab products **WHO** determines the price? **Codes** 1. Me (retailer), 2. Supplier (seller), 3.Burgained price, 4. Market Price 5. Other(specify)	
G4WHAT is the distance in KM from where you purchase your products? (**Probe Keenly)**	
G5 When selling baobab products, what **MODE** of transport do you use to transport raw materials for baobab products to the destinations (selling point) markets? **Codes:** 1. Pick up, 2.Bus, 3. Motorbike, 4. Bicycle, 5.Wheelbarrow, 6.Trekking, 7.Truck, 8.Other (specify), N/A= 889	
G6 When selling baobab products what **MODE** of transport do you use to transport finished baobab products from store or purchasing area to the market (selling points) **Codes:** 1. Pick up, 2.Bus, 3. Motorbike, 4. Bicycle, 5.Wheelbarrow, 6.Trekking, 7.Truck 8.Other (specify), N/A= 889	
G7 Approximately how long does it take for the purchased products to reach your destinations in hours? **(Probe Keenly)**	
Notes	

SECTION: H BAOBAB SALES AND REVENUE

H1 Please indicate the information on the number of baobab products you sold and their prices for the last one **WEEK?**

Weekly sales	Product 1.Mabuyu 2.Pulp on seed 3.Pulp	Unit of measure **(USE CODES IN G1 ABOVE)**	No Units of sales	Total sales	Price per Unit Ksh	Total Revenue
MON						

TUE						
WED						
THUR						
FRI						
SAT						
SAN						
Total Weekly Sales					**Total Weekly revenue**	

H2 WHERE do you sell your baobab products? Codes 1=Rural market, 2.Urban market, 3.Rural town Market, 4. Home 5.Other (specify	
H3. **WHOM** do you sell your baobab products to? (TARGET CUSTOMERS) **Codes**: 1.Fellow retailers, 2.Urban consumers, 3. Rural consumers, 4. Processors, 5. Clinic, 6. Other (specify)	
H4 WHEN do you sell most of the products? **Codes:** 1. Market days, 2. Any other day, 3. Rush hours 4. Other(specify)	
H5 How do your products reach the customer? **Codes:** 1. Take to the buyer, 2.From my business point (premise), 3.Other(specify	
H6 HOW do you sell your baobab products? **Codes:** 1. Directly to the markets, 2. On order, 3. Both, 4 other (specify)	
H7 How many **HOURS** do you operate your business per day? In **Codes:** 1= 6 hours, 2= 8hrs, 3=10hrs, 4=12hrs 5= 16hrs, 6. Other(specify)	
H8 Do you have baobab products **STORAGE FACILITY**? **Codes**: 1=YES 0=NO	
H9 *If **YES***, is it **RENTED OR SELF-OWNED**? **Codes** 1.Rented, 2. Self-owned, 3= N/A= 889	
H10 If rented, **HOW** much do you pay per month in Ksh?	
H11 Are the baobab sales **DIFFERENT** each month? **Codes**: 1=Yes 0= NO	
H12 if Yes, which month do you experience **PEAK** sales? **Probe until you get one specific month**	
H13 Would you say that sales of this year are different from sales of last year? **Codes**: 1. Very different 2. Somehow different 3. Not different 4.Not Sure	
H14 In which ways can you say your current sales Volume are different from sales of last year? **(Before covid-19) Actual Sales Vol** **Codes:** 1.25% Lower 2. 50% Lower, 3. 100% Lower, 4. 25% Higher, 5. 50% Higher .6. Same 7. Other specify	
H15 Has the price of baobab products changed in the last one year? **Codes**: 1=YES 0=NO	
H16 If **YES** how has the **PRICE** changed in the last one year? **Codes:** 1.25% Lower 2. 50% Lower, 3. 100% Lower, 4. 25% Higher, 5. 50% Higher .6. Same 7. Other specify	
H17 If **YES, h**ow has the **COST OF YOUR PRODUCTS** changed in the last one year **Codes:** 1.25% Lower 2. 50% Lower, 3. 100% Lower, 4. 25% Higher, 5. 50% Higher .6. Same 7. Other specify	

SECTION I: EFFECT OF CORONA VIRUS PANDEMIC ON BAOBAB RETAIL BUSINESS

I1 Has **COVID-19** affected your baobab business? Yes =1 No=0	
I2 If yes**,** how has it affected your **SALES VOLUME? (Mention actual sales volume)**	
I3 If yes, how has the pandemic affected the **PRICE** of your products**?**	
I4 If yes, how has the pandemic affected the **COST OF YOUR PRODUCTS**? (purchase price by the retailer)	
I5 If YES, overall how has the pandemic affected your baobab business **PROFITS?**	
Codes: 1.25% Lower 2. 50% Lower, 3. 100% Lower, 4. 25% Higher, 5. 50% Higher .6. Same 7. Other Specify (Record the actual figure if the retailer is able to recall)	

SECTION J: ACCESS TO CREDIT

Have you had access to credit for the last one year? 1= YES [ ] NO=0 [ ] if yes proceed

Lending source		Would you or anyone in your household able to take a loan or borrow cash in kind if you want? (if no continue to the next source	Has you or anyone in your household taken a loan from the following organizations in the last 12 months?
J1	Non-governmental organization		
J2	Formal lender (bank/ financial institution)		
J3	Informal institution		
J4	Friends and relatives		
J5	Group based microfinance (SACCOs)		
J6	Informal credit: such as merry go round, funeral societies		
		1=YES 0= NO 2= 889	1= YES 0= NO 3= 889

J7 What was the loan used for?	1. Capital for business, 2. Payback other debt, 3. Business related expense, 4.Buy food, 5.Medical treatment, 6.Study, 7.Agricultural expense(fertilizer, seed), 8.ceremony, 9.Buy durable household goods 10.Other specify	
J8 Was any of this loan used in baobab enterprise	1= Yes 0=No	
J9 If **YES**, what was it used for?	1. Capital, 2. Pay rent, 3. Labour, 4.Purchase products, 5.Set up storage facility, 6. Transport products 7.Other (specify)	

SECTION K: Access to Training

K1. Have you or any member of your household received any formal training on baobab products or baobab business?	YES=1 NO=0	
K2. If YES, what was the training about?	1. Marketing, 2. Nutrition, 3. Packaging, 4.Standards and regulations, 5. Cost analysis 6= (other specify)	
K3. How frequent was the training?	1.Once per week, 2.Once per month, 3.Semi-annually, 4.Other(specify)	
K4. When was the most recent training on baobab have you received?	1. Within 1 month ago, 2. Within 3 months ago, 3.Within 6 months, 4. Within 1 year, 5.More than one year ago, 6= Any other (specify)	

SECTION L: Access to Information

L1 Did you have access to any information on Baobab?	1=Yes, No=0	

L2 If YES, What was the source of the information?	1. Fellow Retailers, 2. Internet, 3. Friends, 4. Baobab Processors, 5.Baobab Consumers, 6. Radio, 7.TV, 8. NGO, 9. Other (specify)	
L3 What type of information did you receive?	1. Baobab Products, 2.Baobab prices, 3. Quality standards 4.Biz Certification, 5. Baobab Processing, 6 Other(specify)	

SECTION M: Group membership/ Trade Union/ business union

M. Do you belong to any group or organization that provides a different form of help or assistance? YES= 1 [ ] NO= 0 [ ] If yes, proceed to **M1**

M1 Type of group (tick appropriately) ***YES=1*** ***NO=0***		How many years have you been a member	How often do you meet? 1. Daily, 2.Weekly, 3.Twice per month 3.Monthly, 4. Semi-annually, 5.Annually 6.Other (specify)	Benefits of the group 1. None, 2.Marketing, 3.Credit 4.Advertising. 5. Saving 6. Other
Retailer Group				
Self-help group				
Merry go round				
Trade group				
SACCOs				

M2 If NO, why can't you join a group?

Reason	Response	Rank
I am not interested at all	Yes= 1 [ ] NO= 0 [ ] N/A= 889 [ ]	
Groups have minimal benefits to me	Yes= 1 [ ] NO= 0 [ ] N/A= 889 [ ]	
Groups have a high financial obligation	Yes= 1 [ ] NO= 0 [ ] N/A= 889 [ ]	
Groups are poorly managed	Yes=1 [ ] NO=0 [ ] N/A=889 [ ]	
M3 If you're not a member of any group would you wish to join any group in the future YES =1, N0=0 N/A= 889		
Notes		

SECTION N: ATTITUDE TOWARDS BAOBAB PRODUCTS

N. When you think about baobab products how much do you agree or disagree with the following statements Code (Tick appropriate, 5=Strongly agree, 4=Agree, 3= Neutral, 2= Disagree, 1=Strongly disagree)

Attitudinal statement	5	4	3	2	1
Quality attitudes					
N1 Baobab products are highly nutritious					
N2 Baobab products have a long shelf life and remain fresh					
N3 Selling well-labelled products gives me higher returns					
Livelihood attitudes					
N4 Baobab products improve people's livelihood and health					

N5 Baobab products are a key source of income					
N6 Baobab products are a source of employment					
N7 I can survive with income from baobab business alone					
Market attitudes					
N8 I easily access baobab products whenever I need them as they are readily available					
N9 Inputs to the baobab business are affordable					
N10 Buyers pay high prices for baobab products					
N11 Baobab products are profitable					
N12 By selling baobab products, processors, farmers, collectors receive good economic returns					
N13 Starting a baobab business requires a high amount of capital					

SECTION O: QUALITY STANDARDS FOR BAOBAB RETAIL BUSINESS

1. Kindly indicate the quality standards and regulations for baobab business that you are aware of. Please indicate whether you adhere to these standards

Quality standards	Aware of the quality standards ***Yes=1 No=0***	Adherence to the quality standards ***Yes=1 No=0***
Product-related standard		
O1 All the products on the shelf should be well labelled		
O2All products should be well packaged and sealed		
O3 I should constantly check on the shelf life of the products		
O4 I should inspect the products before purchasing them from the suppliers		
O5 The products I sell should have a standard mark(KEBS)		
O6 The products should be consistent in packaging, taste, colour, and flavour		
Employees related standards		
O7 I should not alter the product once they are packaged (mix or repackage the products)		
O8 I should ensure the availability of the products to customers at all time		
O9 The price of the products should pocket friendly to customers (no exploitation)		
O10 I should constantly attend training on product handling, customer care, and business management		
O11 All employees should be aware of the nutritional components and health of the products		
O12 I should ensure where the products are placed(shelf) is free from dust and other foreign materials		
O13 All the employees should observe high food safety and personal hygiene.		

Business-related standards		
O14 I should always pay my taxes and other relevant fees		
O15 I should segregate the waste materials well (bin for plastic, food, and paper separately)		
O16 I should adhere to all government/ groups/ regulations		
Total awareness /adherence score		

SECTION P: What factors (challenges) influences your adherence to these standards.

Challenges	*YES =1, N0= 0, 2= Not sure*	Rank
P1 Lack of awareness about the standard		
P2 Standards are difficult to comply		
P3 Compliance of standards is expensive		
P4 The business is small		
P5 Lack of training		
P6 Any, other specify		
Notes		

SECTION Q: INFORMATION ON INCOME

Q1 Apart from the baobab business do you have any **OTHER** source of income 1=YES, N0=0	
Q2 If YES, indicate the source of income **Codes:** 1=Formal employment, 2= Crop production, 3= Livestock production, 4= Casual employment, 5= Pension, 6= Other businesses 7= Other (specify)	
Q3 Overall, including all sources of income how much money do you get on average in a month (KSH)	

Q4 If No spontaneous response, select the corresponding category in the table below

Less than 3,000		30,001-100,000	
3001-7500		100,001-200,000	
7501-15000		Greater than 200,000	
15001-30000		Refused to answer	

SECTION R: MENTION ANY OTHER RELATED INFORMATION ON BAOBAB RETAIL BUSINESS THAT MIGHT HAVE BEEN LEFT OUT FROM THE QUESTIONNARE

Enumerator's views. How do you judge the quality of the response based on the ability of the respondent to recall information and stay focused during the interview? Very good = 4 [ ], Good = 3 [ ] Fair = 2 [ ] Not good = 1 [ ]