

**EVALUATING SMALLHOLDER FARMERS' WILLINGNESS TO PAY FOR  
IMPROVED MAIZE DRYERS IN NJORO SUB-COUNTY, NAKURU COUNTY,  
KENYA**

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**A Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirements for  
the Master of Science Degree in Agribusiness Management of Egerton University**

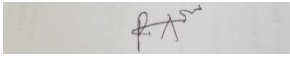
**EGERTON UNIVERSITY**

**OCTOBER, 2024**

**DECLARATION AND RECOMMENDATION**

**Declaration**

This thesis is my original work and has never been submitted for any award at any other university.

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**Recommendation**

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## **DEDICATION**

I dedicate this thesis to my lovely wife, Anne Raychelle Myra and our daughter Laylah Ellyne Willow, thank you for believing in me and your boundless love, support and understanding throughout this entire process. This thesis is also dedicated to my dear mother, Mary Atieno Akoko, who has been supportive and a source of motivation throughout my academic journey

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## ABSTRACT

Maize, the most common staple food in many parts of Sub-Saharan Africa, is usually preserved through the traditional drying method. However, the conventional approach exposes maize to severe losses and quality deterioration; therefore, improved methods should be considered as an alternative to dry maize. Studies have found enhanced dryers are a more efficient and sustainable way to preserve agricultural products; however, developing countries, including Kenya, have yet to adopt these technologies. This study sought to evaluate the economic viability and smallholder maize farmers' willingness to pay for improved maize dryers in Njoro Sub-County. The specific objectives included characterizing smallholder maize farmers based on their desire to use improved dryers, which was analyzed with descriptive statistics, determining smallholder farmers' willingness to pay for enhanced maize dryers, which was analyzed using the double-bounded model and establishing factors influencing smallholder farmers' willingness to pay for improved maize dryers in Njoro Sub-County which were analyzed using the Tobit model. A multistage sampling method was used to select a sample of 306 small-scale maize farmers. Data was collected using a standardized questionnaire Through a Cross-sectional survey. From the results, the factors that were associated with willingness to use the improved maize dryer were advanced education, more years of farming experience, larger land size, cooperative membership, access to more extension services and access to commercial market channels, and those that were associated with unwillingness to use the improved maize dryer were advanced age, larger household sizes and access to more post-harvest training. The findings emphasize the importance of considering education, farming experience, land size, cooperative membership, access to extension services, and commercial market channels when marketing improved maize dryers. The ideal adopters are farmers with advanced education, years of farming experience, larger land size, cooperative membership, and access to relevant services. To enhance the adoption of improved maize dryers, stakeholders should support farmers in expanding production land, joining cooperatives, accessing extension services, and connecting with commercial maize markets. Additionally, awareness programs targeting older farmers with large households and those lacking post-harvest training may help address factors associated with unwillingness to use improved maize dryers. In conclusion, adoption and willingness to pay for enhanced maize dryers within Njoro Sub-County is influenced by several factors, such as educational level, farming experience, and land size of the smallholder farmers.

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## **LIST OF ABBREVIATIONS AND ACRONYMS**

AflaSTOP:	Storage and Drying for Aflatoxin Prevention
CV:	Contingent Valuation
CVS:	Contingent Valuation Survey
EAC:	East African Community
EUT:	Expected Utility Theory
GDP:	Gross Domestic Product
KALRO:	Kenya Agricultural Livestock and Research Organization
MC:	Moisture Content
NCPB:	National Cereals and Produce Board
SSA:	Sub-Saharan Africa
TPB:	Theory of Planned Behavior
TRA:	Theory of Reasoned Action
WFP:	World Food Program
WHO:	World Health Organization
WTP:	Willingness to Pay
WTU:	Willingness to USE

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background Information

Many smallholder households in most of Sub-Saharan Africa (SSA), including Kenya, largely depend on maize enterprise as the primary source of their livelihood (Kamau *et al.*, 2017). However, due to seasonality in maize production and an estimated yield loss of maize to insect pests and pathogens of 22.5% (19.5–41.1%) at the global scale (Savary *et al.*, (2019). The harvested maize must be adequately dried for longer and safer storage, to uniformly distribute its consumption across other periods when maize is scarce. Sufficient maize drying also allows farmers and other commercial actors along the maize value chain to bargain for better market prices (Groote *et al.*, 2019). However, like other cereal crops, maize usually undergo considerable losses when left to dry in the fields. In this regard, most farmers harvest their maize before they are fully dry, with a moisture content ranging from 19% to 25% (Reykdal, 2018).

Insect multiplication and damage, mould development, and manual processing are, in most cases, identified as the primary cause of maize losses among smallholder farmers in Kenya (Bradford *et al.*, 2020). Most maize-growing regions experience warm and humid climatic conditions, which encourage pests and insects to attack when maize is in the fields and even during storage (Bradford *et al.*, 2020; Tonui, 2014). In many cases, maize harvesting in these regions coincides with the onset of rains, giving maize less time to dry. Consequently, high moisture levels above 14% provide favorable conditions for the growth of molds and fungi growth and grain germination (Bradford *et al.*, 2020; Tonui, 2014).

In Kenya, the major market players in the maize value chain, including the marketing boards, such as National Cereals and Produce Board (NCPB) and other major maize millers, require maize to have specific quality standards. Specifically, they recommend commercial maize to have at most 13.5% moisture content (Nyoro *et al.*, 2007). Since most smallholder farmers are less endowed and lack modern resources to manage their grains post-farm level, those who do not meet the above set quality standards usually sell their maize comparatively at lower prices to avoid losses. Therefore, initializing drying technologies is considered to potentially reduce post-harvest losses and increase the value of maize or its marketability to about 80% (Hansen *et al.*, n.d.; Mbebe *et al.*, 2020). Improved maize dryers offer a more attractive means farmer can dry, store, and sell their maize when market prices are higher. In

addition, proper drying can also allow maize to be put to several uses, including malting for beverages and preparation of seeds for subsequent farm productions (Reykdal, 2018).

Smallholder farmers in Sub-Saharan Africa, particularly in Kenya, still use traditional drying methods to dry their maize (Groote *et al.*, 2019). Despite several studies indicating that traditional drying methods are quite undependable and unhygienic and, in most cases, result in poor maize quality, smallholder farmers nonetheless believe that the methods are less expensive and require fewer skills to conduct (Mbebe *et al.*, 2020; Udomkun *et al.*, 2020). Furthermore, in most cases, traditional drying methods have led to the development of aflatoxin contaminations, a major food safety and public health concern (Udomkun *et al.*, 2020).

In this regard, the mechanization of grain drying technologies has become an essential subject for many agripreneurs and agribusiness managers. Most recently, several programs have been initiated by the national government and development partners in Kenya, aiming to intensify maize drying through research and innovations sustainably (Ndirangu *et al.*, 2018). The advancements in farm technologies and scientific methods in handling and preserving farm produce have benefitted farmers and have transformed most agribusiness enterprises to be profitable and more sustainable (Malabo, 2018; Stathers *et al.*, 2020). The development of more complex high-tech machinery to do most of the chain activities has significantly increased recently (Channa *et al.*, 2019).

Despite extensive research on agricultural technology use, very few studies have focused on maize dryers' economic benefits, specifically on estimating farmers' willingness to pay (WTP) for them. The lack of sufficient literature on the economics of maize dryers has also made it difficult to compare improved technologies to traditional open-air drying (Groote *et al.*, 2019; Ndirangu *et al.*, 2018). Most of the available literature is focused on drying in the most developed countries, with limited attention paid to Sub-Saharan African countries (Mbebe *et al.*, 2020).

To develop appropriate strategies that would help enhance the adoption of improved maize dryers, there is a need to have a full understanding of the WTP of the small holder farmers. The WTP estimates will demonstrate the maximum amount of money that the farmers are willing to part with to access the innovation. This decision is influenced by factors such as perceived benefits, potential returns, and available resources. With this understanding, stakeholders (e.g., agribusiness entrepreneurs, policymakers, and development partners) get a

snapshot of the economic thresholds, thus influencing the pricing and design of the technology. This implies that with information on realistic price points for maize dryers, technology providers can redesign more affordable drying solutions with flexible payment plans. The approach will ensure that the innovation is accessible to more farmers. Additionally, the WTP estimates are important in informing policy decisions. For instance, if smallholder farmers shy away from using the technology because of price, policymakers can advocate for government intervention through subsidies or incentives aimed at reducing the financial burden on farmers. Also, understanding is important in designing drying solutions that align with farmer needs.

Koskei *et al.* (2020) assert that in the Sub-Saharan region, 20-30 of the total staple maize harvested is lost due to post-harvest losses. The study further indicates that post-harvest losses harm food security and safety. A significant percentage of post-harvest losses is linked to improper drying. However, by reducing the moisture content of the maize to 13.5% or below, the quality of the maize harvested will be enhanced and less prone to spoilage. Additionally, harvested maize can be stored from one season to another, a strategy that would help stabilize maize supply, contributing to improved maize security. However, factors such as high upfront costs, low awareness and education, lack of financial resources and risk aversion behavior limit adoption of the improved maize drying technologies.

From a policy perspective, it would be essential to determine the economic benefits of using these technologies and whether smallholder farmers are willing to pay for them. It would also be interesting to assess whether there are discrepancies between WTP and economic aspects, such as costs, an essential factor affecting the technology use rate (Shee *et al.*, 2020). Evaluation of the acceptance factors and farmers' characteristics will provide crucial tools for understanding appropriate policy mechanisms for encouraging smallholder farmers to use improved maize dryers. Therefore, this study analyzed the economic viability of the available dryers and estimated smallholder farmers' WTP for these technologies in Kenya. The outcome of this study, e.g., understanding smallholder farmers' price sensitivity, will inform product design (maize drying solutions), policy recommendations, and pricing to ensure that more people have access to the technology.

## **1.2 Statement of the problem**

In Kenya, the maize value chain plays a vital role in promoting the livelihood of both rural and urban households as a source of food and income. However, post harvest losses is proving

to impede maize farming. Although improved maize drying solutions are already in the Kenyan market and can help reduce post-harvest losses, the adoption rate remains low because of factors such as high upfront costs, low awareness, and education, lack of financial resources, and risk aversion behavior among smallholder farmers. The conventional approach of maize drying, such as sun drying, is widely used but ineffective. Because of high moisture content, harvested maize is susceptible to pest infestation, aflatoxins, and developing molds. This reduces the quality and quantity of harvested maize, reducing farmer's income and widening food insecurity. Although the drying solutions have been found to be efficient, their economic feasibility and WTP among stallholder farmers remain largely unexplored. Also, there is no data to justify how much farmers are WTP for the technology. Because of the gap, it is difficult for stakeholders (policymakers, developers, and agribusinesses) to design effective strategies to improve adoption rates by making drying solutions accessible and affordable to more people. This, this gap will be addressed by evaluating the economic viability of the technologies and estimating small holder farmers' WTP in the study area. Study outcomes will inform the development of strategies that can be used to enhance the adoption rate, a critical step in reducing food losses and improving food security in the country.

### **1.3 Objectives**

#### **1.3.1 General Objectives**

To contribute to food security through the reduction of post-harvest losses among smallholder maize in Njoro Sub-County Kenya

#### **1.3.2 Specific Objectives.**

- i. To characterize smallholder maize farmers based on their willingness to use improved maize drying methods in Njoro Sub-County.
- ii. To determine smallholder farmers' willingness to pay (WTP) for improved maize dryers in Njoro Sub-County.
- iii. To establish factors that influence smallholder farmers' willingness to pay (WTP) for improved maize drying services in Njoro Sub-County

#### **1.4 Research Questions**

- i. To characterize smallholder maize farmers based on their willingness to pay for improved maize drying methods in Njoro Sub-County?
- ii. What is the Smallholder farmers' willingness to pay (WTP) for improved dryers in Njoro Sub-County?
- iii. What are the factors influencing smallholder farmers' willingness (WTP) to pay for improved maize dryers in Njoro Sub-County?

#### **1.5 Justification of the study.**

According to the African Union Commission, AUC (2018), post-harvest losses for grains alone are estimated to be worth USD 4 billion annually (at 2007 prices). This amount surpasses the value of grain imports into Africa and the total food aid received in sub-Saharan Africa over the previous ten years. It could satisfy the yearly food needs of approximately 48 million people. Therefore, based on the 2017 regional scorecard for implementing the Malabo Declaration, the AUC recognizes one of the continent's critical challenges, including the lack of awareness and implementation of post-harvest losses management. Thus, the AUC developed the Post-Harvest Loss Management Strategy 2018, which this study will support by identifying factors influencing willingness to pay for improved dryers. The maize value chain is integral in promoting the livelihoods of most rural households in Kenya (Emmanuel, 2016). Estimating the economic viability of improved dryers and farmers' willingness to pay to dry their maize using these technologies will provide an important guide to both the business and policymakers, as it will provide helpful information in understanding the potential economic trade-offs associated with using improved dryers. This information will assist in making accurate and effective drying technology investment decisions. Additionally, implementing proper and efficient drying technologies would potentially improve food safety and reduce losses, thereby contributing to the achievement of Sustainable Development Goals number 1 and 2, that is, reducing poverty and hunger, respectively. These technologies will also provide a base for realizing Kenya's Big 4 agenda, food security.

#### **1.6 Scope and Limitation of the Study**

The scope of this study was smallholder maize farmers in the Njoro sub-county. This was a limitation as it cannot be used to generalize the whole country because other maize-growing

counties are subject to different agroecological, administrative, and production support conditions. Another limitation of the study is that since most smallholder farmers do not keep records, the study relied heavily on farmers' memory recall to collect the needed data. However, this limitation was overcome by using experienced enumerators who sufficiently probed the farmers to obtain accurate data.

### 1.7 Definition of terms

- **Post-harvest losses:** Losses in quantity and quality occur from harvesting to consumption.
- **Value Chain:** A product undergoes a set of interrelated and interconnected activities as it moves from the primary unit of production to the final consumption. These interlinked activities that maize passes through before reaching the final consumer include harvesting, drying, storage, processing, and consumption.
- **Drying:** The adiabatic process involves removing moisture from the grains to an optimum level of 13% or less. One fundamental principle of grain drying is to balance grain moisture content (MC) with the surrounding air to prevent rapid deterioration due to grain respiration and germination and discourage microbial growth.
- **Aflatoxin is a harmful substance produced by molds (*Aspergillus flavus* and *Aspergillus parasiticus*)** often found in insufficiently dried and poorly stored grains. Aflatoxin is potent liver cancer, causing hepatocellular carcinoma in humans and animals (Bradford *et al.*, 2017)
- **Economic benefits:** These can be quantified regarding money generated, such as net income, revenues, etc. It can also be money saved when discussing a policy to reduce costs
- **Willingness to pay:** Sometimes abbreviated as WTP, farmers would be willing to give up the maximum price or amount of money to use the improved maize dryers.
- **Improved maize dryers:** Innovative drying solutions to help reduce moisture levels in harvested maize to safe levels, below 13.5%.
- **Traditional drying methods:** Non-mechanised approaches to maize drying such as open-air drying and field drying. Dependent on weather conditions and widely used.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Maize farming in Kenya

Since its first domestication approximately nine thousand years ago, maize has increasingly participated in various agricultural food chains worldwide (Erenstein *et al.*, 2022). Globally, maize farming has grown dramatically due to increased demand, technological developments, yield improvements, and more cultivable land. In terms of quantity of output, maize has risen to the top of the list of crops cultivated and sold and is predicted to surpass it during the coming period. It is a versatile crop that, apart from serving a variety of non-food uses, is primarily used as a constituent in feed worldwide. Most notably, it is an essential food source in Latin America and Sub-Saharan Africa. Globally, maize is grown on approximately 197 M hectares of land, with substantial areas in SSA, Latin America, and Asia (Erenstein *et al.*, 2022). In many nations, particularly Latin America, SSA, and some nations in Asia, maize serves as a food source. It accounts for almost 20 percent per cent of food energy and is a well-established and significant crop for human food. Globally, maize produces around 1,137 million metric tons more annually than wheat and rice (Erenstein *et al.*, 2022). Production of maize has increased over the past 25 years, backed by both significant yield growth and expansion of growing areas. In about 165 nations spread over Asia, Africa, the Americas, Asia, and Europe, maize is grown in both developed and developing economies. The continents of Asia and America account for about one-third of the world's maize acreage, respectively, followed by Africa and Europe (Erenstein *et al.*, 2022). Maize is primarily grown as livestock fodder in most parts of the world; however, in Sub-Saharan Africa (SSA), 95% of maize grown is used for human consumption.

Maize is an essential food source, especially in Southern and East Africa. In Kenya, mainly, maize farming occupies 48.5% of total arable land and accounts for 0.3% of the world's maize production, representing 3% of Kenya's gross domestic product (GDP) and 21% of the total value of primary agricultural commodities produced in Kenya (Mutiga *et al.*, 2019). Maize is grown both for subsistence and commercial and provides a source of livelihood to about 98% of Kenya's 3.5 million smallholder farmers (Walker & Davies, 2017). Out of the maize produced in Kenya, about 75% is produced by small and medium-scale enterprises, while only 25% comes

from large-scale enterprises (Kiritani, et al., 2011). Therefore, attention should be given more to small-scale farmers as they constitute a larger composition of total maize yield in Kenya.

Maize performs well in regions experiencing an average rainfall ranging between 900-1700 mm. However, maize can grow with a minimum of 500 mm and a maximum of 2500 mm rainfall. In the last five years, an average of 1.4 million hectares has been put under maize production, averaging about 40 million bags annually, depending on weather and market conditions; however, the demand for maize is still higher than the amount produced, an average demand of 45-50 million bags per year (Kiritani et al., 2011). This means the government has to import maize from neighboring countries like Uganda, Tanzania, and other world markets to meet the country's maize deficit.

## **2.2 The concept of maize drying**

Drying is an adiabatic process that involves the removal of moisture content from the grains to an optimum level of 14% or less (Bala, 2016). Drying can remove almost any volatile fluid into any of the heated gases, even though it is typically thought to be the elimination of moisture in a hot airstream. For drying, as described the moist grains must absorb energy from the environment by radiation, conduction, or convection, or internally via inductive or dielectric heating (Keey, 2011). Moisture inside the grains vaporizes, and the water vapor is then taken up by a gas that acts as a carrier. The three primary divisions of grains are cereals, legumes, and oil seeds. They constitute the major staple foods in worldwide consumption, contributing significantly to both animal feed and human diet (Jimoh et al., 2023). Grains offer a significant source of necessary nutrients for human wellness, including minerals, vitamins, crude fat, fibre, proteins, carbohydrates, and inorganic compounds. Dried grains serve as a base ingredient to make several valued goods, including extracts, drinks, alcoholic drinks, and vinegar (Jimoh et al., 2023). Another product of dried grain widely used commercially is flour, such as maize flour, bean flour, rice flour, and many others. Typically, it is employed in producing baked goods such as cakes, pastries, cookies, and bread. As the most popular and diverse unit function in the agricultural processing of grain industry, drying acts as preliminary processing for further primary operations. The process of drying strongly impacts the grade of grain. Drying is essential and has a significant how well grinding and milling activities work. Numerous drying processes and processing variables, including air velocity, drying time, heat intensity, and the initial state, may greatly impact the finished product's value, including excessive moisture, burnt grains,

and cracks (Jimoh *et al.*, 2023). For example, increased grain wetness is linked to fungal proliferation, germination, respiration, and mold growth in grains. It is therefore unsuitable for extended storage. Maize drying is a critical chain activity as it prevents grain quality from deteriorating (Tonui, 2014). One fundamental principle of grain drying is to balance grain moisture content with the surrounding air from preventing rapid deterioration and discouraging microbial growth (Bola. *et al.*, 2013). Reykdal (2018) describes grain drying as adding thermal energy to the grain under controlled conditions to remove water from the grain.

Drying of farm produce after harvesting has a significant effect in reducing food losses and improving food availability, which directly addresses Sustainable Development Goals (1 and 2), that is, increasing global food security, as well as raising the economic status of smallholder farmers through increased income generation (Katila *et al.*, 2019). Maize must be thoroughly dried to ensure safe storage. When grain is not sufficiently dried, it can become contaminated with aflatoxins and mold and be harmed by insects. The drying process is a significant issue near the equator since there are two seasons of rain across most maize-growing regions, and little time might pass between harvesting and rainfall. Because it inhibits the growth of insects and mold, the drying of grains is a key element in lowering losses after harvest. In Africa, novel drying techniques, such as solar dryers, are being developed and tried (Groote *et al.*, 2019). While usage is required all year round, the production of maize is extremely seasonal in Africa. Due to this, it is crucial for producers to safely preserve maize to improve food security and receive higher prices for the extra supply they sell. However, despite the positive impact of drying technologies, many farmers in developing countries have not realized full gains due to low uptake resulting from negative perceptions (Rehman *et al.*, 2016).

In developed countries, such as Australia, maize drying is a strategy for managing risks against adverse weather conditions and fluctuating market prices. In a study by Strahan & Page (2003), large quantities of maize were dried in an in-store dryer, where the air was supplied from the bottom of a perforated surface to reduce the moisture content to about 14%. In-store drying is widely accepted as an energy-efficient system and often requires little skills to operate. However, in-store dryers are hard to optimize due to the differences in air conditions, grain temperature, and moisture content during the drying process.

In a study conducted by Shahi *et al.* (2011), economic evaluation of poly-house solar dryers (PSD) in India, the economics of this dryer was evaluated in terms of cost per kg of the

material dried and fuel consumed during drying. The benefits were then compared to conventional drying methods. The payback period of the dryer was also calculated, including fixed cost, variable cost, and income from the dryer per year. The total cost of drying was estimated as the cost of manufacturing, running costs, including labor costs, and the total cost of electricity. The payback period was approximately 1.5 years, after which initial investment would be recovered. Another study by Jimoh *et al.* (2023), on the process of drying grains, including the temperature, duration, energy required, retention of nutrients, and cost, concluded that the optimal elimination of moisture capability, drying circumstances, and drying settings had a substantial impact on the dried grain final quality. The use of procedures including ultrasound, superheated steam, dielectric frequency, and humidification increased the overall quality against the untreated conventional drying process (Jimoh *et al.*, 2023). The nutritional value of grains suffers from improper, partial, and excessive drying. Grain that has been dried but still has moisture levels over the threshold moisture level has not fully dried. Grain that has partially dried is prone to mold growth, infestation of insects, and quality degradation. The grains are severely dried and will likely start losing their essential nutrients and germination viability if the amount of moisture falls below the crucial level of wetness. Their examination of several grains drying techniques, including vacuum, microwave, fixed bed, infrared, hybrid dryers, fixed bed, fluidized bed, and infrared dryers, found a significant contribution to speedy drying periods and cost savings.

However, in SSA, few empirical studies have focused on improved maize drying methods (Mbebe *et al.*, 2020). Traditionally, African farmers would dry the kernels of grain, store them in appropriate structures with sufficient airflow for additional drying, shell cobs, and finish drying the grains, followed by storing the seeds (Groote *et al.*, 2019). For drying, grain cobs get husked and spread out on the floor in a very thin covering. Where possible, artificial material including stones, flooring, or tarmac may be utilized for covering the floor. Traditional techniques like drying under the sun are subject to weather, labor-intensive, sluggish, and result in significant losses (Pandey *et al.*, 2018). Insects and birds frequently eat grains that are left out in open spaces to dry, and the grains themselves can get polluted by the mingling of dust, rocks, and numerous other foreign things. When crops are held at excessive moisture levels due to unseasonal rainfall or cloudier climate mold growth can cause significant losses. In Kenya, smallholder farmers have long used traditional drying methods to dry their maize, despite

traditional methods taking longer and exposing maize to factors that can potentially lower maize quality (Groote *et al.*, 2019). Inappropriate methods of drying, sorting, grading, and storing maize leave behind broken grain, dirt, impurities, and other contaminants, increasing the proneness of the maize to further damage by pests and pathogens in the course of storage (Mutungi *et al.*, 2020).

### **2.3 Basic grain drying principles**

A traditional technique for storing food and grains is drying, which involves removing moisture from grains or any food item stored while simultaneously transferring mass and heat. The end product has an extended shelf life, less weight, and a smaller size, which makes it easier to carry and store. The grain mass's inter-granular gaps continuously exchange moisture and heat with the outside air. Vapor pressure exists for any material that contains moisture; the greater the humidity, the greater the vapor tension. This is connected to water movement, which is connected to the environment's humidity content. The grains and surrounding air circulate water and heat continuously and dynamically until the point where hygroscopic balance is reached at a specific temperature. The quantity of moisture and the temperature in total both have a direct relationship with the gas pressure of air (Ziegler *et al.*, 2021).

Sorption happens once the air vapor tension is higher than the pressure of vapor inside the grains. This can be brought on by either absorption or adsorption, each of which induces the food to rewet. A substance's fixation inside a different substance or material, whether liquid or gas, is known as absorption. This process is the outcome of a complicated web of capillary actions, and chemical processes. Adsorption is the process by which one substance - the adsorbate - attaches itself to the exterior of another substance - the adsorbent. Desorption takes place, which results in drying if the atmosphere's vapor force is smaller than the vapor force of the food. An inner moisture disparity is created once the vapor tension of the air is less compared to the vapor tension on the grain's periphery. This causes the peripheral liquid to evaporate, creating a water gradient that causes the moisture to diffuse via pores and tissues from the inside to the peripheral regions. When water gets to the outermost layer and gathers there, a new pressure differential is created between the inside and outside of the grains as well as between the outermost part and the surrounding air. Additionally, more evaporation takes place, creating a freshwater differential (Ziegler *et al.*, 2021).

## 2.4 Maize marketing

Marketing of agricultural products involves the transformation of the maize value chain from subsistence farming to increased market-oriented production, which depends on the level of agricultural enterprises willing to adopt and pay for new technologies. As the marketed share of agricultural output increases, input utilization decisions and output combinations are progressively guided by profit maximization objectives (Kimani & Gruère, 2010). In this regard, maize farmers will have to acquire improved technologies to increase their incentives. However, most smallholder maize farmers do not possess suitable markets due to low product quality and, therefore, feel that they run too high a risk of not being able to sell their produce at a fair price. According to Kirimi *et al.* (2011), the primary source of local supplies in a typical or favorable year is local production by large and small-scale farmers. Most brokers get smallholder maize produce, which they bulk up and resell to big merchants. The next significant link within the supply chain is large milling companies, which generally purchase grain from bigger merchants, the NCPB, and smaller dealers. The major millers mostly sell to a decentralized network of local outlets such as street kiosks, multifunctional stores, and traditional markets, and to a smaller extent to the more affluent shoppers who frequent supermarkets. Retail-based posho mill operators are significant participants in several regions. Customers purchase grain and then pay a charge to have it milled specifically for a posho meal. The majority of rural families and the poorest urban populations in the nation, particularly the western region, favor this alternative since it offers a reasonably inexpensive way to create maize meals.

The nation increasingly depends on imports whenever the primary yields from the key growing regions are subpar. Distributors and millers frequently choose this route when it can be obtained from Uganda and Tanzania since there are fewer import limitations or hurdles. Kenya, however, grows reliant on the global market whenever the amount required cannot be sourced locally. Now is when mill owners and wholesalers make their case for removing the fifty percent levy on maize shipped via Mombasa port. When imports account for a significant portion of the marketable supplies, the maize supply chain's structure is significantly altered. The marketing networks are becoming more consolidated and less competitive, which is the most significant shift. Large milling companies and distributors, including the NCPB typically place bulk orders for imports through Mombasa. Since they rely almost entirely on smallholder producers for supplies and the majority of them have less to market amid drought years, smallholder

distributors, itinerant merchants, and tiny millers in non-formal marketing networks are less competitive during drought periods. Consumers are becoming increasingly reliant on large-scale milling companies for maize meals due to the lack of grain in the local non-formal marketplaces during these seasons.

Maize intended for domestic consumption is managed by the National Cereals and Produce Board (NCPB), a parastatal organization under the Ministry of Agriculture. The NCPB is charged with keeping certain quality standards for commercial maize. Depending on the type of grain, quality may include factors such as color, insect damage, foreign materials, moisture content, heat damage, breakage, stress crack, germination levels, and milling indices. These factors are all affected by choice of drying methods used (Tonui, 2014).

## **2.5 Methods of maize drying in Kenya**

### **2.5.1 Traditional methods**

Traditional methods are the most common and widely used methods to dry maize among smallholder farmers in Kenya. This is because its requirements are readily available, little or no capital investment is required, and it mostly uses family as the source of labor. The traditional methods include:

#### **Open-air drying**



**Figure 2.1 Picture of traditional open-air drying method**

In open-air drying, shelled grains are laid out and spread on bare ground or a clean ground cover such as tarpaulins, concrete slabs, or a thin polythene sheet and left to dry in the sun until the desired moisture level is achieved. This method is considered simpler and cheaper (Lhendup, 2005). Since traditional open-air drying completely depends on the prevailing weather conditions, it is not recommended in areas experiencing unpredictable rainfall patterns, such as Njoro. The open-air method exposes maize grains to contamination with dust, rain, and foreign materials (Ramirez-gutierrez, 2019). In addition, maize takes longer to dry during cloudy weather, leading to microbial and chemical spoilage and deteriorating maize quality (Gunathilake *et al.*, 2018). The method is also considered labor-intensive, unhygienic, unreliable, and time-consuming, and requires a larger surface area to dry large batches of maize (Tonui, 2014).

### **Field drying**

Field drying is a traditional system in which farmers leave their maize crops standing in the field for an extended time to dry before harvesting naturally. This method involves leaving maize crops standing on the ground for one or two months to reach moisture content that is fit for storage. The challenge with this method is that, despite being considered the cheapest, it is prolonged during rainy seasons and can lead to considerable losses due to birds, insects, rains, and wind (Dorn & Down, 2011).

Furthermore, rainfall and wind damage can reduce crop crop quality as there is limited control over these natural occurrences. New improved crop varieties meant for high yields are especially prone to environmental damage; for example, traditional maize varieties usually have a better maize cob cover than hybrid maize, which exposes the latter to attack by natural agents. One disadvantage of field drying is that it may delay clearing for the next season's activities. For instance, when the next rainy season follows immediately, this could impede field preparation. In addition, this method is not possible in irrigated fields where early and timely harvesting is required since high cropping intensity is established.



**Figure 2. 2 Picture of Stooked maize in a field**

#### **2.4.2 Improved maize dryers**

Traditional open-air drying is not appropriate for drying maize in so humid environments. Therefore, various projects have been launched to develop improved dryers using available materials to improve upon traditional methods (Ndirangu *et al.*, 2018). Improved dryers are considered to be faster and more efficient and can provide better maize quality compared to the ones considered to be faster and more efficient. They can provide better maize quality than traditional methods. Moreover, these dryers can efficiently and effectively control moisture and temperature during drying, and they can be operated at any time of the day with less labor while producing a higher milling yield of grains (Ramirez-gutierrez, 2019).

However, improved dryers are expensive and some require amounts of fuel or electricity to operate, increasing the cost of drying maize (Ramirez-gutierrez, 2019). Improved maize drying systems are discussed below:

##### **Solar dryers**

Solar drying is one of the most efficient, cost-effective, renewable, and sustainable technologies rapidly finding their way in Sub-Saharan Africa (SSA) as an alternative to energy-saving measures in conserving agricultural products (Udomkun *et al.*, 2020). Unstable energy prices in Africa and the relative abundance of solar radiation experienced in most areas across the continent have made solar energy more preferable (Ramirez-gutierrez, 2019). This method is environmentally friendly and offers minimum interference with food taste and nutritional components (Adeyeye *et al.*, 2022).

There are two most commonly used solar dryers in Africa: passive and active solar dryers. Passive solar energy dryers depend entirely on solar energy. In such systems, power-driven fans circulate solar-heated air through the crop (Ekechukwu & Norton, 1999). On the other hand, active solar dryers are more complex, but are more farmer-friendly, as they are installed with moisture meters to test grain moisture levels (Lakshmi *et al.*, 2021). Solar dryers available in Kenya include multipurpose solar dryers, dehydrate, Solar POD dryers, and



**Figure 2. 3 Picture of solar maize dryers**

Greenhouse dryers.

### **EasyDry M500 Dryer**

EasyDry M500 is a highly portable maize dryer that can dry approximately 500 kilograms in three hours or less, depending on the initial moisture level. The dryer uses maize cobs as the primary source of energy, which is burnt to provide heat. The heat produced passes through the dryer's heat exchanger, which heats the drying air. The dry and hot air is then pushed by a fan



**Figure 2. 4 Picture of EasyDry M500 Dryer**

powered by 5 liters of petrol through the maize bed hanging on a table-like structure housed within a canvas bag. The operator regularly turns the maize after 30 minutes to ensure uniform drying. This type of dryer was initiated by Agricultural Cooperative Development International (ACDI), identifying the most promising storage options to minimize the growth of aflatoxin and to develop economically viable dryers that will allow small-scale farmers to increase their incomes and reduce post-harvest losses (Walker & Davies, 2017).

## **2.6 The importance of improved maize dryers**

In many developed countries, large grain handlers use mechanical dryers to dry their grains (Groote *et al.*, 2019). The systems used include in-store aeration, fluidized-bed dryers, and column dryers. Artificially heated air is used to dry grains with a lot of moisture content in fluidized bed dryers and column dryers. Drying grains with high moisture levels is essential to achieve a higher milling yield efficiently.

According to Soponronnarit (1999), mechanical drying can help achieve a higher milling yield of more than 4.8 percent within a shorter time than open-air drying. With very high competition in the milling industry in Kenya, achieving such a milling yield would likely improve the financial performance of the Kenyan economy if the technology were to be adopted by smallholder maize farmers.

The results of improved dryers in developed countries have been very impressive, with farmers reporting a substantial reduction in grain wastage, improved quality, and cases of aflatoxin contamination. However, for commercial farmers, it will be essential to consider the profits generated while using these technologies. Otherwise, it would defeat the point of mechanization if losses are incurred, given the price fluctuations of maize in Kenya. Proper training in using the equipment and an increased level of awareness is necessary to increase the diffusion rate.

## **2.7 Aflatoxins as the primary cause of maize quality loss**

Another significant issue is spoilage by mycotoxins, which is particularly problematic in the context of maize and renders the crop unfit for human food, as human, or livestock feed. Mycotoxins generated by storage fungi worldwide damage a sizable portion (about 40%) of grain crops (Kumar & Kalita, 2017). Mycotoxins and molds are a risk in the agricultural value chain because they induce dry matter depletion and reduce the quality of stored grains. The most prevalent and significant mycotoxins include aflatoxins, ochratoxin, deoxynivalenol, and fumonisins, particularly in maize (Kumar & Kalita, 2017). The most hazardous class of mycotoxins is thought to be aflatoxins. Aflatoxins are a group of mycotoxins produced primarily by strains of *Aspergillus*. The strains found in grains include *Aspergillus flavus*, *A. parasiticus*, *A. nomius*, *A. tamarii*, and *Emericella spp* (Muthomi *et al.*, 2012). However, *Aspergillus flavus* is the most common and naturally occurring mycotoxin that frequently attacks maize and produces high amounts of aflatoxin contaminating the grain (Mutegi *et al.*, 2009). Aflatoxin overexposure can result in aflatoxicosis, a serious condition that can even be fatal. *Aspergillus flavus* is primarily found in temperate settings, while *Penicillium verrucosum* is a significant mycotoxigenic mold frequently found in wet chilly climates (Kumar & Kalita, 2017). The aflatoxins are grouped into aflatoxin B1, aflatoxin B2, aflatoxin G1, and aflatoxin G2 depending on the color they produce when subjected to radiation but Aflatoxin B1 is the most abundant and the most toxic group of aflatoxins (Probst *et al.*, 2011)

Grain germination is hampered, and the grains are damaged by mold while being stored. Due to the musty smell, fatty acids rise, glucose and starch concentrations decrease, leading to grain quality reduction (Kumar & Kalita, 2017). Aflatoxin has been associated with liver cancer, causing hepatocellular carcinoma in humans and animals, which is a result of poor or suboptimal drying of grains (Tonui, 2014). Aflatoxin is also associated with poor growth in young children, as contended by Watson *et al.* (2018), who studied the effects of aflatoxin exposure on Gambian infants. About 4.5 billion people globally are directly and indirectly affected by aflatoxins, which have been linked to liver cancers, kidneys, lungs, urinary and digestive tract infections, birth defects, and nervous system problems (Bradford *et al.*, 2020). Aflatoxin also affects people who have hepatitis, which is often prevalent in regions where mycotoxins are present in food supplies (Chen *et al.*, 2013).

In addition to negatively affecting health, aflatoxins severely restrict access to grains in international markets. In the Eastern African Community, strict rules are also being put in place to prevent maize contamination. A high level of pollution may cause exports to fall and, as a result, farmers may lose cash. If aflatoxin concentrations are higher than allowed, revenue losses could reach about 100% (Kumar & Kalita, 2017). Even though many countries in SSA have established tolerable aflatoxin contamination limits, most contaminations still exceed the maximum thresholds, reducing maize competitiveness in the export markets (Udomkun *et al.*, 2017). Furthermore, many households and national economies suffer from lost income through the government's deliberate burning of contaminated maize for public food safety (Okaru *et al.*, 2017). When grain intended for export does not meet required standards, aflatoxin-contaminated grain lingers in the country's food system, harming the health and well-being of individuals already consuming subpar diets (Kumar & Kalita, 2017). This is due to the likelihood that rules will only have a little effect on the products consumed on farms or traded in unofficial marketplaces.

Another phenomenon that degrades food, changes its flavor and scent, and may have negative health impacts on people is lipid peroxidation. Even rats can cause significant agricultural damage when stored at the farm stage in developing economies, and fungus can cause considerable crop deterioration when stored in environments with high humidity levels. Grain handling techniques and the adoption of improved drying techniques and structures for storage can minimize storage damage to about 1% or less (Kumar & Kalita, 2017). Wastages can

be reduced by physically keeping insects and rodents out and by providing an atmosphere that does not support the development of microbes. The destruction of grains during preservation can be decreased by being aware of management points at harvesting as well as drying before storage. To minimize losses while storing grains, taking prompt preventive measures for both abiotic and biotic causes may be very beneficial.

## **2.8 Willingness to pay for improved maize dryers**

In recent years, farm product drying has been considered to reduce food losses and improve food security (Shee *et al.*, 2019). Several research projects have been initiated in response to promoting improved drying systems as an alternative measure to ensure quality food is available to the rising global population. These projects aim at increasing food availability from available resources without putting much pressure on the environment (Pandey *et al.*, 2018; Ramirez-Gutierrez, 2019). Storage and Drying for Aflatoxin Prevention (AflaSTOP), a project funded by Bill and Melinda Gates Foundations, and other donor communities in Kenya are identifying more economically and technically efficient drying technologies that will allow smallholder maize farmers to increase their incomes from quality maize, as well as, to reduce the levels of losses during drying (Butler *et al.*, 2018).

In this regard, an important question is how much farmers are willing to pay for improved drying technologies. WTP is a marketing concept defined as the economic value of a good or service under certain conditions (Le Gall-Ely, 2009). Simply put, it is the maximum amount of money farmers would be willing to give up on using the improved maize dryers. Farmers' willingness to pay is influenced by several factors, such as demographic characteristics, socioeconomic factors, institutional factors, market access, infrastructure, and cognitive factors (Li *et al.*, 2020). Noor Aizuddin *et al.* (2012), found that household size, education, age, income, dependence ratio, impression of the quality of an item, location, and financial resources influence the willingness to pay in the study about the willingness to pay for healthcare services. The incremental cost of a given commodity or product is another significant element that affects a person's WTP for improved maize dryers. The WTP of agricultural producers may also be influenced by various interconnected variables, including socioeconomic status, demographics, infrastructural availability, the quality of the available components, and personal risk tolerance (Shee *et al.*, 2019). In another study by Yang *et al.* (2020), it was found that farmers' willingness to pay for biodegradable mulch was influenced by training, education, and preferences over

BDM characteristics. They also argue that farmers must first decide whether to accept modern technology or not, after which they must decide what price they are ready to spend on it. Two common theoretical approaches are available for making reliable estimates of willingness to pay. These include: revealed preference and stated preference approaches (Whittington *et al.*, 1990). In the revealed approach, is observed to decide how much something is worth if it is not traded in markets, and participants bid for real money for the product (Hamelsky *et al.*, 2005). It is based on observing behavior and the amount of money they will be required to pay to obtain drying services. This approach allows participants to provide unbiased WTP estimates however, such data on this type of market is difficult to obtain.

On the other hand, the stated preference estimates the value of a good or service by using individuals' stated behavior in a hypothetical setting (Alpizar *et al.*, 2001). Therefore, although these methods are more practical, expressed preference techniques are subject to hypothetical prejudice. The approach applies a contingent valuation method, which uses field investigation and questionnaire data gathering to gain insight into the respondent's interests. Individuals are asked directly through surveys to quote how much they would be willing to pay for a given good or service (Schkade & Payne, 1994; Whittington *et al.*, 1990). The survey questions are divided into three major sections; the first describes farmer and farm characteristics, the second describes the good or service being valued, and the third addresses the question of willingness to pay.

However, the contingent valuation method elicits the problem of biases that could undermine the validity of the preference information gathered (Bateman *et al.*, 1995). First, strategic that arises when the respondents refuse to respond to survey questions or would not reveal their true willingness to pay for strategic reasons. People may not disclose much information about their WTP, which suggests that substantial amounts of data are required for a precise calculation of WTP. Second, information bias whereby people are willing to pay depending on the quantity and quality of the information provided to them, and lastly the hypothetical since respondents are not making real market transactions (Bateman *et al.*, 1995; Kanninen, 1995). A different approach to the basic CV that uses additional inquiries which can increase the accuracy of the projection is the double bounded model (Shee *et al.*, 2019). The DB concept asks two questions instead of just one, the first asking if the person responding is inclined to pay a specific sum for a good or service, then asking if they would rather pay the first offer or not. If either reply is positive, the genuine WTP falls somewhere between both of the

proposed bid values; if both replies are positive, the real value is within the second offer and that of WTP's upper limit; whereas if both replies are negative, WTP is lower than the second offer. The biggest critique of the basic CV is what is known as hypothetical prejudice, which refers to the tendency for consumers to overestimate the price that they would preferably willingly pay for a commodity in comparison to the price they ultimately pay (Shee *et al.*, 2019). An alternate strategy known as a cheap chat script might be used to clarify this hypothetical prejudice to the respondents before posing the valuation inquiry. Discrete choice tests, where choices are inferred from reactions to fictitious choices, and trial auctions, where offers are incentive-compatible, are other significant methods for determining expressed preferences (Shee *et al.*, 2019).

## **2.9 Willingness to use improved maize dryers**

The continued diffusion of technological advancements into many facets of everyday life seems essential for today's societies to be wealthy. However, the reception of these innovations and the degree to which individuals are prepared to adopt and endure these advances are major issues and should not be disregarded given the increased exposure that people have to technology. This is particularly so when dealing with a variety of clients who typically lack both technical know-how and subject knowledge in addition to having a thorough understanding of the effects of these technological advancements. The topic of technology acceptability has been studied from a variety of angles. It explains the embracing, reception, and continued use of newly developed tools and technologies (Zaunbrecher *et al.*, 2016). According to conventional acceptance notions, as argued by Zaunbrecher *et al.* (2016), a user's willingness to utilize an innovative technology is mostly influenced by how simple they consider the technological framework to be to operate and how beneficial they view it to be. It makes perfect sense that technological acceptability and people's willingness to embrace advanced innovations in their daily lives are significantly more complicated issues. The acceptance of technology is primarily influenced by people's opinions of risk or their subjective estimates of the likelihood and likely consequences of projected unfavorable events. Perceived risks are defined by a nuanced interplay of perceived advantages, obstacles, and the alleged threat posed by technological advances, woven together with an individual's tendency toward resistance or rejection (Zaunbrecher *et al.*, 2016). It is significant to look at the elements that affect a technology's acceptability and utilization to comprehend the forces behind technology uptake. Relative

benefits, consistency, complexity, trial feasibility, and observability are elements that influence how quickly innovations are adopted and used (Patel & Connolly, 2007).

The extent whereby a new technology is seen as superior to the concept it replaces is known as its relative benefit. The benefit can be thought of about its economic viability, social standing, or usability. Innovations that outperform the norm will be more readily embraced and implemented. The level of how well a new idea fits within prospective consumers' values, encounters, and interests is referred to as consistency (Scott *et al.*, 2008). Numerous research findings indicate that the possibility of adoption increases as the new technology becomes more compatible. In addition, the sophistication of a new technology is alluded to whenever it is thought to be difficult to understand and use. Moreover, a complexity-simplicity continuum may be used to categorize novel innovations, with the proviso that potential users could not completely comprehend the value of the innovation. Key players will adopt technologies easier if they think they are simple to use. The extent to which a fresh concept may be tried out on a restricted basis is known as trial plausibility. Since implementing new ideas requires investing time, energy, and materials, ideas that may be evaluated before being fully implemented have a higher likelihood to be accepted. Last but not least, observability relates to how adopter may see innovation outcomes may see innovation outcomes (Scott *et al.*, 2008).

Agriculture is a major factor in the economy's expansion, increased food security, eradicating poverty, and developing rural regions. The productivity rate has decreased since most smallholder farmers rely on conventional farming and storage techniques. For example, in most developing nations, smallholder farmers who employ conventional cultivation techniques produce over 70% of their nation's maize (Manandhar *et al.*, 2018). To meet the anticipated increased demand, boosting agricultural output is essential. Therefore, looking at recent findings in cases of contemporary technology advancements regarding agriculture is instructive. Agricultural innovations include an extensive spectrum of improved practices and technologies that impact agricultural output growth. New technology typically increases output and lowers the average expenses for production, which leads to significant increases in agricultural income. Innovative technology users increase productivity, fostering ongoing economic and social development. Increased income and decreased poverty, better eating habits, lower prices for basic foods, more employment opportunities, and higher wages for those without access to land

have all been related to the acceptance of improved farming methods (Manandhar *et al.*, 2018). The constant interaction within the features of the innovation and the variety of settings and conditions affects what farmers choose about whether or not and how to embrace new technology. Dispersion itself comes about as the consequence of several individual choices to start utilizing the newly developed technology, choices that are frequently the outcome of a contrast of the modern invention's potential advantages with its unclear costs of adoption.

The elements that influence the use of agricultural innovations have been divided into three broad groups: institutional, social, and economic factors (Kumar & Kalita, 2017). Participating in social networks boosts social capital and promotes the sharing of ideas, information, and trust. In a social context, participants exchange information on the benefits and utilization of cutting-edge technology. Farmers exchange knowledge and gain insight from one another in the specific setting of agricultural advances, which highlights the importance of social networking effects for each person's actions. The acquisition of information about technological advances is an additional variable that influences how it is used (Manandhar *et al.*, 2018). It renders it simpler for producers to adopt current innovation by enticing them to learn about it and how to utilize it well. Farmers intend to employ technologies that they are aware of or those they have been educated about. Knowledge reduces ambiguity regarding a technology's effectiveness, which may eventually lead to the individual's assessment changing from purely subjective towards objective. However, not all farmers are going to utilize a new technique just because they are aware of it. This only suggests that, from a personal viewpoint, producers may view and evaluate technology differently than scientists. Therefore, confirming the information is reliable, consistent, and accurate is essential. Farmers must be cognizant of the existence, benefits, and applications of the technology in order to make use of it.

It has additionally been argued that access to extension services is a crucial component of technology adoption (Shiferaw *et al.*, 2015). Via extension agents, producers are typically educated on the presence, practical application, and advantages of novel technologies. Between the innovators of the technology and its consumers, the extension representative acts as a channel. This contributes to reducing the cost of transaction connected with sharing new technology knowledge within a vast and diversified community of producers. Typically, extension agents focus on a small group of agricultural producers who are seen as peers and have an immediate or long-term effect on the whole community of producers in their local regions.

Walisinghe *et al.* (2017) argue that availability of financial services encourages technology use. By relieving the liquidity constraint and raising user tolerance for risk, it is believed that easy access to funding promotes the usage of riskier innovations. A key aspect of assessing whether a new idea is accepted is the overall benefit gained by the user via utilization, accounting for all costs related to using the novel technique. The cost of deploying agricultural innovations has been identified as an obstacle to technology adoption.

Off-farm revenues have been shown to favor the use of innovation (Fernandez-Comejo *et al.*, 2005). This is because income earned outside of agriculture is a crucial approach for helping rural families in several emerging economies get over their credit limits. In farming communities with absentee or malfunctioning loan markets, income from other sources is reportedly used to replace borrowed funds. It is hoped that off-farm income will provide farmers with access to finances so they may purchase inputs that will boost production, such as improved seeds as well as fertilizers. If producers think using technology will be compatible with their needs and environment and will be an effective investment, they will be encouraged to utilize it. Farmers view the effectiveness of technology, and this view has a significant impact on their choice to use it. Human capital is expected to significantly influence farmer choices about using novel technology (Danquah *et al.*, 2017). The ability of a farmer to gather, analyze, and apply knowledge relevant to the usage of cutting-edge technology increases with his level of education. This is because increased knowledge changes people's perspectives and beliefs, making them more open-minded, considerate, and able to weigh the benefits of contemporary technology. This facilitates the introduction of new technologies, which ultimately affects the rate at which they are embraced.

## **2.10 Theoretical framework**

This study is based on three main theories, which offer the basis for understanding factors that determine willingness to pay for enhanced maize dryer technology, a vital aspect in reducing post-harvest loss. For instance, the Expected Utility Theory examines how variables such as farming experience and education level affect a farmer's perception of utility and willingness to pay. On the other hand, TRA & TBP demonstrate the significance of social networking and personal beliefs in influencing the intention of smallholder farmers to adopt agricultural innovations. The Economic Theory of Content Valuation (CVC) will be used to establish the economic rationale behind technology adoption and payment. Collectively, the three theories

provide a comprehensive framework for evaluating farmers' willingness to pay and adopt agricultural innovations, such as improved maize dryers.

### **2.10.1 Expected Utility Theory**

The concept of Expected Utility Theory (EUT) states that an individual compares various innovations with traditional technology and uses them if the expected utility from the use exceeds the expected utility of conventional technology (Batz *et al.*, 1999). The utility of the outcomes under consideration is usually specified in terms of potential profits and losses. The option with the greatest expected utility will then be the one with the most considerable expected profit. According to the rule of maximizing expected utility, that option will be the optimal choice.

Despite the significant contribution of the concept of expected utility in the study of economic behavior, several criticisms have been raised concerning its application (Allais & Hagen, 2013). Some theorists from the social and behavioral sciences argue that the cognitive limitations of human beings make the concept of expected utility as a guide to choice too idealized for use in most significant decision contexts. Such critics thus advocate notions of bounded rationality that are more sensitive to those limitations and make use of evaluative concepts that do not depend on the precise sorts of assessments that are involved in determinations of expected utility (Dietz & Stern, 1995). These theories have argued that the application of expected utility to economic decisions, particularly on policy decisions, has led to misleading information.

### **2.10.2 Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB)**

These theories attempt to frame farmers' behavior in a limited number of psychological constructs (Beedell & Rehman, 2000). Both models assume that farmers make logical and reasoned decisions, evaluate available information, and implicitly or explicitly consider their actions. A person's behavior is determined by his/her intention to perform or not perform the behavior and this intention is, in turn, a function of his/her attitude towards the behavior and his/her subjective norm. In TRA, the intention is determined by two central constructs, attitude and subjective norms (Fishbein, 1979). In addition to these constructs, perceived behavioral control is also interpreted as a perceived budget constraint (Beedell & Rehman, 2000). In TPB, the likelihood of a farmer engaging in the use of drying technology is correlated with the strength

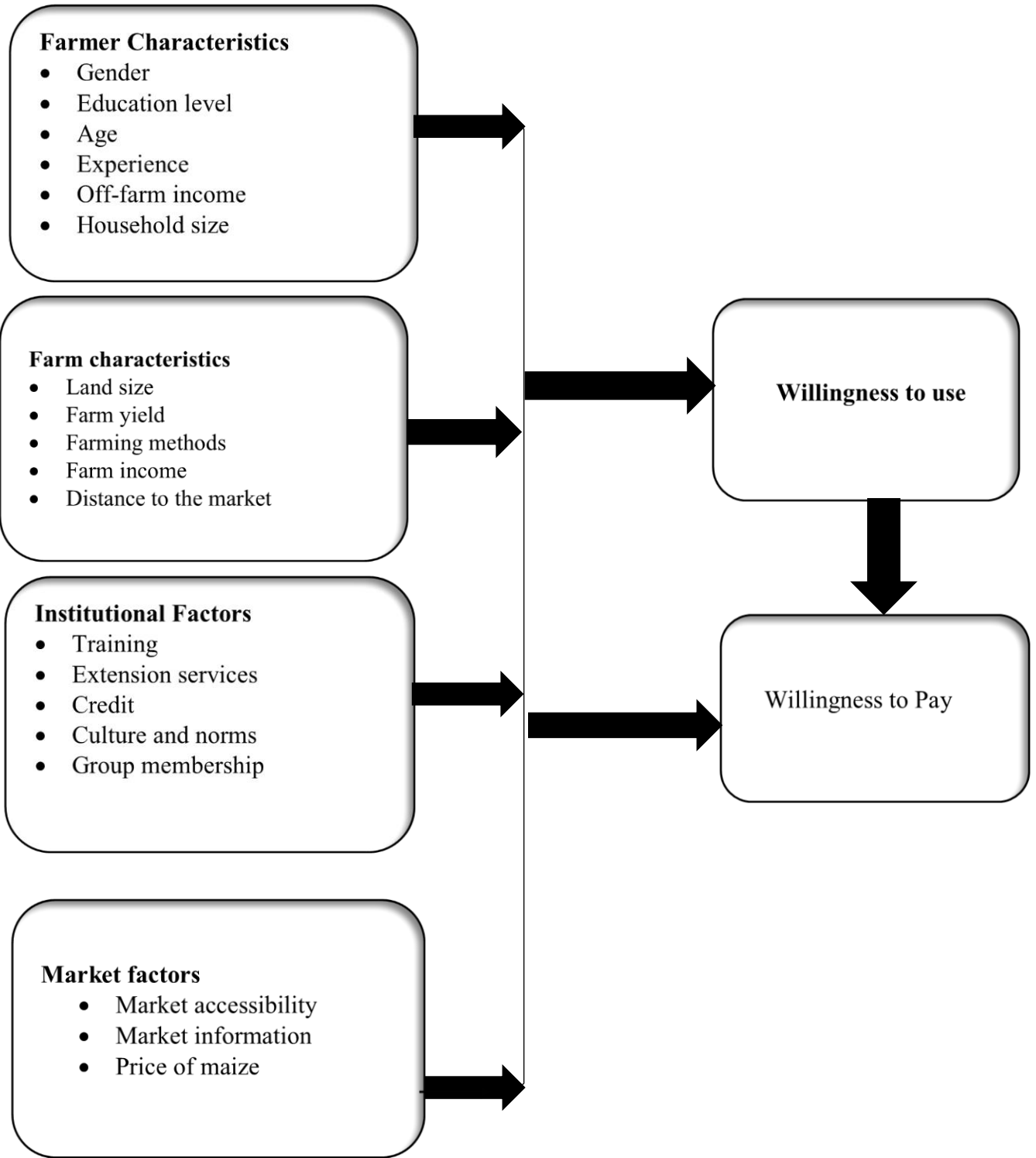
of his or her intention to engage in the behavior. A behavioral intention represents an individual's commitment to act and that factors that directly influence intentions to engage in drying technology adoption a farmer's attitudes towards the technology, farmer's perception of subjective norms, and the extent to which a farmer perceives himself to have control over the new technology.

### **2.10.3 Economic Theory of Contingent Valuation**

The contingent valuation method (CVM) is an approach used to establish economic values placed on a non-market resource, usually ecosystem and environmental services (e.g., improved agricultural technologies). It involves assessing a population's willingness to pay for an environmental service. Thus, the method helps assign a market value to non-market resources. Therefore, the theory evaluates smallholders' willingness to pay for improved maize drying technology. Applying the theory in our study gives a better understanding of the economic reasons for adopting the innovation and willingness to pay.

### **2.11 Conceptual Framework**

A conceptual framework is a scheme of concepts and variables the researcher operationalizes to achieve the set objectives. In this study, the idea depicts an assumption that farmers and traders will always adopt technologies that can maximize their outputs. The reduction of post-harvest losses depends on incorporating new technologies in managing produce after harvest. High or low post-harvest losses affect total maize produce, farmers' income, and food security. Willingness to pay is influenced by several factors, including socio-demographic factors, farm-specific characteristics, market-related factors, institutional factors, and farmers' perceptions and attitudes. Therefore, factors influencing willingness to pay for improved drying technologies and their effect on reducing post-harvest losses are conceptualized to have a relationship [See Figure 2.5].



**Figure 2.5** Conceptual Framework

# CHAPTER THREE

## METHODOLOGY

### 3.1 Study Area

This study was conducted in Njoro Sub-County, Nakuru County, Kenya. Njoro Sub-County was chosen because smallholder farmers in Njoro sub-county suffer considerable post-harvest losses due to chilly weather and unpredictable rainfall. Njoro is located 18 km southwest of Nakuru town. It lies at an altitude of 1800m above sea level with a mild climate. Njoro experiences temperatures ranging between 17-22<sup>0</sup>C and average solar radiation of 602 kWh/m<sup>2</sup>. The main economic activity in Njoro sub-county is majorly crops and livestock production and has grown to be the hub for most agricultural research and education within the county. Njoro host a couple of research institutions including Kenya Agriculture and Livestock Research Organization (KALRO) and Egerton University, known for its diverse research in Agriculture. The location of the study site is shown in figure 2.2 below:

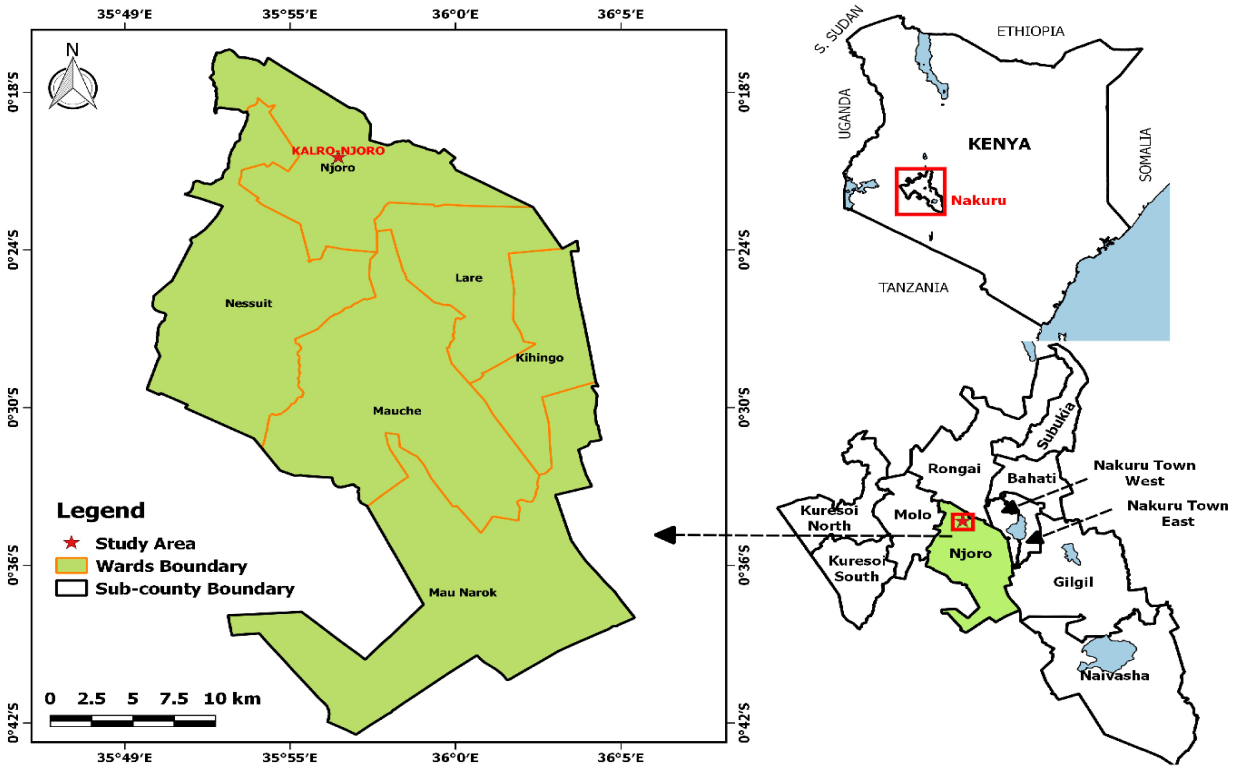


Figure 3. 1 Map of Njoro Sub-County

### 3.2 Sampling design

In estimating farmers’ willingness to for dryers, their socio-economic and institutional characteristics in the Njoro sub-county, a cross-sectional survey research design was adopted. A multistage sampling procedure was used to select the respondents from a sampling frame of smallholder maize farmers' Njoro sub-county. The first stage involved purposive sampling, where three wards were selected from five in the Sub-County. Njoro, Mauche, and Mau-Narok were selected as they are key maize growing areas in Nakuru County. The second stage involved simple random sampling to select smallholder maize farmers from each of the three wards.

Since the population size was unknown, the required sample size will be determined by proportionate using a formula by Anderson *et al.* (2015) as follows:

$$n = \frac{z^2 pq}{E^2} \dots \dots \dots 6$$

Where; n=required sample size; Z=confidence level ( $\alpha=0.05$ ); p=proportion of the sample containing the major interest; q=1-p and E=acceptable margin of error. Since the proportion of the population is not known, p=0.5, q=1-0.5=0.5, Z=1.96, and E=0.056. Due to time, weather, and financial constraints, a sample of 306 farmers was to be selected from a population of smallholder maize farmers in the Njoro sub-county. An acceptance error of 0.056 was therefore applied to adjust the accuracy of the study to capture the omitted variables.

**Table 3. 1 Sample size distribution**

Ward	Target population	Proportion	Sample size
Njoro	52,696	0.28	86
Mauche	35,087	0.19	58
Mau-Narok	98,376	0.53	162
Total	186,159	1	306

Source: KNBS (2019).

### 3.3 Study Data and Data Collection

The study used both primary and secondary data. Secondary was gathered from related studies to the area of interest, and the information obtained helped in the literature review. Primary data was acquired through a semi-structured questionnaire that was targeted to smallholder maize farmers. The household data included household composition, maize drying

practices, socio-economic characteristics, access to extension services, and credit. The study also used observations that will help to validate some of the responses.

Data was gathered using structured questionnaires through administered face-face interviews. Since farmers are not expected to buy the dryers but rather pay for drying at a fee, a contingent valuation approach was applied to capture farmers' willingness to pay for drying services. A bidding game was applied, where the game began by providing a certain value to the farmer. The enumerator then kept raising or lowering the initial amount until the respondent says no or yes respectively depending on the first response. The final amount was interpreted as the respondents' maximum or minimum willingness to pay.

### **3.4. Analytical framework**

#### ***Objective 1: Characterize smallholder maize farmers based on their willingness to use improved maize drying methods***

Descriptive statistics and inferential statistics was used. This involved the use of means, percentages, tables, graphs and chi square to describe and characterize maize farmers based on their willingness to use various maize drying methods in the study area. The hypothesis testing threshold value,  $P < 0.10$  (10%), was adopted as supported Dahiru (2008). According to Dahiru (2008), the cutoff point,  $P < 0.05$ , is purely arbitrary since the boundary can be moved to 0.10 (10%) to make the "significant test" less stringent or to 0.01 (1%) to make it more stringent.

#### ***Objective 2: To determine smallholder farmers' willingness to pay (WTP) for improved maize dryers in Njoro Sub-County.***

A bounded model is usually used to determine WTP. The single-bounded model could be used, however, the method requires a large sample size and is also statistically not very efficient (Cooper *et al.*, 2002). A multiple-bounded model could also be used, which allows for multiple bids, which is useful when there is very little information about the initial bid to include, but for this case we assume the initial bid to be Ksh. 135 per bag of maize which is well documented in recent studies (Groote *et al.*, 2019). Multiple-bounded approaches are also subject to design bias and are influenced by the range of bids included (Vossler *et al.*, 2004). Consequently, the Double-bounded model was adopted. The model is incentive compatible and the estimates are unbiased and more efficient than the single-bounded approach (Hanemann *et al.*, 1991).

#### ***Objective 3: To determine factors influencing the level of farmers' willingness to pay for improved maize drying services***

Tobit model was used. The acceptance probability  $P$  is written as follows (Johannesson *et al.*, 1996):

$$P = F(B) = 1/(1 + e^{-\Delta V}) \dots \dots \dots 19$$

Where:  $F(B)$  is the survivor function yielding the probability of accepting to pay a bid  $B$ .

$\Delta V$  is the change in utility caused if a farmer uses improved maize dryers, and is expressed as

$$\Delta V = \beta_0 + \beta_1 bid + \beta_2 Z_i$$

Where:  $Z_i$  is a vector of socioeconomic factors,  $\beta_1$  for  $i = 0, \dots, 2$  are parameter estimates.

**Table 3.2:** Description of variables to be used in generalized ordered Tobit models

Variable	Description	Expected sign
<b><u>Dependent variable</u></b>		
WTP	(categorical) 1= Unaware; 2=Basic awareness; 3= Advanced awareness)	
<b><u>Independent variables</u></b>		
Age	Age of the decision maker (discrete)	+/-
Gender	Gender of the household head dummy (1=female, 0=female)	+/-
Education	Household's years of schooling (discrete)	+/-
Farming experience	Years of farming experience (discrete)	+/-
Off-farm income	Amount received from farm sales (discrete)	+/-
Household size	Size of the household (discrete)	+/-
Training	If a household has attended a workshop/forum/conference on farming in the last year? (dummy)1=Yes, 0=No	+/-
Extension	Number of contacts with extension officer per year (discrete)	+

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Market	If a household has been able to access the markets for produced maize (dummy) 1=Yes, 0=No	+
Distance to Market	Household location to the market (discrete)	+/-
Membership	If household belongs to a producer group/cooperative 1=Yes, 0=No (dummy)	+
Purpose	Household major reason for maize farming 1= Subsistence, 2=Commercial, 3= Other (categorical)	+
Information source	Household major source of information on maize dryers (categorical) 1= extension staff, 2= Government extension staff, 3= Media, 4= Other farmers/traditional knowledge	+

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## **CHAPTER FOUR**

### **RESULTS AND DISCUSSION**

This chapter presents results and discussion of the findings of the characterization of smallholder maize farmers based on their willingness to use improved dryers which was analyzed with descriptive statistics, the smallholder farmers' willingness to pay for improved maize dryers which was analyzed using the double bounded model and the factors influencing smallholder farmers' willingness to pay for improved maize dryers in Njoro Sub-County which was analyzed using the Tobit model.

#### **4.1 Farm and Farmer Characteristics**

##### **4.1.1 Farmer characteristics**

The results as shown in Table 1 indicate that majority of both the male and female respondents were willing to use improved maize dryers. According to the results, 89.6 % and 89.5% of females and males respectively were willing to use the improved maize dryer. The results also indicated that willingness to use the improved maize dryer was highest among respondents with tertiary education (92.5%). This finding is in concurrence with Paltasingh and Goyari (2018), who postulated that education has a strong threshold effect on the probability of a farmer adopting modern technology. A majority of other respondents who were classified within the other education level categories also indicated that they were willing to use the improved maize dryer. As indicated in table 1, 92.3 %, 89.8 %, 88.1 % of respondents with no education, primary education and secondary education respectively reported that they were willing to use the improved maize dryer.

With regards to farming experience, respondents with over 5 years of farming experience had the highest proportion of willingness to use the improved maize dryer (90.6%) as shown in table 4.1. This finding is in agreement with Ainembabazi and Mugisha (2014), who established that farming experience is useful in technology adoption especially in early stages of adoption of a given technology when farmers are still testing its potential benefits. According to Wordofa *et al.* (2021), farmers who adopted technologies recorded more years in schools and on farming activities as compared to those who do not use farming technologies.

**Table 4.1. Gender, farming experience and education level of the household head by willingness to use for improved maize dryer**

Variable		Willingness to use improved maize dryer	
		No	Yes
Gender	Female	10.4%	89.6%
	Male	10.5%	89.5%
Education Level	no education	7.7%	92.3%
	primary education	10.2%	89.8%
	secondary education	11.9%	88.1%
Farming Experience	tertiary education	7.5%	92.5%
	0-2 years	12.5%	87.5%
	3-5 years	13.8%	86.2%
	over 5 years	9.4%	90.6%

The results as shown in table 4.2 indicated that the mean age of farmers willing to use the improved maize (44.29) was lower than that of farmers not willing to use the improved maize dryer. This can be because farmers with advanced age are limited in searching information about various agricultural technologies as compared to younger farmers (Massresha *et al.*, 2021). The results also indicated that the household size of respondents willing to use the improved maize dryer (4.88) was lower than that of households not willing to use the improved maize dryer. This is explained by households having a bigger household size having more available manpower to engage in the more labour intensive manual drying methods as compared to households with smaller household size. Thus, households with smaller household size are more likely to adopt agricultural mechanization.

**Table 4.2. Mean of farmer characteristics by willingness to use for improved maize dryer**

Variable	Willingness to Use improved maize dryer (%)		
	Mean	Std. Deviation	Std. Error Mean
Age	No 46.00	10.64	1.88

	Yes	44.29	11.56	0.70
	No	5.06	1.52	0.27
House hold size	Yes	4.88	1.86	0.11

#### 4.1.2 Farm characteristics

The findings showed that respondents who were willing to use the improved maize dryers had a larger land size acreage (2.8) as shown in table 4.3. Similarly, respondents with a larger maize production land size acreage (1.8) were willing to use the improved maize dryer. Contrary to farmers with small farms, those with large farms are more likely to accept new technologies because they can afford to dedicate a portion of their land to testing the technique (Uaiene & Arndt, 2009) . Additionally, in order to be profitable, bulky technologies like mechanized machinery or animal traction need economies of size (Feder *et al.*, 1985).

According to the results, respondents who were willing to use the improved maize dryer recorded a higher bag yield during the high season (6.07) and low season (19.44). This can be explained by economies of scale where farmers with higher output benefit from the reduced labor required to use maize dryers as compared to farmers with low yield who may be required to incur the same labor cost as farmers with higher yield when using the improved dryers. The results further indicated that as compared to their counterparts not willing to use the improved maize dryer, the respondents willing to use the improved maize dryer recorded higher quarterly farm income in Kenyan shillings; 24768.25, 14695.26, 21826.64 and 20770.07 for the first, second, third and fourth quarter of the year respectively. A plausible explanation for this is that farmers with higher income have a higher likelihood of affording to invest in technology.

**Table 4.3. Mean of farm characteristics by willingness to use for improved maize dryer**

Variable	Response to WTU	Mean	Std. Deviation	Std. Error Mean
Farm size	No	2.72	2.56	0.45
	Yes	2.85	2.48	0.15
Farm size under maize	No	1.55	1.25	0.22
	Yes	1.76	1.77	0.11

High-season	No	5.06	21.38	3.78
	Yes	6.07	23.66	1.43
Medium-season	No	8.38	18.87	3.34
	Yes	6.45	14.42	0.87
Low-season	No	13.25	19.25	3.4
	Yes	19.44	27.72	1.67
Distance to market	No	4.34	5.59	0.99
	Yes	4.35	5.89	0.36
Farm Income Jan-Mar	No	21875	23201.43	4101.47
	Yes	24768.25	54579.06	3297.24
Farm Income Apr – Jun	No	14531.25	17422.61	3079.91
	Yes	14695.26	17441.82	1053.7
Farm Income July - Sep	No	18750	19068.63	3370.89
	Yes	21826.64	33854.25	2045.21
Farm Income Oct-Dec	No	18468.75	21162.94	3741.11
	Yes	20770.07	29061.07	1755.64

Regarding the willingness to use the improved maize dryer between production for commercial and subsistence use, a larger proportion of respondents producing both commercially and for subsistence (91.1%) were willing to pay for the improved maize dryer. Only 66.7% of respondents strictly producing commercially were willing to use the improved maize dryer while 84.2% of respondents strictly producing for subsistence were willing to use the improved maize dryer as illustrated in table 4.4.

**Table 4.4. Maize production purpose of the farm by willing to pay for improved maize dryer**

Maize production purpose	Willingness to Use improved maize dryer (%)	
	No	Yes
Subsistence	15.80	84.20

Commercial	33.30	66.70
Both subsistence and commercial	8.90	91.10

#### 4.1.3 Institutional characteristics

The results indicated that cooperative membership plays a significant role in the drying method used as shown in table 4.5. Cooperative membership association with the drying method used was found to be significant at a 5% significance level. Only the respondents who belonged to cooperatives were found to use solar dryers. This is supported by Ruzzante *et al.* (2021), who established that organization membership correlates with adopting many agricultural technologies. Among the respondents who used on-field drying, 23.6% did not belong to cooperatives while those that belonged to cooperatives comprised 15.2%. Inversely, among the respondents who used open air drying, 27.3% belonged to cooperatives while those that did not belong to cooperatives comprised 22.1%. With regards to access credit, 25.6% of respondents who used on-field drying did not have access to credit while only 17.8% of respondents who used the drying method had access to credit. Similarly, 24.1% of respondents who used open-air drying did not have access to credit while only 17.8% of respondents who used the drying method had access to credit. The results further showed that only respondents with access to credit used solar drying (0.9%).

**Table 4.5. Institutional characteristics of the farmer by drying method**

Variable		Drying method (%)				$\chi^2$ Value	$\chi^2$ Asymptotic significance	Phi
		On-field	open air	solar dryers	both on field and open air			
Coop	No	23.60	22.10	0.00	40.70	16.409**	0.04	0.23

memb	Yes	15.20	27.30	3.00	30.30			
	No	25.60	24.10	0.00	30.20			
Credit	Yes	17.80	17.80	0.90	57.00	26.05	0.00	0.29

\*\*=5% significance level

The results as illustrated in table 6 indicated that a higher %age of the respondents willing to use the improved maize dryer belonged to cooperatives (97%) as compared to willing users who did not belong to cooperatives (89.0%). In contrast, a higher %age of respondents willing to use improved maize dryers (90.5%) did not have access to credit as compared to respondents willing to use improved maize dryers (87.9%). This is in contrast to who postulated that access to loans is a useful method to get around some of the financial challenges farmers face when adopting new technology. An explanation to this is that most maize farmers store their maize for a significant period as they wait for suitable price to sell their price and sometimes this period can reach a year. Thus, farmers don't, find it wise to use credit to pay for the dryer as the credit facilities relative to the cost of using the dryers often have a short repayment period.

**Table 4.6. Institutional characteristics of the farmer by willingness to pay for improved maize dryer**

Variable	Response to WTU (%)	
	No	Yes
Cooperative membership	No	11.00
	yes	97.00
Access to credit	No	90.50
	Yes	87.90

The results in table 4.7 indicated that respondents who received extension services more frequently annually (0.35) were willing to use improved maize dryer as compared to respondents not willing to use improved maize dryers (0.09). According to Ruzzante *et al.* (2021), extension is a proxy for education and education in developing nations enables farmers to comprehend new technology and make educated decisions about them. Inversely, respondents who received more Post harvest management trainings frequency annually (0.22) were not willing to use improved maize dryers as compared to respondents willing to use improved maize dryers (0.20). This can

be explained by farmers who attend more post-harvest management trainings are better skilled in minimizing losses while still using conventional drying methods. Thus, they don't perceive improved maize dryers as a necessity.

**Table 4.7. Mean of institutional characteristics by willingness to pay for improved maize dryer**

Variable	Response to WTP	Mean	Std. Deviation	Std. Error Mean
<b>Extension</b>	No	0.09	0.296	0.052
	Yes	0.35	1.097	0.066
<b>Training</b>	No	0.22	0.608	0.108
	Yes	0.2	0.603	0.036

#### 4.1.4 Market characteristics

The results as shown in Table 4.8 indicated that the association between the choice of NCPB and millers as the main marketing outlet and drying method adopted was significant at a 1% significance level. This is supported by Hagspiel *et al.* (2020), who established that modern market channels stimulate the adoption of modern technology. From the analysis, among the respondents who used on-field drying, 28.2% marketed their produce mainly to NCPB and millers, 22.7% marketed their produce mainly to other maize traders (brokers) and 16.7% marketed their produce mainly to consumers/neighbors. Among the respondents who used open-air drying, 53.8% marketed their produce mainly to NCPB and millers, 16.8% marketed their produce mainly to other maize traders (brokers) and 16.7% marketed their produce mainly to consumers/neighbors. The results showed that it was only respondents who used NCPB and millers as their main marketing channel (2.6%) adopted the use of solar dryers.

**Table 4.8. Market outlet of the farmer by drying method**

Main marketing	Drying method	$\chi^2$ Value	$\chi^2$	Phi
----------------	---------------	----------------	----------	-----

outlet	On-field (%)	open air (%)	solar (%)	both on field and open air (%)	Asymptotic significance		
NCPB & millers	28.2	53.8	2.6	12.8			
Consumers/neighbours	16.7	16.7		33.3	55.893***	0.001	0.43
other maize traders	22.7	16.8		44.5			

\*\*\*1% significance level

According to the results in table 4.9, majority of the respondents who were willing to use the improved maize dryer sold their produce to cooperatives (89.9%), followed by consumers and neighbors (89.7%). The third most used marketing channel among farmers willing to use the improved maize dryer was brokers at 87.5% while NCPB was the least preferred marketing channel at 66.7%.

**Table 4.9. Market characteristics of the farmer by willingness to pay for improved maize dryer**

Type of market	Response to WTP (%)	
	No	Yes
NCPB and millers	33.3	66.7
Consumers/neighbours	10.3	89.7
Traders/brokers	12.5	87.5
Corporative	10.1	89.9

The results indicated that respondents willing to adopt improved maize dryers on average received a higher price for their maize (3063.37) as shown in table 4.10. This is because farmers who get higher prices have higher incomes are more likely to afford technologies.

**Table 4.10. Mean of price of maize by willingness to pay for improved maize dryer**

<b>Willingness to use improved maize dryer</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Std. Error Mean</b>
No	3051.61	838.598	150.617
Yes	3063.37	817.667	49.487

#### 4.2 Willingness to pay for improved maize dryers

According to the results, majority of the respondents (72.1%) were not willing to pay for the improved maize dryer at the initial bid of KES 135. Depending on the first reply, i.e., “yes” or “no”, the respondents were asked for their WTP for a second follow-up bid to which they answered either “yes” or “no”. If the respondents answered “no” to the first bid, the follow-up bid is a lower amount. If the respondents answered “yes” to the first bid, the follow-up bid is a higher amount. The results are presented in Table 4.11 and Table 4.12.

**Table 4.11. Willingness to pay at KES 135**

<b>WTP</b>	<b>N</b>	<b>%</b>
No	238	77.8
Yes	68	22.2
<b>Total</b>	<b>306</b>	<b>100</b>

A lower second follow-up bid of KES 128, KES 122, KES 115, and KES 108 was presented to the respondents who were not willing to pay at KES 135. From this reduced bid, 18.9% of the respondents were willing to pay at KES 128, and only 6.3% were willing to pay at KES 122. The results also showed that 8.0% were willing to pay at KES 115 and 30.7% were willing to pay at the lowest possible bid of KES 108. Nevertheless, most of the respondents not willing to pay at KES 135 (36.1%) were still not willing to pay at the lowest possible bid of KES 108.

**Table 4.12. Decreased Bid if no at KES135**

<b>Bid/Price</b>	<b>No</b>		<b>yes</b>	
	<b>Count</b>	<b>%</b>	<b>Count</b>	<b>%</b>

<b>108</b>	86.00	36.10	73.00	30.70
<b>115</b>	0.00	0.00	19.00	8.00
<b>122</b>	0.00	0.00	15.00	6.30
<b>128</b>	0.00	0.00	45.00	18.90

A higher second follow-up bid of KES 142, KES 148, KES 155, and KES 162 was presented to the respondents who were willing to pay KES 135. From this increased bid, 7.4% of the respondents were willing to pay at KES 162, and only 2.9% were willing to pay at KES 155. The results further showed that 8.8% were willing to pay at KES 142 however, most of the respondents not willing to pay at KES 142 (80.9%) were still not willing to pay at the lowest possible increased bid of KES 142.

**Table 4.13. Increased bid if yes at KES 135**

<b>Price/Bid</b>	<b>No</b>		<b>Yes</b>	
	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>
<b>142</b>	55	80.90%	6	8.80%
<b>155</b>	0	0.00%	2	2.90%
<b>162</b>	0	0.00%	5	7.40%

From this analysis, the initial proposed price of drying a bag of maize (KES 135) was perceived to be expensive by the respondents. According to the results, the price with the highest proportion of willing customers was at KES 108 which was the lowest bid offered to the respondents. This implies that the ideal price for drying one bag of maize should be KES 108 or lower because even when presented with the lowest possible bid of KES 108, 36.1% of the respondents were still not willing to pay for the technology.

### **4.3 Factors Influencing willingness to pay for improved maize dryer**

The results from the Tobit regression analysis of respondents' social economic factors influencing willingness to pay for improved maize dryers are presented in Table 4.14. The results from the study showed that maize production purpose positively and significantly influenced willingness to pay for improved maize dryers at a 10% significance level. This implies that a more commercially oriented producer is more likely to pay for the improved maize dryer. This

can be attributed to market standards of maize moisture content. Thus, a producer who produces for commercial selling will be more inclined towards investing in the dryer as it aids in attaining the required market maize moisture content to avoid possible losses. The losses may arise from market rejection of poorly dried maize or post-harvest losses from maize spoilage thus reducing output. This finding is in agreement with Kuwornu *et al.* (2011), who established that market incentive provision significantly influences the willingness to pay for maize drying.

The results further indicated that membership to a cooperative positively and significantly influenced willingness to pay for an improved maize dryer at a 10% significance level. This implies that producers who belong to cooperatives are more likely to pay for the improved maize dryer. Cooperative members are more likely to pay the improved maize dryer because they benefit from economies of scale. Therefore, the cooperative members will have a higher bargaining power in accessing a lower cost of accessing the maize dryer because they will demand for the dryer as a farmer group. Moreover, cooperative members benefit from capacity building trainings in maize drying hence they are more knowledgeable on the importance of using the improved maize dryer and are thus more willing to pay for the dryer. Additionally, in Kenya, association with groups and cooperatives and access to credit services is interlinked. Therefore, cooperative membership positively influences willingness to pay for maize dryers due to access of funds for payment of the service. This finding is supported Paudel *et al.* (2019), who established that smallholder farmers' willingness to pay for scale-appropriate farm mechanization is influenced by group/cooperative membership.

**Table 4.14. Tobit Regression Model on social economic factors influencing willingness to pay**

<b>WTP</b>	<b>Coef.</b>	<b>Std. Err.</b>	<b>t</b>	<b>P&gt; t </b>	<b>[95% Conf. Interval]</b>	
Gender	21.23	13.49	1.57	0.12	-5.48	47.95
Age	-0.35	0.62	-0.57	0.57	-1.58	0.88
Household size	-5.56	3.54	-1.57	0.12	-12.57	1.46
Education level of Household head	-15.92	10.31	-1.54	0.13	-36.34	4.5
Main occupation	7.28	7.21	1.01	0.32	-7.01	21.57
Maize production purpose	13.93	7.84	1.78	0.08*	-1.59	29.45

Land size	6.61	5.12	1.29	0.2	-3.52	16.75
Maize production land size	-14.01	9.42	-1.49	0.14	-32.66	4.64
Maize farming experience	22.98	19.42	1.18	0.24	-15.48	61.43
Annual Extension services received frequency	-0.21	12.34	-0.02	0.99	-24.65	24.24
Annual postharvest management trainings frequency	14.12	13.04	1.08	0.28	-11.71	39.95
Cooperative membership	24.4	12.49	1.95	0.05*	-0.34	49.14
Access to credit	-14.52	14.98	-0.97	0.33	-44.17	15.14
Cons	27.7	160.69	0.17	0.86	-290.51	345.92
var(e.WTP)	4397.38	661.2		3264.97	5922.55	

Where \* represents significance at 10% level.

The results from the Tobit regression analysis of respondents' production factors influencing willingness to pay for improved maize dryer presented in table 4.15. The results from the study showed that the price of maize per 90 kg bag positively and significantly influenced willingness to pay for improved maize dryer at a 5% significance level. This implies that the higher the price of a 90KG bag received by a producer the more likely the producer is to pay for the improved maize dryer. A plausible explanation for the nature of this relationship is that higher produce prices incentivise the farmers to invest in machinery that will enable them to sell their produce and benefit from higher prices. This finding is in agreement with Kuwornu *et al.* (2011), who established that market incentive provision significantly influences the willingness to pay for maize drying.

**Table 4.15. Tobit Regression Model on production factors influencing willingness to pay**

WTP	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
What state do you sell your maize	19.33	56.6	0.34	0.73	-92.74	131.41
Which is your main marketing outlet	-1.79	12.72	-0.14	0.89	-26.98	23.41
Distance to market	-0.34	1.29	-0.26	0.79	-2.89	2.21

Price per 90kg	0.03	0.01	2.33	0.02**	0	0.05
Prices satisfactory	-7.81	16.95	- 0.46	0.65	-41.38	25.77
Maize harvesting method	1.04	33.77	0.03	0.98	-65.84	67.92
Moisture at harvesting	-1.01	1.57	- 0.65	0.52	-4.11	2.09
Use maize drying	-5.55	29.11	- 0.19	0.85	-63.2	52.11
Cost to dry one bag of maize	-0.08	0.19	- 0.41	0.68	-0.45	0.3
%age lost through drying	1.83	18.08	0.1	0.92	-33.98	37.64
%age thrown away during sowing	-13.24	27.26	- 0.49	0.63	-67.23	40.74
Storage period	3.27	11.12	0.29	0.77	-18.75	25.3
cons	27.7	160.69	0.17	0.86	-290.51	345.92
Var (e WTP)	4397.3	661.2		3264.9	5922.55	
	8			7		

Where \*\* represents significance at 5% level.

The results from the Tobit regression analysis of respondents' perceptions about the improved maize dryer influencing willingness to pay for improved maize dryer presented in table 4.16. The results from the study showed familiarity with improved maize dryer negatively and significantly influence willingness to pay for improved maize dryer at a 5% significance level. This implied that the more a farmer was familiar with the improved maize dryer the less likely they were to adopt the technology. A plausible explanation to this is that when a farmer has more information about a technology, the farmer is able to assess the suitability of technology with regards to their production systems comprehensively and determine whether or not they want to pay for the technology.

The results from the study showed extent of liking maize dryers negatively and significantly influence willingness to pay for improved maize dryer at a 10% significance level. This implied that the more a farmer liked the maize dryer the less likely they were to pay for the technology. This relationship is explained by the fact that a farmer's positive perception of a

technology is not the only reason that leads to a farmer paying for the technology. Farmers consider combinations of factors before deciding to pay for a technology. Hence, a farmer having a positive opinion of a technology does not translate to a farmer being ready to pay for the technology. This is supported by Sadik-Rozsnyai and Bertrandias (2019) who suggested that the perceived value of new functional technological attributes integrated in rather functional products does not systematically lead to an increased WTP. According to Sadik-Rozsnyai and Bertrandias (2019), new technological attributes increase WTP only when they trigger social motivations.

The results also indicated that family and neighbours allowing the respondent to use the improved maize dryer positively and significantly influenced willingness to pay at a 1% significance level. This means that family and neighbours' approval of the improved maize dryer increased the likelihood of paying for the improved maize dryer. This is attributed to adoption of technology not only depending on one own's perception of the technology but also on the perception of the individuals one considers as important otherwise known as a subjective norm. A subjective norm is linked with apparent social influence to conduct or not to conduct a given behavior (Ajzen, 1991). Numerous researchers have also pointed out the implication of social networks in agriculture and risk management (Ali *et al.*, 2022). In this regard, people who are close to a farmer such as family and neighbors could influence farmers to indulge or not to indulge in agricultural risk management such as through improved maize dryers.

**Table 4.16. Tobit Regression Model on respondents' perceptions about the improved maize dryer influencing willingness to pay**

WTP	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
Familiar with improved maize dryer	-34.42	16.89	-2.04	0.044**	-67.87	-0.96
Extent of liking maize dryers	-16.47	8.35	-1.97	0.051*	-33.01	0.07
Perceive improved dryers to be expensive	-3.59	7.94	-0.45	0.65	-19.31	12.14
Improved maize dryers are not compatible with my production	-6.87	6.09	-1.13	0.26	-18.93	5.2

Improved maize dryer can reduce post-harvest losses	12.07	11.18	1.08	0.28	-10.08	34.21
Improved maize dryer important for management	-14.43	10.15	-1.42	0.16	-34.54	5.67
Extent of need for improved maize dryer	-8.51	25.63	-0.33	0.74	-59.27	42.25
Does improved maize dryers reduce costs	13.14	14.97	0.88	0.38	-16.51	42.79
Need for use assistance for improved maize dryer	-4.36	19.44	-0.22	0.82	-42.86	34.14
Improved maize dryer do not suit my production	-1.29	6.31	-0.21	0.84	-13.78	11.19
Neighbours and family will allow me to use improved maize dryer	23.75	8.35	2.85	0.005***	7.22	40.29
Access to maize drying methods	-0.72	5.07	-0.14	0.89	-10.75	9.32
cons	27.7	160.69	0.17	0.86	-290.51	345.92
Var (e WTP)	4397.38	661.2		3264.97	5922.55	

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*Where \*\*\*, \*\* and \* represents significance at 1%, 5% and 10% level respectively*

## **CHAPTER FIVE**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Conclusions**

In conclusion, the study effectively characterizes the smallholder maize farmers in Njoro Sub-County with respect to their willingness to use and pay for improved maize dryers, determined their willingness to pay (WTP) for improved maize dryers and established factors that influence smallholder farmers' willingness to pay. The following are the conclusions per objectives

- I. The findings reveal that a higher proportion of both male and female respondents were willing to use the improved maize dryer, particularly those with tertiary education, extensive farming experience, and larger landholdings. Farmers who were younger, from smaller households, and engaged in both commercial and subsistence maize production showed greater willingness to adopt the technology. Additionally, cooperative membership and regular access to extension services positively impacted the likelihood of using the improved maize dryer, while familiarity with post-harvest management training appeared to deter adoption. These insights underscore the importance of targeting well-educated, experienced, and commercially oriented farmers, as well as the need to leverage cooperative networks and extension services to promote the technology effectively.
- II. The study found that the initial proposed price of KES 135 was considered too high by respondents, with a significant portion only willing to pay at KES 108 or lower. This price sensitivity indicates that while there is a demand for the technology, the cost must be adjusted to meet the financial constraints of the target audience. Commercially oriented farmers, cooperative members, and those receiving higher maize prices were more likely to pay for the improved maize dryer, suggesting that these factors should be highlighted in marketing strategies. Furthermore, the study suggests that while the price of maize per bag and cooperative membership positively influence WTP, familiarity with the technology and personal preferences did not significantly impact willingness to pay.
- III. Familiarity with the technology and extent of liking negatively affected the willingness to pay, which implies that a more tailored approach to technology demonstration and education might be necessary. Positive influences included commercial maize production, cooperative membership, and higher maize prices, all of which should be leveraged to enhance adoption

rates. Additionally, the study highlights the role of social influences, such as family and neighbors, in increasing WTP, suggesting that community-based promotion and endorsement of the technology could further support its adoption. These comprehensive findings provide a strategic framework for policymakers and stakeholders to address barriers and enhance the effectiveness of initiatives aimed at reducing post-harvest losses and improving food security in the region.

## **5.2 Recommendations**

- I. Based on the research findings, it is recommended that marketing strategies for the improved maize dryer should focus on targeting farmers who are well-educated, have extensive farming experience, and manage larger landholdings. These characteristics are strongly associated with a higher likelihood of adopting the technology. Additionally, emphasizing the importance of cooperative membership and access to extension services in marketing campaigns will further enhance adoption rates. By aligning the marketing approach with the needs and profiles of these ideal clients, stakeholders can effectively promote the improved maize dryer to those most likely to benefit from and invest in it.
- II. To increase the likelihood of adoption, stakeholders should implement support mechanisms that assist farmers in expanding their production land, joining cooperatives, and accessing extension services and commercial market channels. These measures address the factors that are positively associated with willingness to use the improved maize dryer. Ensuring that these support structures are in place will help create a more favorable environment for technology adoption, as they directly impact the farmers' ability to utilize the maize dryer effectively and integrate it into their farming practices.
- III. Pricing strategies should be adjusted to reflect the findings that the initial proposed price of KES 135 was perceived as too high. Setting the price at KES 108 or lower, as preferred by the majority of respondents, is recommended to make the technology more accessible. However, even at this lower price, a significant portion of respondents remain reluctant to pay. Therefore, it is crucial for marketers to consider not only the price but also the overall value proposition of the improved maize dryer. Ensuring that the technology aligns with farmers' practical needs and preferences, and addressing community opinions about the technology, will enhance willingness to pay and overall adoption rates.

### **5.3 Further Research**

The study focus on factors influencing willingness to pay for the improved maize dryer. However, since the technology has been in existence for a while, studies should be conducted to establish the impact of the technology on profitability, this information may increase the willingness to pay for the dryers by farmers.

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## **APPENDICES**

### **APPENDIX A: QUESTIONNAIRE**

#### **TITLE: EVALUATING ECONOMIC VIABILITY AND FARMERS' WILLINGNESS TO PAY FOR IMPROVED MAIZE DRYERS IN KENYA.**

##### **SECTION A**

Thank you for giving me a chance to speak to you. I am Peter Akoko from Egerton University, Pursuing masters in agribusiness management. The purpose of the study is purely academics and aim at understanding the economic trade-offs between traditional and improved maize dryers and how much smallholder farmers are willing to pay to use them. In connection to these objectives, I would like to ask you a few questions to see how you feel about improved maize dryers in reducing post-harvest losses and how much you're willing to pay to use them. Your response together with those from others will be analyzed and the findings will assist the policy makers and business owners in designing food security policies and appropriate maize drying investments that will see a reduction in maize losses during drying and storage.

##### **PART I: DESCRIPTION OF IMPROVED MAIZE DRYERS**

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Depending on exactly where and how an improved dryer is situated, it could have a significant impact on reducing post-harvest losses. The use of improved dryers can substantially reduce grain wastage and improved maize earning farmers' higher incentives.

Common traditional open-air drying is not appropriate for drying maize in too humid environments like Njoro region, where rains are frequent and unpredictable, and always coinciding with harvesting periods. Improved dryers, however, are faster, requires less area to dry grains and they can be operated at any time of the day with less labor.

Improved maize dryers can be managed by farmer groups or cooperatives and therefore, individual farmers are not expected to buy the dryers, but instead, farmers will be required to pay a certain amount as a service fee to dry their maize. Improved dryers will be provided to active farmer cooperatives/farmer groups by the national government and other donor organizations such as Food Processing and Innovation Lab (FPIL) Project. The dryers are easy to use and can dry maize in a short shorter time compared to the common traditional method.

**PART II: WILLINGNESS TO PAY QUESTIONS:**

1. Have you ever used improved maize dryer before?
  - a) Yes
  - b) I'm currently using improved maize dryer
  - c) No
2. If yes, which dryer do you use?
  - a) Solar
  - b) Biomass/electrical
3. How do you access the above drying method(s)?
  - a) Own
  - b) Rent
  - c) Hire
  - d) Corporative
  - e) Others (specify)
4. The following statements will assess your opinions on the willingness to pay for improved maize dryers
  - a) Not at all
  - b) To small extent
  - c) To moderate extent
  - d) To large extent
  - e) To very large extent
5. Are you willing to use improved maize dryer?  
Yes=1, No=0
6. If the service provider comes to the farm and charges Ksh.135 for drying one bag of, would you accept?  
Yes=1, No=0
7. If yes,
  - a) How many bags would you dry?.....
  - b) What if the price is increased by 5%, 10%, 15% or 20%, would you still be willing to pay?

Yes=1, No=0

- c) Suppose price is decreased by 5%, 10%, 15% or 20%, would you still be willing to pay?

Yes=1, No=0

### **PART III: FARMER AND FARM CHARACTERISTICS**

8. Gender of the respondent.
  - a) Male
  - b) Female
9. When were you born?
10. What is the size of your household?
11. Who is the head of the household?
  - a) Myself
  - b) Spouse
  - c) My parents
  - d) Other relatives
  - e) Don't know/prefer not to say
12. What is the highest level of education of the household head?
  - a) Not gone to school
  - b) Primary education
  - c) Secondary education
  - d) Tertiary education
  - e) Prefer not to say
13. What is your marital status?
  - a) Single/ Never married
  - b) Monogamously married
  - c) Polygamously married
  - d) Widowed
  - e) Divorced
  - f) Separated
  - g) Don't know/Prefer not to say
14. Which of the following best describe your main occupation?
  - a) Employed

- b) Farmer
- c) Self-employed/entrepreneur
- d) Retired/not employed
- e) Don't know/Prefer not to say

15. For how long have you been farming?

16. Please indicate the size of your farm in Acres?

17. How much maize do you harvest for different seasons?

Season	Quantity (Bags)	Units (Kg, Ton)
High Sep- Feb		
Medium Feb-April		
Low April- July		

18. What is your average monthly income?

Activity	Jan- March	April- June	July- Sep	Oct- Dec
On-farm activities				
Employment				
Trading activities				
Remittances				
Others				
Total				

**PART IV: INSTITUTIONAL INFORMATION**

19. How many times did you receive extension visits in the last one year?

20. How many times did you receive training on post-harvest management in the last one year?

21. Do you belong to a farmer corporative?

- a) Yes
  - b) No
  - c) Prefer not to say
22. If yes, what roles does the group play to you in relation to maize drying?
- a) Training on maize drying
  - b) Provision of drying inputs
  - c) Marketing of maize
  - d) Others (specify)
23. If not, why?
24. Do you have access to credit?
- a) Yes
  - b) No
25. If yes, which sources?
- a) Banks and financial institutions
  - b) Family/friends
  - c) Farmer groups
  - d) Others (specify)
26. The following statements describe the relationship between your norms and the willingness to pay for Improved maize dryers. Do you think your relatives and your neighbors would allow you to use and pay for mechanized maize drying technologies?
- a) Not at all
  - b) To a small extent
  - c) To a moderate extent
  - d) To a large extent
  - e) To a very large extent

**PART V: MARKE INFORMATION**

27. What state do you sell your maize?
- a) Unprocessed/wet maize
  - b) Dry maize
28. Which marketing outlet do you use?
- a) NCPB and Millers

- b) Consumers/neighbors
  - c) Other maize traders (brokers)
  - d) Corporative
  - e) Others (specify)
29. What price do you sell your maize?
30. What is the distance from your farm to the nearest market in meters?
31. Which one of the following do your buyers use to express the quality of maize?
- a) Foreign matter
  - b) Brokenness
  - c) Moldiness
  - d) Cleanliness
  - e) Size of the grain
  - f) Other (specify)
32. Are the prices satisfactory?
- a) Yes
  - b) No

#### **PART VI: ATTITUDE AND PERCEPTION ON IMPROVED DRYERS**

33. How do you harvest your maize?
- a) Manually
  - b) Using maize harvesting machines
  - c) Others (specify)
34. What is the moisture level of your maize at the time of harvesting?
35. Do you use drying of maize as a way of preservation method?
- a) Yes
  - b) No
36. If yes, which drying method do you use?
- a) On-field drying
  - b) Open-air drying
  - c) Solar dryers
  - d) Others (specify)
37. How much do you spend to dry 1 bag (90kilogramgrams) of maize?

38. What percentage of maize is lost during drying process?
- a) Less than 10%
  - b) Between 10 and 20%
  - c) Between 20 and 40%
  - d) More than 40%
39. Do you sort your maize before packaging?
- a) Yes
  - b) No
40. If yes, what percentage of your harvested maize is thrown away?
- a) Less than 10%
  - b) Between 10% and 20%
  - c) Between 20% and 40%
  - d) More than 40%

41. Do you store your dry maize before selling?

- a) Yes
- b) No

42. If yes, how long do you store your maize before selling?

- a) Less than one month
- b) 1-3 months
- c) More than 3 months

To what extent do you agree with the following statements describing your personal attitudes and perception to using improved maize dryers.

42. I like Improved maize dryers

- a) Strongly disagree
- b) Disagree to some extent
- c) Disagree
- d) Agree to some extent
- e) Agree
- f) Strongly agree

43. Improved maize dryers can reduce maize losses during drying

- a) Strongly disagree

- b) Disagree to some extent
- c) Disagree
- d) Agree to some extent
- e) Agree
- f) Strongly agree

44. Improved maize dryers do not suit my farming activities

- a) Strongly disagree
- b) Disagree to some extent
- c) Disagree
- d) Agree to some extent
- e) Agree
- f) Strongly agree

45. Improved maize dryers are not convenient

- a) Strongly disagree
- b) Disagree to some extent
- c) Disagree
- d) Agree to some extent
- e) Agree
- f) Strongly agree



## APPENDIX B: ETHICAL APPROVAL

**EGERTON**

TEL: (051) 221 7808  
FAX: 051-221 7942



**UNIVERSITY**

P. O. BOX 536  
EGERTON

**EGERTON UNIVERSITY INSTITUTIONAL SCIENTIFIC AND ETHICS  
REVIEW COMMITTEE**

**EU/RE/DIR/009**

*Approval No. EUISERC/APP/272/2022*

*13<sup>th</sup> March 2022*

Peter Obuon Akoko  
P.O. BOX 536  
Egerton, Kenya,  
Telephone: +254702102038  
E-mail: peterobuon@gmail.com

Dear Peter,

**RE: ETHICAL APPROVAL: EVALUATING ECONOMIC VIABILITY AND  
SMALLHOLDER FARMERS' WILLINGNESS TO PAY FOR IMPROVED MAIZE  
DRYERS IN NJORO SUB-COUNTY, KENYA**

This is to inform you that the *Egerton University Institutional Scientific and Ethics Review Committee* has reviewed and approved your above research proposal. Your application approval number is *EUISERC/APP/272/2022*. The approval period is *13<sup>th</sup> March 2022 – 13<sup>th</sup> March, 2023*

This approval is subject to compliance with the following requirements;

- i. Only approved documents including (informed consents, study instruments, MTA) will be used.
- ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by *Egerton University Institutional Scientific and Ethics Review Committee*.
- iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to *Egerton University Institutional Scientific and Ethics Review Committee* within 72 hours of notification
- iv. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to *Egerton University Institutional Scientific and Ethics Review Committee* within 72 hours.
- v. Clearance for Material Transfer of biological specimens must be obtained from relevant institutions.

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# APPENDIX C: NACOSTI PERMIT

  
**REPUBLIC OF KENYA**

  
**NATIONAL COMMISSION FOR  
SCIENCE, TECHNOLOGY & INNOVATION**

RefNo: **675538** Date of Issue: **15/April/2022**

**RESEARCH LICENSE**



**This is to Certify that Mr. Peter Obun Akoko of Egerton University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nakuru on the topic: Evaluating Economiv Viability and Smallholder Farmers' Willingness To Pay For Improved Maize Dryers In Njoro Sub County, Kenya for a period ending 15/April/2023.**

License No: **NACOSTI/P/22/64486**

**675538**  
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SCIENCE, TECHNOLOGY &  
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## APPENDIX D: ABSTRACT SNAPSHOT



32nd International Conference of Agricultural Economists  
2-7 August 2024 | New Delhi | India

### Evaluating Smallholder Farmers' Willingness to Pay for Improved Maize Dryers in Njoro Sub-County, Nakuru, Kenya

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#### Abstract

Maize is most common staple food in Sub-Saharan Africa but in most cases, preserved using the traditional drying method which expose maize to severe losses and quality deterioration. Improved maize drying methods are therefore considered an alternative technique to dry maize. Studies from developed countries have found improved dryers to be more efficient and sustainable, however, developing countries like Kenya are still yet to adopt these technologies. Evaluating smallholder maize farmers' willingness to pay for improved maize dryers in Njoro Sub-County explains this slow adoption rate. This paper sampled 306 small-scale maize farmers and characterized them based on their willingness to use the dryers. Double bounded choice model was then used to determine farmers' willingness to pay. The results show that commercial maize production (P-value = 0.078,  $\beta$  = 13.92958), cooperative membership (P-value = 0.053,  $\beta$  = 24.40269), higher maize prices (P-value = 0.022,  $\beta$  = 0.0276285) and subjective norms (P-value = 0.005,  $\beta$  = 23.75356) positively influenced willingness to pay, while factors like familiarity (P-value = 0.044,  $\beta$  = -34.41718) and liking of the maize dryer (P-value = 0.051,  $\beta$  = -16.46909) had a negative impact. The findings emphasize the importance of considering education, farming experience, land size, cooperative membership, access to extension services, and commercial market channels when marketing improved maize dryers. The ideal adopters are farmers with advanced education, years of farming experience, larger land size, cooperative membership, and access to relevant services. To enhance the adoption of improved maize dryers, stakeholders should support farmers in expanding production land, joining cooperatives, accessing extension services, and connecting with commercial maize markets. Additionally, awareness programs targeting older farmers with large households and those lacking post-harvest training may help address factors associated with unwillingness to use improved maize dryers.

JEL Codes: Q12, Q16, D12, O33



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