CONSUMER PREFERENCE AND WILLINGNESS TO PAY FOR CERTIFIED HIGH-IRON COMMON BEAN GRAINS (*Phaseolus vulgaris* L.) IN WEST POKOT COUNTY, KENYA

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A Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirements for the Degree of Master of Science in Agricultural Economics of Egerton University

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DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been presented for an award of a degree, diploma, or certificate at Egerton University or any other University.

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Recommendation

This thesis has been submitted to Egerton University's Graduate School with our approval as Egerton University supervisors.

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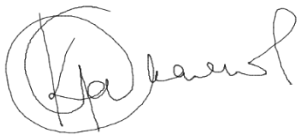

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DEDICATION

I dedicate this thesis to parents Francis Kirwa and Dinah Kirwa, and siblings, Annita, Winnie and Victor.

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ABSTRACT

Common beans play an important role in curbing food and nutrition insecurity in Kenya. This has created much interest in the research sector, resulting in the development of high-iron common bean varieties to alleviate iron deficiencies. Despite this development, there is information asymmetry among consumers, especially in distinguishing *Nyota* high-iron bean grains from other conventional common bean variety grains. Certification of *Nyota* high-iron common bean grains would ensure that consumers make informed nutritional choices. In this regard, this study sought to (1) assess the factors likely to influence consumer preference for certified high-iron bean grains, (2) to determine the factors likely to influence consumers' willingness to pay, and (3) to determine the socio-economic and institutional factors and product attributes likely to influence consumer preference for market outlets. Theory of random utility guided the study. A stratified multistage sampling technique was used to select 384 household decision makers in West Pokot urban centres. Through an exploratory research design, data was collected using semi structured questionnaire, choice cards, standardised focus group discussion guide tool and a key informant guide tool. A mixed logit model, a semidouble-bounded logit model, and a rank-ordered probit choice model were used to assess preference, willingness to pay, and preference for market outlets, respectively. Findings indicated that (90%) and (14%) of household decision makers preferred certification of high iron beans by a public body and a private body respectively, whereas (91%) preferred mandatory labelling, (12%) preferred precooked beans, and (54%) preferred low prices. Age and education were identified as heterogeneous factors. The semidouble-bounded logit model indicated that household decision makers were willing to pay an average price premium of KES 281 per kilogram of certified high iron bean grains. The model could explain 39% of the willingness to pay variance. Willingness to pay was significantly influenced by age, the proportion of monthly income allocated to food items, access to nutrition information, trust in certification agencies and awareness of food certification. The findings revealed that the open-air market outlet was the most preferred (44.99%), cereal shops (25.47%) and supermarkets (21.80%), while telebased outlets were the least preferred (7.73%). Furthermore, the household decision maker's sex, education level, occupation status, perceptions of service quality, and distance to the nearest market significantly influenced the preference for market outlets. Interventions for implementing lower pricing, and enhancing consumers trust in certification agencies and nutrition education tailored to age and years of education as well as improving in open air markets is essential. This necessitates a paradigm shift in the norm of stocking and trading unpackaged and uncertified common bean grains to the new reality.

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LIST OF ABBREVIATIONS AND ACRONYMS

BDM	Becker DeGroot Marschak
CGIAR	Consortium of International Agricultural Research Centers
FAO	Food and Agriculture Organization of the United Nations
GAIN	Global Alliance for Improved Nutrition
IDRC	International Development Research Centre
IFPRI	International Food Policy Research Institute
KALRO	Kenya Agriculture Livestock and Research Organisation
KDHS	Kenya Demographic Health Survey
KES	Kenyan Shilling
KNBS	Kenya National Bureau of Statistics
MoALD	Ministry of Agriculture and Livestock Development
MoF	Ministry of Finance
MoH	Ministry of Health
PABRA	Pan Africa Bean Research Alliance
PGS	Participatory Guarantee Systems
SAS	Statistical Analysis System
SDGs	Sustainable Development Goals
UN	United Nations
UNDESA	United Nations Department of Economics and Social Affairs
UNHSP	United Nations Human Settlements Programme
WHO	World Health Organization of the United Nations
WPCIDP	West Pokot County Integrated Development Plan
WPCNAP	West Pokot County Nutrition Action Plan
WTP	Willingness to Pay

CHAPTER ONE
INTRODUCTION

1.1 Background of Study

Globally, malnutrition remains a significant public health challenge, affecting at least one-third of the world's population. Nearly every country grapple with severe nutrition-related issues, including undernutrition and micronutrient deficiencies (WHO, 2020). While some advancements were made between 2010 and 2020, the prevalence of malnutrition, as measured by Sustainable Development Goal Indicator (2.1.1), has stagnated since 2015. In fact, malnutrition has increased from 8.0 % in 2019 to around 9.3 % in 2020, and it is expected to rise further in 2021 (FAO, 2021). A closer examination reveals that, only 52 out of 194 countries have been on track to meet stunting goals. Notably, the other 140 countries failed to achieve five of six global maternal, infant, and young child nutrition (MIYCN) targets on stunting, wasting, low birth weight, anaemia, and childhood undernutrition (Development Initiatives, 2021). The consequences of this persistent lack of progress are far-reaching. In 2020, wasting and overweight were found in 6.7 % of children under 5 (45.4 million) and 5.7 % of children under five years (38.9 million), respectively (Sachs *et al*., 2022). Malnutrition is thus a public concern, as it is the most critical contributor to child mortality, accounting for 45 % of deaths in children under five years of age (WHO, 2020).

The undernourishment rate in Africa increased from 19.6 % in 2014–2016 to 21.8 % in 2018–2020 (FAO, 2021). This trend has dire consequences, as malnutrition is estimated to affect approximately 21% of the African population in 2020, roughly translating to one in every five people (Reid, 2022). The Sub-Saharan Africa endures the most of this crisis, with 264.2 million people were undernourished in 2020. This equates to approximately 24.1% of the population, the highest prevalence worldwide (FAO, 2021), this has to the annual death of more than 3.5 million children under the age of five every year (Drammeh *et al.*, 2019). Beyond mortality, malnutrition imposes substantial economic losses averaging 6.9% of Gross Domestic Product in Kenya and 11% across Africa (MoF, 2019; IFPRI, 2016). This statistic has the potential to rise soon as the population increases. Despite the fact that many Sub-Saharan African nations have started working to reverse the trend of all forms of malnutrition by 2030, most initiatives are not progressing at the appropriate rate, according to Shrivastava *et al.* (2022). This necessitates additional efforts to eradicate malnutrition.

In the year 2020, Kenya made significant strides towards achieving the Sustainable Development Goals target 2.2 on stunting, wasting, and underweight rates among children (Development Initiatives, 2020). Despite this progress, the country’s population suffers from

micronutrient deficiencies. Kenya's global hunger index score for the year 2022 was 23.2, putting it near the bottom of the severe category of countries faced with hunger (Bernstein & Wiesman, 2018). Zinc and iron deficiency have been identified as a critical issue among micronutrient deficiencies. Iron deficiency affects 69% of Kenyan children under five years (Kisiangani *et al.*, 2015).Moreover, iron deficiency is a significant issue for 29% of women aged 15 to 49 (World Bank, 2019).

West Pokot County faces a significant malnutrition crisis, with alarming rates of stunting (33.5%), wasting (11%), and underweight (21%) among children under five (KNBS, 2022). The main driver of acute malnutrition being poor dietary intake and low nutritional diversity due to reduced consumption and production of milk among women and children of ages; 6-11 (11.2%) months, 12-17 months (20.8%), and 18-23 months (21.8%) (MoH, 2017; Namuleen *et al.,* 2021). Compounding these issues, is that in the year 2017 women consumed from less than five food groups, with beans accounting for only 26.9% of food diversity. This limited dietary intake is further worsened by low adherence to iron folic acid supplementation among pregnant women (Action against Hunger, 2019). Without urgent intervention, the future of health and development of West Pokot County remain at stake (County Government of West Pokot, 2018).

Out of the three strategies of combating malnutrition; dietary diversity, food fortification, and micronutrient supplementation (Bouis *et al.*, 2017), biofortification provides a offers a cost-effective and accessible approach to addressing vitamin and mineral deficiencies (Hotz & McClafferty, 2007; Stein *et al.,* 2005). In comparison with other strategies, biofortification requires only a one-time investment in the dissemination of nutrient-dense varieties. Additionally, biofortification targets low-income households by leveraging on their regular consumption of staples such as cassava, beans, and rice (Stein *et al.,* 2005; Stein *et al.,* 2007). It is also estimated that consuming high-iron common beans could improve the cognitive performance of target populations and provide up to 80% of the estimated average requirement for non-pregnant, non-lactating women of reproductive age (Andersson, 2017; Beebe, 2020. Given the increased iron and zinc requirements of this demographic (Dietary Reference Intakes, 2019), biofortified beans offer a promising solution to address their nutritional needs.

To combat malnutrition, the biofortification of beans with iron and zinc has been a key focus of in breeding programs in Latin America and Africa since the early 2000s (Beebe, 2020). In Kenya, seven varieties were formally released in 2012 as the first high-iron common bean varieties in this region (Kimani *et al.,* 2019). To further promote high-iron common beans

(Nyota, Angaza and Faida), the KALRO and international consortia, PABRA, GAIN and Harvest Plus are implementing the Commercialisation of Biofortified Crops (CBC) Programme project. This program aims to combat hidden hunger by promoting staple food crops that are rich in essential vitamins and minerals. Two major staples were biofortified by using conventional plant breeding methods; high-iron bean, and Vitamin A Orange sweet potato. The *Nyota* High iron bean variety is the first of these biofortified crops to be introduced in the Kenyan market in 2020. In combating malnutrition, the Kenyan government adopts multi-sectoral approach to improve nutrition for population groups (MoALD, 2011). It seeks to address malnutrition by promoting diversified diets, food fortification, as well as, vitamin and mineral supplementation. Recognising the significance of these approaches, the common bean value chain has been identified as a priority due to its substantial potential for enhancing food and nutrition security (MoALD, 2011).

Jada *et al.* (2023) highlights that the successful integration of biofortified foods into the diets of the target population hinges upon their acceptance and consumption. As a result, certification schemes are becoming popular as a tool for food chain governance (Veldstra *et al.,* 2014) and a consumer policy tool (Thøgersen *et al.,* 2019). Implementing certification processes is crucial in promoting consumer trust in biofortified products (Moser *et al.,* 2011). Such certification serves to bolster confidence in the quality claims associated with biofortified foods, a point supported by Wang *et al.* (2018). However, it is essential to recognise that certification alters a product, potentially impacting consumer acceptance, willingness to pay, and purchasing behaviour, particularly in the case of novel certified high-iron common bean grains. Thus, an in-depth understanding of consumer-stated preferences becomes imperative to ensure the successful scaling up of certified high iron common beans as a viable solution for addressing iron deficiency in Kenya and eventually contributing to food security.

1.2 Statement of the Problem

Common beans are a major staple food in Kenya. Their role in curbing food and nutrition insecurity in Kenya cannot be underestimated. This has created much interest in the research sector, resulting in the development of high-iron common bean varieties to alleviate iron deficiencies. Despite significant strides in the development of high-iron common beans varieties, a notable challenge persists in the form of information asymmetry. Consumers' inability to distinguish *Nyota* high-iron beans from other conventional common beans varieties (such as *Rosecoco* and *Chelalang*) may be an area of interest since they have similar phenotypic traits. This necessitates the involvement of a certification authority for easing the identification,

distinction, and verification processes of the high-iron beans in the market. As such, certification of *Nyota* high-iron bean varieties by relevant certification bodies may provide an avenue for this verification. In this regard, there are limited studies on consumer preference, valuation, and purchasing patterns for certified high-iron common bean grains in Kenya. It is essential to solve the highlighted problem by analysing the hypothetical household behaviour towards consuming certified high-iron beans in West Pokot County. Findings may be used to identify food policy interventions ideal for household consumption, improving Kenya's food and nutrition security situation.

Figure 1: Nyota Beans Variety

Figure 2: Chelalang Beans Variety ,

Figure 3: Rose Coco Beans Variety

1.3 Research Objectives

1.3.1 General Objective

To contribute to improved food and nutrition security through an analysis of consumer behaviour for certified high-iron common bean grains in Kenya.

1.3.2 Specific Objectives

i. To identify the factors likely to influence consumers' preference for certified high-iron common bean grains among West Pokot County urban households.
ii. To determine the factors likely to influence consumers' willingness to pay for certified high-iron common bean grains among West Pokot County urban households.
iii. To determine the socio-economic, institutional factors and product attributes likely to influence consumers' preference for market outlets for purchasing certified high-iron common bean grains among West Pokot County urban households.

1.4 Research Questions

i. What factors are likely to influence consumers' preference for certified high-iron common bean grains among West Pokot County urban households?
ii. What factors are likely to influence the consumers' willingness to pay for certified high-iron common bean grains among West Pokot County urban households?
iii. What are the socio-economic, institutional factors, and product attributes likely to influence consumers' preference for market outlets for purchasing certified high-iron common bean grains among West Pokot County urban households?

1.5 Justification of the Study

Kenya has been working on improving nutrition security through policy formulation (MoALD, 2011). However, despite these efforts, Kenya still faces issues with malnutrition (Bernstein & Wiesman, 2018). To tackle this problem, reducing malnutrition is a priority in several strategic plans, including the WPCIDP 2023-2027, WPCNAP 2019-2023, Kenya National Food Fortification Strategic Plan 2018-2022 (MoH, 2018), and the Kenya National Food and Security Policy (MoALD, 2011). The study is also in line with African Union (2020) roadmap for upscaling biofortification and reducing malnutrition in children by 2025. This roadmap targets a 5% reduction in low weight and a 10% reduction in stunting through the upscaling of biofortification. The study will also contribute to attaining sustainable development goal target 2.2, which aims to end all forms of malnutrition by 2025 (UN, 2015).

Therefore, this study's findings provide vital information on consumer behaviour, contributing to formulating policies that improve household food and nutrition security.

1.6 Scope and Limitations of the Study

The study focused on household decision makers who shop for common bean grains at West Pokot County urban markets. To ensure that only the households mentioned above were selected, respondents were screened to confirm that they were the main primary shoppers in their households. In conducting stated preference research, the different choices made by respondents in hypothetical settings are often prone to hypothetical bias. Additionally, the study findings are also only limited to West Pokot County urban areas. However, this study speculated that consumers with representative characteristics in other urban areas of Kenya are likely to behave the same. Furthermore, a lack of proper record keeping affected the accuracy of the responses. The study relied on the household decision maker's ability to recall and understand information. To minimize recall bias, information elicitation on their consumption habits started with the most recent period. In addition, questions were formulated to be clear and precise to reduce variation in comprehension.

1.7 Operational Definition of Terms

Certification: It is a process where *Nyota* high-iron common bean grains are verified and labelled by a third party (public), private, participatory guarantee systems and joint public private certification body.

Common bean: Any variety of legumes of family *Fabaceae*, genus *Phaseolus* and species *Vulgaris,* which are widely cultivated for their edible dry grains.

Decision-maker: A household member responsible for making critical decisions concerning food consumption.

Market: A place where willing buyers and sellers exchange money for common bean grains**,** whether physically or virtually.

Participatory Guarantee Systems: They are locally focused certification systems for common bean grains and are built on a foundation of trust, social networks and knowledge exchange.

Tele-based Outlet: This is market outlet where a household decision maker rings or messages their preferred retailer to send them a given quantity of certified high-iron beans.

Urban area: It is a populated area and fringe area of towns and centres whose economy is characterized by high levels of development and human activity.

CHAPTER TWO
LITERATURE REVIEW

2.1 The Importance of Production, Consumption and Certification of High-Iron Common Beans

The common bean is a globally significant legume, particularly in Sub-Saharan Africa, where it has traditionally been a staple food for many, especially low-income households (Nakazi *et al.,* 2017; Uebersax *et al.,* 2023). This is due to its high protein content and unique blend of carbohydrates, dietary fibre, and minerals, which contribute significantly to human health (Didinger *et al.,* 2022). As such, the common bean is expected to play a crucial role in ensuring food and nutrition security (Nadeem *et al.,* 2021).

Total dry bean world production and area harvested in the year 2020 was 27.5 million metric tons and 34.8 million hectares, respectively. Regionally, Asia leads in dry bean production with about 43% of global production, followed by the Americas North, Central, and South America (29%), and Africa (26%). Europe and Oceania contribute about 2% of total production. In 2020, the worldwide production of dry beans reached 27.5 million metric tons, with a harvested area of 34.8 million hectares. Since 1990, dry bean production has increased by approximately 60%, while the harvested area has increased by 36% during the same period (FAO, 2022).

Globally, Kenya ranks seventh in common bean production and second in East Africa (KenInvest, 2016; Ogecha *et al.,* 2019). About 1.5 million smallholder farmers grow these beans on about a million hectares, yielding approximately 0.6 Metric tonnes per hectare (Duku *et al.,* 2020). National production in Kenya is assessed to be approximately 427,000 Metric tonnes annually against a consumption of about 666,000 Metric tonnes annually. This translates to a per capita consumption of 8.6 kilograms annually (KNBS, 2021). However, in the country's western areas, it might reach 66 kilogrammes per year (Katungi *et al.,* 2011).

Beans is a source of protein to more than 310 million people in rural and urban areas of Eastern African and Latin American communities (Buruchara *et al.,* 2011; Petry *et al.,* 2015). They offer a higher nutritional value than cereals due to the balance of carbohydrates to proteins and the high diversity of amino acids (Sá *et al.,* 2020). At 340 calories per 100 grams, beans provide energy and are rich in vitamins, fibre, and antioxidants, thereby contributing up to 35% of daily protein requirements. Consuming high-iron common beans improves cognitive abilities, increases physical efficiency in women, and enhances iron levels in women (Luna *et al.,* 2020; Murray-Kolb *et al.,* 2017). Common beans are also lauded as more environmentally sustainable protein sources than animal-based proteins (McDermott & Wyatt, 2017). Common

beans are excellent candidates for transition from animal-based to plant-based proteins for Africa's rural and urban poor, who often struggle to afford alternative sources of these nutrients (Bessada *et al.,* 2019; Huertas *et al.,* 2022).

Certification is essential for credence quality products such as high iron common as it builds consumers' confidence (Perez, 2019; Wang *et al.,* 2018). Furthermore, it provides visible and salient information, thereby, allowing establishment of credibility of invisible attribute (Darnall *et al.,* 2018). As de Brauw and Bulte (2021, p115) noted "The addition of iron and zinc to common beans varieties improves one's health, nevertheless one cannot distinguish a high iron bean from a normal one since they look the same". As a result, certification schemes are becoming popular as a tool for food chain governance (Veldstra *et al.,* 2014) and a consumer policy tool (Thøgersen *et al.,* 2019).

Based on various standards, there are numerous types of food certifications. For instance, organic certification, is given to products produced solely using organic practices. Certifications differ in their operational approach (for example, local-based versus third-party certifications) as well as their origin (for example, domestic versus foreign certifications). Regardless of standards, operational processes, or sources, the primary goal of certifications is to distinguish certified food from ordinary food, provide evidence for products with credence attributes, and assist consumers in making food choices (Truong *et al.,* 2022)

2.2 Empirical Framework

2.2.1 Consumer Preference for Certification of Foods Products

Food control systems in SSA are still weak. Notwithstanding, preference studies have investigated consumer behaviour to food quality certification in developing countries (Akinwehinmi *et al.,* 2022; Birol *et al.,* 2015; Lagerkvist *et al.,* 2013; Shikuku *et al.,* 2023; Wongprawmas & Canavari, 2017) and developed countries (My *et al.,* 2018). Furthermore, studies have examined quality certification demand for baby food and juice in developing countries (Masters & Sanogo, 2002; Owuor *et al.,* 2022) as well as on demand for fair-trade and organic certification of various food products in developed countries (Banerji *et al.,* 2016; Gracia *et al.,* 2011; Loureiro & Umberger, 2007; Roe & Sheldon, 2007; Scarpa *et al.,* 2005).

Whereas the aforementioned literature is varied in terms of recommended certification systems, the studies also reveal the importance of costs associated with certification of food products. Alternatively, consumer preference for participatory guarantee systems certification of food products could have also been investigated because they can reduce the costs and simplify bureaucratic procedures required by third-party certifications (Kaufmann & Vogl,

2018; Sacchi *et al.,* 2015). At the same time, it would have been valuable to consider mandatory and voluntary labelling approaches in response to the increasing interest in food labels in the global south, where food retailers are introducing their own labelling systems in traditional marketplaces (Mandle *et al.,* 2015). This is particularly relevant due to the inadequate food certification and labelling regulation measures and uncertainties around consumer preferences for nutritious foods (Abate *et al.,* 2021; Hoffmann *et al.,* 2021).

A study by Silva *et al.* (2017) investigated preference for certified bean attributes in Brazil using the rating scale exercises for different attributes. However, a well-known problem with the rating scale exercises is that they do not explicitly capture the trade-off between attributes (Srinivisan *et al.,* 2011). Departing from this methodology, the application of a discrete choice experiment is advantageous because it reflects the actual decision-making process and allows for the elicitation of whole preferences for any set of attributes (Louviere *et al.* 2000).

Using ordinary least squares Katungi *et al.* (2011) investigated consumers who are also producers, for a set of attributes related to consumption flavour and yield attributes. However, this model is disadvantageous when ordinary least squares assumptions are violated, because the model oversimplifies, or misrepresents, reality (Currit, 2002). Chege *et al.* (2019) investigated consumer preference for nutritious food using the Becker DeGroot Marschak method. However, Wertenbroch and Skiera (2002) show that the Becker DeGroot Marschak method produces lower estimates than non-incentive compatible methods such as, contingent valuation. In exploring consumer demand heterogeneity. Aseete *et al.* (2018) and Wu *et al.* (2017) used a choice experiment and a latent class model in analysis; both mixed logit and latent class logit models offer attractive specifications in analysing consumer preferences (Hensher & Greene, 2003). However, Guo and Shen (2022) found that mixed logit performs better.

Sichilima *et al.* (2016) examined the factors influencing the trade of dry common beans in Zambia using the hedonic pricing model, which is a revealed preference approach. The revealed preference approach has limitations as it cannot solely explain choices and must rely on external factors such as objectives and expectations for interpretation (Elsner *et al.,* 2014). The stated preference approach, on the other hand, could have been utilized, as it presents cost information directly to the respondent in valuation tasks, thereby making it more salient (Alberini, 2019). In addition, the study only included price as the extrinsic attribute. The study might have been enhanced by including processing, labelling, and certification attributes.

Kilima *et al.* (2020) conducted a study on the factors influencing consumers' selection of dry common beans in Tanzania using the double hurdle model. One drawback of the standard double-hurdle model is its reliance on the assumption of bivariate normality of the error terms. When this assumption is not met, the model's maximum likelihood estimates may become unreliable (Aristei & Pieroni, 2008). Kenamu *et al.* (2019) assessed heterogeneity in the frequency of common bean consumption in Malawi using an ordered probit model with price as the extrinsic attribute. Hamukwala *et al.* (2019), Swema and Mwinuka (2021), and Wanyama *et al.* (2019) conducted a choice experiment on consumer preference for common beans and maize using only the intrinsic attributes (colour, grain size, cooking time and gravy quality). It could have been beneficial to improve the study by incorporating processing, labelling, and certification attributes.

According to studies by Mishili *et al.* (2011), Quaye *et al.* (2011), Swema and Mwinuka (2021), three major factors influence bean consumption: consumer characteristics, visible product attributes, and invisible product attributes. Colour, gravy quality, and other attributes that consumers can observe before purchasing are visual product attributes for beans. In contrast, invisible product attributes are those that are realised ex-post. Consumers' expectations of a product's invisible attributes are formed through history, experience, culture, advertising, and other sources of information. Demographic (age, gender), socioeconomic (income, education), and psychographics (tradition) characteristics are among the consumer characteristics. Taking consumer preferences into account in product development is also crucial for the acceptance of new bean varieties (Katungi *et al.*, 2009).

Food preferences and choices are shaped by various factors beyond just demographics and income. Rizwan *et al.* (2022) emphasizes the importance of understanding psychology, dietetics, and nutritional information in influencing consumer food preferences. Additionally, cultural and societal factors such as social interactions, community taboos, and individual tastes play a significant role in shaping eating habits (Chadwick *et al.*, 2013). According to Glanz *et al.* (1998), individuals often gravitate towards familiar foods and are resistant to developing new preferences.

Consumer food preferences and perceptions are influenced by cultural orientation, as indicated by Nuani *et al.* (2022). Research on common bean consumption suggests that employed individuals and those with higher education levels tend to engage with people who have diverse eating habits (Gitonga, 2015). Furthermore, attitudes towards product labelling have been shown to impact consumer choices (Wu *et al.*, 2017). Alonso *et al.* (2018) showed how food security is influenced by ethnicity, place of origin, and social upbringing. The study's

findings show that while all respondents value all production attributes, their preferences for consumption attributes vary. Furthermore, wealthy farming households were willing to pay a premium for larger grain sizes, whereas low and middle-income households were unconcerned.

Consumers' preferences can be assessed in various ways, including through stated and revealed preference methods (Breidert *et al.,* 2006). The stated preference approach involves eliciting willingness to pay in a hypothetical setting, while the revealed approach obtains estimates of WTP based on actual (previous or current) purchases (Adamowicz *et al.*, 1998). As certified high-iron common bean grains are a new product in the Kenyan market, market data for them still needs to be discovered, because it does not rely on previously disclosed purchase data (Mangham *et al.,* 2009).

The choice experiment, a stated preference approach, is used to analyse respondents' preferences for non-market goods or services (Louviere & Hensher, 1982; Louviere & Woodworth, 1983). In the choice experiment, respondents are given options in each choice set, allowing them to choose their preferred alternatives (Hanley *et al.,* 2001). The researcher can measure how well respondents can trade off the attributes.

2.2.2 Consumer Willingness to Pay for Quality Certification of Food Products

There is a rich literature on willingness to pay for quality certification of maize and pearl millet products in sub–Saharan Africa and Asia (Banerji *et al.,* 2016; De Groote *et al.,* 2011, 2016; Hoffman *et al.,* 2015, 2019; Prieto *et al.,* 2021). Primarily, these studies focused on quality certification of maize and pearl millet, leaving out quality certification of common beans given that it is a priority value chain in improving food and nutrition security in Kenya (MoALD, 2011). Additionally, the studies mentioned above used experimental auctions. One major limitation of this approach is that various crops and varieties of the same product offered to consumers may differ in density leading to inaccurate willingness to pay estimates. This makes consumers to reveal a temporary preference for drier food products under auction rather than a permanent valuation (Prieto *et al.,* 2021). Hoffmann and Moser (2017) investigate how labelling maize as tested for aflatoxin, affects sales in the informal markets of urban and peri-urban areas where certified food and grain labelling are not commonly observed (Booth *et al.,* 2021; Hoffmann *et al.,* 2019). While labelling is essential, investigating labelling approaches demanded by consumers could have been equally important. Additionally, the marketing intervention studied was led by only single certification body rather than several certification bodies.

Oparinde *et al.* (2016) conducted research on consumer willingness to pay (WTP) for high iron beans in Rwanda. They used a random-effects double hurdle econometric approach and a Becker-DeGroot-Marschak auction mechanism. However, Wertenbroch and Skiera (2002) demonstrated that Becker-DeGroot-Marschak auction mechanism produces lower WTP estimates than non-incentive-compatible methods such as contingent valuation method which are considered more cost-efficient (Breidert *et al.*, 2006). Rubyogo *et al.* (2019) investigated consumer acceptance and willingness to pay for high-iron beans in northern Tanzania using a double-bounded contingent valuation method. To improve model estimates, the more efficient One-and-One-half-bounded contingent valuation method could have been used (Cooper *et al.*, 2002).

In willingness-to-pay studies, various factors are hypothesized to influence consumer WTP. These factors include socio-demographic, perceptual, psychological, and institutional factors (Ongudi *et al.*, 2017). De Groote *et al.* (2011) found that consumers' WTP estimates were influenced by monthly household income, consumer familiarity, levels of awareness, education levels, and trust. According to Ngigi *et al.* (2010), the presence of children in a household, safety concerns, income, and consumption consistency all influence a household's WTP. De Groote *et al.* (2011) found that Kenyan consumers were willing to pay a premium for fortified maize, but this depended on consumer familiarity and levels of awareness. Chelang'a *et al.* (2013) found that the presence of children in a household, years of schooling, the age of the household decision-maker, and the number of years respondents consumed vegetables positively influenced WTP. Bett *et al.* (2013) showed that significant factors affecting WTP in their study included the age of consumers, income levels, education, family size, price of substitute products, and taste or flavour.

Contingent valuation is a common method for valuing non-marketed goods and services. Contingent valuation involves eliciting information about the highest price a consumer would be willing to pay for a specific quantity of a commodity (Wertenbroch & Skiera, 2002). It is a flexible approach and more straightforward to use compared to auction mechanisms, which are more expensive, time-consuming, and complex to organize and execute, especially where the targeted respondents have low education levels (Brebner & Sonnemans, 2018; Predmore *et al.*, 2021).

2.2.3 Consumer Preference for Market Outlets

In recent years, research on food retailing preferences in many developing countries has mainly focused on on-farm and roadside markets that sell uncertified foods. However,

Minten and Reardon (2008), Neven and Reardon (2004) find that there is a growing trend of non-traditional outlets selling foods in some of these countries (Gorton *et al.,* 2011; Okello *et al.,* 2012). These non-traditional outlets include supermarkets, speciality stores such as cereal stores (Koech *et al.,* 2022), and e-marketing outlets (Ramesh *et al.,* 2023). Despite this shift, previous studies that examined consumer food shopping outlet preferences (Anku & Ahorbo, 2017; Dadzie & Nandonde, 2019; Gido *et al.,* 2016; Koech *et al.,* 2022; Meng *et al.,* 2014; Shafiwu *et al.,* 2018) primarily overlooked all possible stores where consumers purchase products (Dornelles, 2019). Considering that consumers prefer to shop for food products from e-marketing channels, this aspect is evidently limited in literature.

The recent introduction of an online virtual market has further strengthened this view. This market is accessible anytime and anywhere, offering a wide assortment of products. To retain their customers, physical market outlets have started accepting home delivery orders by phone. They have introduced new services such as the 'click and collect' option, which allows customers to order products on the phone and then collect them directly at their doorstep (Dominici *et al.,* 2021). The increasing number of internet users, the growing adoption of smartphones (ITU, 2022), and evolving food habits have facilitated the development of this marketing channel.

Traditionally, prior research into the decision-making process of consumers patronizing food establishments has predominantly relied on multinomial logit models (Magogo *et al.,* 2015; Okello *et al.,* 2012; Shafiwu *et al.,* 2018; Slamet & Nakayasu, 2016). However, a drawback of these models is their tendency to focus on the most preferred option while disregarding other potential choices, as noted by Palma (2017). Günden *et al.* (2010) addressed this limitation by employing rank data and a Tobit model to evaluate consumer preferences for purchasing organic fruits and vegetables in Turkey. Nevertheless, the assumption that respondents can accurately assess their utility for each alternative and rank them accordingly poses a challenge, ultimately constraining the model's capacity to estimate preferences effectively.

Sociodemographic characteristics have often been used to explain the choice of marketing outlets at the household level. For instance, Günden *et al.* (2010) find that age is associated with preferences for purchase places for agri-food products. Accordingly, a study by Okello *et al.* (2012) and Iton (2017) revealed that consumer characteristics such as age, income and household size are significant determinants of using supermarkets as market outlet choices for the purchases of roots and tubers in Trinidad and Tobago, and vegetables in Kenya, respectively. The findings of a study of Chinese consumers' preference for online grocery

shopping study show that household size and income were the most relevant drivers for online grocery shopping. People with higher incomes have a greater financial incentive to seek certification logos, as they want to ensure they obtain the high-quality, authentic products they are paying for (Wu, 2022). Additionally, education is vital in influencing consumer purchasing behaviour (Lin *et al.,* 2019). People with a higher level of education have a better understanding of the meaning and importance of certification logos. They are more willing to look for them in the purchasing process (Corallo *et al.,* 2019). Equally, Meng *et al.* (2014) reported that income positively influences purchasing food from Ghana supermarkets. Further perceptions of freshness, high quality, traditional production methods, and sustainability are equally important in shaping market outlets preferences (Liu *et al.,* 2013).

To study preferences more efficiently, respondents in a survey are usually asked to rank a set of choices from the most to the least preferred (Milioti *et al.,* 2020). In order to guarantee that the expressed preferences of participants accurately reflect their actual choices in real life, clear descriptions of market outlets, as well as the characteristics included in them, are described to the participants to rank (Moore, 1990).

2.3 Mitigation of Hypothetical Bias in Stated Preference Approaches

Haghani *et al.* (2021) defines hypothetical bias as a divergence of responses from the true estimates due to data being collected in a fictional environment instead of a more realistic environment. Kanninen (1995) noted that discrete dichotomous questions would easily cause starting point bias in contingent valuation. In psychology, people base their decisions on the facts at hand. Therefore, when the starting bid bias is ignored, respondents will value the goods based on the initial bid and subsequent questions.

In contingent valuation, there are numerous methods for calibrating hypothetical biases. Arrow *et al*. (1993) advocated starting the first bid with a different price or reference and then following up with second-bid pricing. Shogren (1993) developed a calibrated technique for obtaining a statistical function related to potential values for a product via a contingent valuation survey and the product's real value. This function could be used to adjust the values of survey respondents who did not participate in the auction. Another approach to calibrating is to include "no answer" or "don't know" in the uncertainty correction procedure (Murphy *et al.,* 2005).

Oath-taking can also be used to mitigate hypothetical bias, where participants sign a commitment to confess their responses are truthful (Carlsson *et al.,* 2013). It works by inadvertently activating specific behaviours, allowing respondents to be exposed to some

specific words unrelated to the following choice task. These triggers can result in actual purchasing behaviours., impacting the participant's following decision in an unconscious way. López-Galán and de-Magistris (2019) validates the efficacy of honesty priming in reducing the hypothetical bias in the contingent valuation method. Cummings and Taylor (1999) introduced cheap talk to eliminate hypothetical bias with private goods. Before bidding, the researcher attempts to elicit unbiased replies by reading a script. These scripts simulate their actual purchasing behaviour as if the product is available in a real market.

Gschwandtner and Burton (2020) advocate including a budget reminder and the opt-out reminder in cheap talk scripts. It has also been proposed, primarily by health economists, that allowing people additional time to reflect on their responses in choice experiment could be an alternate method of minimising hypothetical bias (Whittington *et al.,* 1992). Buckell and Hess (2019) provide another viewpoint by directly associating the strategy of supplementing choice experiment with revealed preference data as a treatment for hypothetical bias because revealed preference data is free of hypothetical bias. Murphy *et al.* (2005b) pointed out that no single technique is the ultimate that eliminates this bias. Ultimately, mitigating hypothetical bias for this study involved a combination of techniques, including cheap talk, budget reminder and an opt-out reminder.

2.4 Theoretical Framework

2.4.1 The Concept of Consumer Behaviour

Consumer behaviour involves understanding how a consumer acquires and disposes of goods, services, time, and ideas (Babin & Harris, 2023). Engel *et al.* (1986) emphasises on the internal cohesion of the decision process on the main phases of consumption; searching, making decisions, using a commodity, and disposal.

2.4.2 The Theory of Consumer Behaviour

Consumer behaviour theories seek to explain how consumers allocate their income over different commodities to maximise their utility (Hill & Schiller, 2015). It is worth mentioning that consumers are rational; therefore, it is possible to express the probability of utility gained from the available alternatives (Cascetta, 2009). However, factors such as price and income level influence the decision-making process. Besides that, the consumer faces several alternatives that shape his decision from a set of choices (Ben-Akiva & Lerman, 2018). As a result, this study was guided by the random utility theory (Adamowicz *et al.,* 1998; Lancaster, 1966). The economic theory underpinning this study is random utility theory and the

explanation that follows is adapted from Grafton *et al*. (2004). Utility theories are based on the idea that people make decisions that maximize their utility based on their own preferences. It is assumed that a person's utility function consists of systematic or measurable component (V) and a random component (ε). Only portion of an individual's preferences can be observed, hence explanations of their decisions can only be expressed in probabilistic terms, as the probability that an individual will choose a particular attribute or combination of attributes over. A person's utility function is represented in equation 1;

$$U_{mi} = V_{mi} + \varepsilon_{mi} \tag{1}$$

where U_{mi} represents the overall utility for choice m for household decision maker i, while ε_{mi} denotes the error term, V_{mi} is the measurable utility which is assumed to be a linear function of observable variables, that may depend on either individual i or choice m or both (Verbeek, 2004). It takes the following form:

$$V_{mi} = \beta_i * X_{mi} \tag{2}$$

where β_i represents the vector of parameters to be estimated, while X_{mi} comprises of vector of choice characteristics, a household decision maker characteristics and possible interactions. Random utility theory posits that individual consumers choose the attribute or combination of attributes from among alternatives that maximizes their utility. As such, if we assume there are K elements in a household decision maker's choice set a and if the i^{th} consumer selects choice m, then U_{mi} is the highest utility obtainable from among the K possible choices (Loureiro & Umberger, 2007). The probability that i will choose n from J can be written as:

$$P_{mi} = P(U_{mi} > U_{mi}; a = 1, 2, 3, ...K) = P(\varepsilon_{ai} - \varepsilon_{mi} < V_{mi} - V_{ai}; a = 1, 2, ...K, a \neq k) \tag{3}$$

For equation 3 to be estimated, error terms were assumed to have Gumbel distribution with independence and identical distribution characteristics (McFadden, 1973). The random utility theory is favoured for this study. By adopting a more holistic approach, the random utility theory provides a more comprehensive understanding of consumer behaviour than other theories.

2.5 Conceptual Framework

The conceptual framework in Figure 1 is based on consumer theory, where the consumer decision process involves the evaluation of alternatives and, subsequently, choice. This study conceptualizes that demographic, institutional, and economic factors, as well as product attributes, are explanatory variables that will likely influence three dependent variables; "consumer preference," "willingness to pay," and "consumer preference for market outlets." It was presumed that there is a relationship between dependent variables, consumer preference, and willingness to pay. Ordinarily, the stronger the preference for a particular good, the higher the WTP is likely to be. Moreover, consumers with a higher WTP may prefer to purchase from outlets that offer premium or specialized products. The study's output can be used to develop appropriate marketing strategies for certified high-iron bean. This will lead to enhanced high-iron bean trading and increased bean consumption hence helping to achieve food and nutrition security eventually.

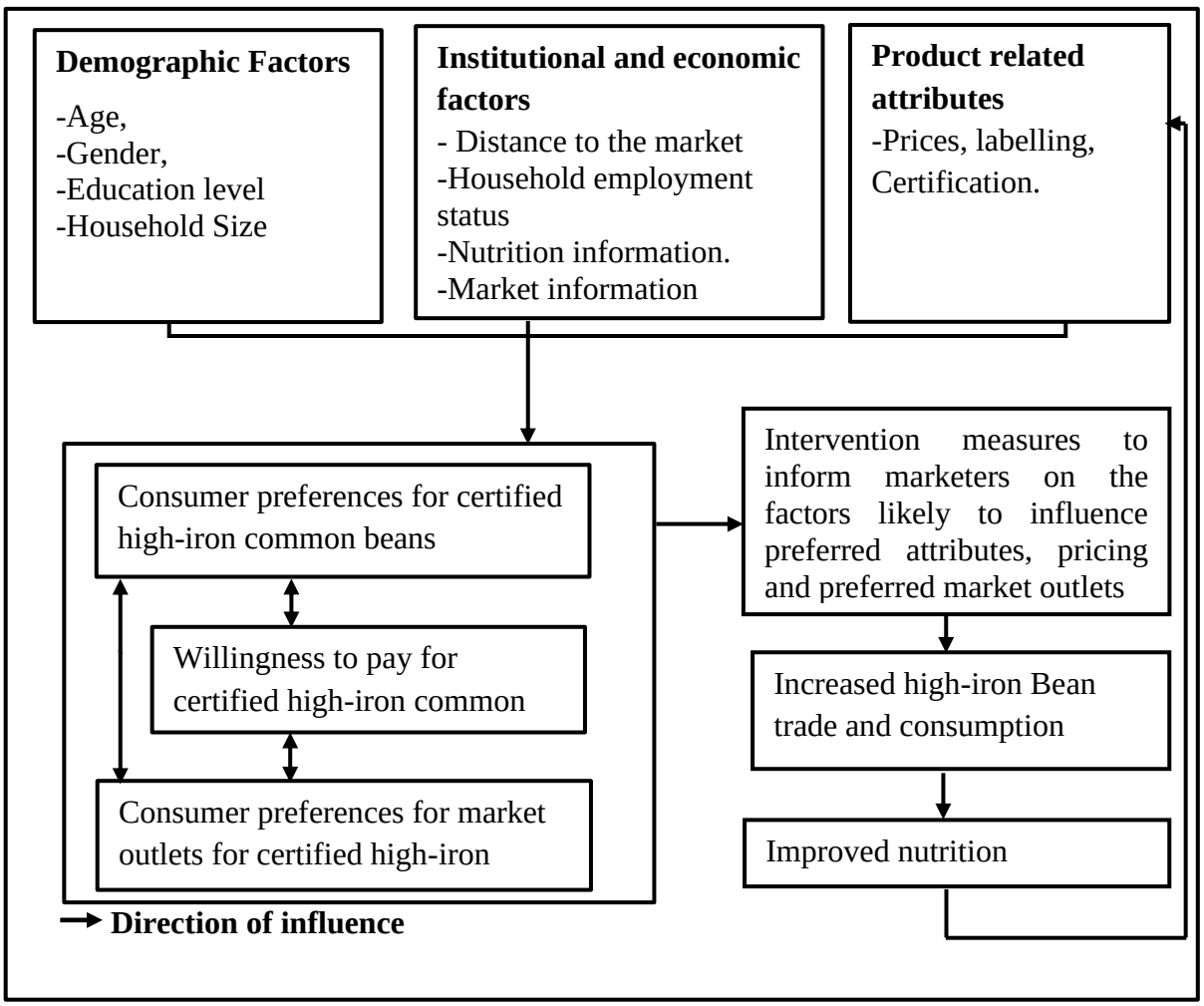

Figure 4: Conceptual Framework

CHAPTER THREE

CONSUMER PREFERENCE FOR CERTIFIED HIGH-IRON BEANS AMONG URBAN HOUSEHOLDS IN WEST POKOT COUNTY, KENYA

Abstract

Enhancing transparency in the food system through product certification assures consumers to make informed nutritional choices. A choice experiment was conducted to evaluate household decision makers' preferences for certified high iron common bean grains attributes. A stratified multistage sampling technique was adopted to select 384 household decision makers, and data was collected using pretested semi-structured questionnaires and choice cards. Data were analysed using JMP 17 and STATA 17 computer softwares. Mixed logit model results showed household decision makers had a positive preference for certification of high iron common bean grains by public bodies and mandatory labelling of high iron common bean grains. However, they had a negative preference for precooked high iron beans and the certification of high-iron common bean grains by a private body. Age and education of the household decision maker were identified as heterogeneous factors. This study therefore recommends mandatory labeling of high-iron beans, a joint private public certification approach, and government-backed certification of high iron common beans. In addition, employing marketing strategies that are tailored to consumers heterogeneous factors and those recognising regional consumer preferences would enhance high iron bean consumption.

3.1 Introduction

Sub-Saharan African urban food systems are undergoing rapid transformation in response to the growing populations. Projections indicate that by 2050, an estimated 68% of the region's inhabitants will reside in urban areas (UNHSP, 2022), surpassing rural populations (Van Den Broeck *et al.,* 2023). This accelerating urbanization presents significant challenges, including food security and nutritional health. While rapid urban growth is associated with rising rates of obesity (Smart *et al.,* 2020), it also exacerbates food insecurity and malnutrition. Inefficient food supply chains and a decline in consumer agency over food choices further complicate the issue (Gwenzi *et al.,* 2023). As such, it is imperative that food systems in SSA urban areas evolve to meet the nutritional needs of their growing populations.

Information economics theory categorizes consumer goods sold in markets into three primary groups. First, search goods are products that can be assessed and evaluated prior to purchase. For instance, clothing may be identified by brand, colour, and size before making a final purchase decision. Experience goods, however, are commodities with attributes such as satisfaction and memories that are challenging to ascertain beforehand and can only be confirmed after purchase. Credence goods, such as organic foods or dietary supplements, present the highest degree of uncertainty, as their quality or efficacy cannot be fully verified, even after consumption (Akerlof, 1995). Consumers of such items are thus exposed to significant levels of uncertainty.

In this context, biofortified goods, such as high-iron common bean grains (Nyota, Faida, and Angaza) released by Harvest plus, can be considered to be credence good. These beans are claimed to have a higher iron content than conventional varieties (Douthwaite *et al.,* 2022; Dulleck *et al.,* 2011). However, as Dusingizimana *et al.* (2023) notes, these varieties are visually indistinguishable from conventional common beans. As a result, consumers who prefer high iron bean varieties may need help in identifying bean varieties to avoid the purchase of non-high-iron beans. To substantiate these claims of high iron content in these beans and ensure that consumers can make informed choices, there is a crucial need to provide clear and accessible information (Akerlof, 1995) and prevent producers from deceiving consumers in African agricultural markets (Elangwe *et al.,* 2021).

One viable strategy to mitigate information asymmetry between consumers and producers of high-iron beans is certification (Carter & Cachelin, 2019). Certification can facilitate informed consumption by enabling more symmetrical information flow between traders and consumers (Newman *et al*., 2014). When purchasing certified foods, consumers often rely on product attributes, such as certification labels, to guide their choices. However,

as Boncinelli *et al*. (2017) suggest, consumers with limited knowledge of a product may not fully understand the implications of certification labels, potentially leading to suboptimal purchasing decisions. Therefore, effective marketing strategies are crucial to ensure that consumers can accurately interpret and value product attributes.

Food certification and grain labelling are not commonly observed in the informal market outlets of many Sub-Saharan African low- and middle-income countries, such as Kenya (Booth *et al.,* 2021; Hoffmann *et al.,* 2019). This is associated with insufficient food regulation measures and uncertainties around consumer preferences for nutritious options in these areas (Hoffmann *et al.,* 2021). Food firms can gain a competitive edge by implementing certification schemes for grains, but only if they can minimize the information imbalance between themselves and consumers. In addition, food producers face challenges in selecting the appropriate certification to satisfy consumer demand and effectively operate in a particular market (Latino *et al.,* 2022). It is on the preceding that the objective of the study is to examine factors likely to influence consumer preference for certified high iron common bean grains, among urban households in West Pokot County, Kenya.

3.2 Materials and Methods for Analysing Factors Likely to influence Consumer Preference for Certified High-Iron Bean Grains

3.2.1 Study Area

This research was conducted in West Pokot County. It is one of the 14 Counties in Kenya's Rift Valley region, with its capital located in Kapenguria. The county is situated within longitudes 34° 47' and 35° 49' east and latitudes 1° and 2° north and covers an area of approximately 9,123.3 km^2. The county comprises of four sub counties namely, West Pokot, North Pokot, South Pokot and Central Pokot (County Government of West Pokot, 2023). According to the Kenya National Bureau of Statistics (2019b), the county has 116,182 households with an average size of 5 people per household.

Kapenguria and the Chepareria urban centres are eligible to become a municipality, while the Kacheliba, Alale, Ortum, Kabichbich, Sigor, Lomut, and Konyao urban centers meet the requirements of being classified as towns according to Kenya's Urban Areas and Cities Amendment Act (2019). Majority of the urban population comprises of economically active people aged between 15 to 60 years (County Government of West Pokot, 2019). Nearly a fifth (18.6%) of the West Pokot County residents live in Kapenguria and Chepareria towns. Since agriculture is not the mainstay activity in the study area, the residents rely on food supplies from other regions that are known for vast agricultural potential with numerous large and small

farms majorly farming crops such as, wheat, beans, maize, tomatoes, leafy vegetables, and potatoes among others. The primary economic activity in the metropolitan parts of the county encompass retail and wholesale trading, fresh produce and cereals enterprises, entertainment and hospitality businesses, and service sectors. These urban centers are crucial for the socioeconomic development of the county, offering employment, housing, education, technology exchange, and agricultural market opportunities. The county is experiencing rapid urbanization due to the high demand for human settlement and commercial spaces. This has led to unplanned developments, uncoordinated land use, and infrastructure challenges (County Government of West Pokot, 2023). Based on these projected diversities, the urban households within the study area were expected to provide insights into preferences, willingness and preferences for market outlets and what drives them.

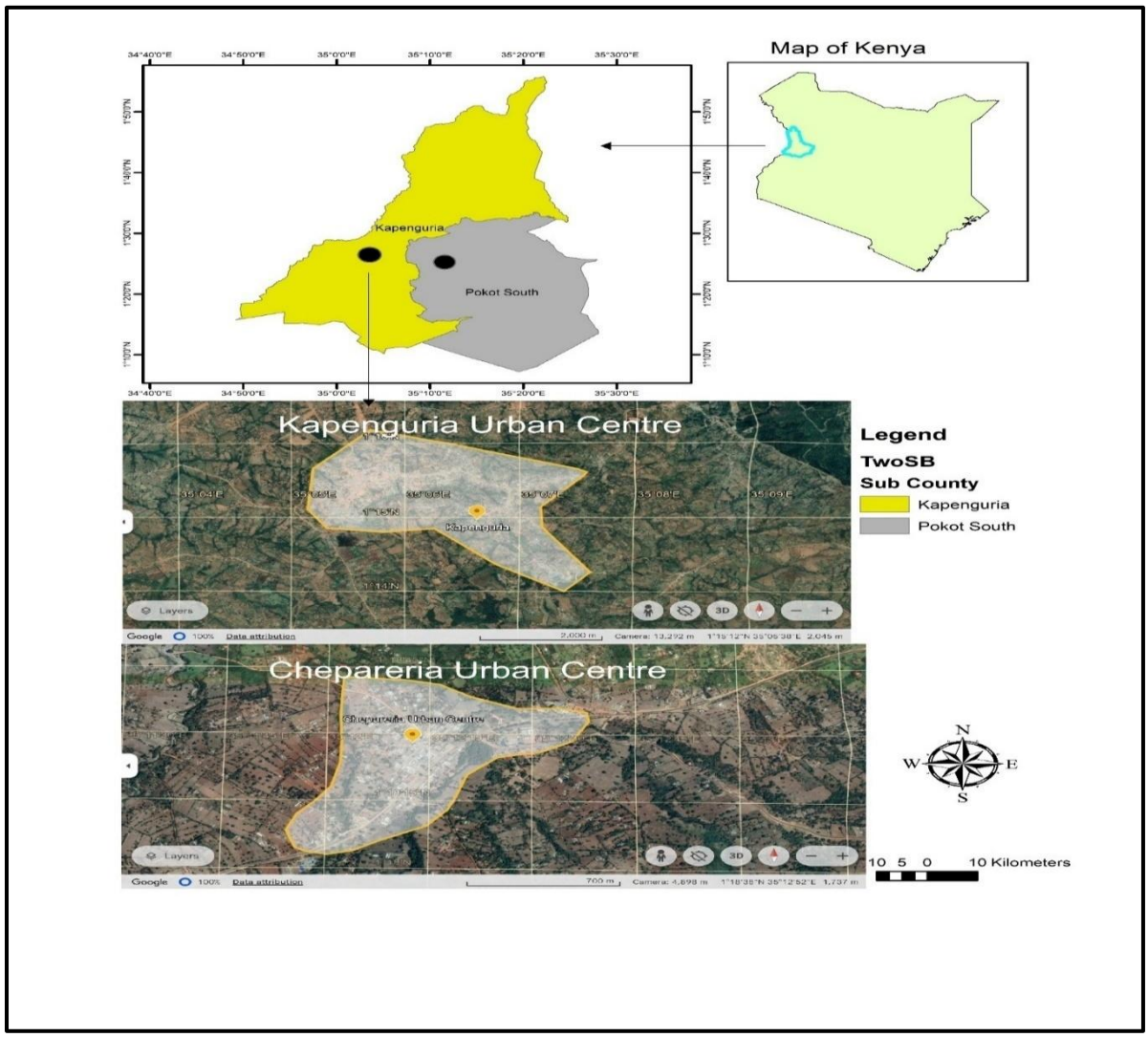

Figure 5: Map of the Study Area

Source; Google earth, Survey of Kenya (2020)

3.2.2 Research Design

An exploratory research design was employed to gather preliminary information and generate ideas for the development of data collection tools (Aityan, 2022). In addition, this study was cross-sectional. This is supported by the view that the study collected data from many different individuals at a single point in time (Kothari, 2004).

3.2.3 Sample Size Determination and Distribution

Determination of the sample size was based on Kothari's (2004) approach, which is specified in equation 4:

$$n = \frac{z^2 \times p \times q}{e^2} \tag{4}$$

where n represents the size of the sample, z is the confidence level (α=0.05), which is 1.96, p is the population proportion of interest (household decision makers), which is set to 0.5 since, statistically, a proportion of 0.5 results in a sufficient and reliable sample size when dealing with the population that is not known with certainty, q is the weighting variable computed as 1-p, and e is the precision rate, which is set to 5% to avoid 95% bias in sampling. This formula results in 384 household decision makers, as shown in equation 8. Table 3.1 shows the sample size distribution in the two urban areas.

$$n = \frac{(1.96^2 \times 0.5 \times 0.5)}{0.05^2} = 384 \tag{5}$$

Table 3.1: Sample Size Distribution

Urban Centre	Urban Population	Proportion to size	Sample
Kapenguria	40,424	0.84	322
Chepareria	7,704	0.16	62
Total	**48,128**	**1**	**384**

Source: West Pokot County Integrated Development Plan (2023)

3.2.4 Sampling Procedure

This study employed a stratified multistage sampling approach for selecting household decision makers. In the first stage, West Pokot County was selected for its high malnutrition rate (KNBS, 2022). In the second stage, the Kapenguria urban centre in the West Pokot subcounty and the Chepareria urban centre in the Pokot South subcounty were purposely selected because they are major urban centers with more developed markets. The third stage

involved the stratification of the market outlets into supermarkets, open-air markets, and cereal shops for the two urban centers. This enabled data collection from household decision makers buying household goods at markets. It was expected that household decision makers who shop at different market outlets have varying socioeconomic characteristics.

In the fourth stage, a mixed sampling technique was adopted and split into two levels. The first level used nonprobability/judgment sampling (Kothari, 2004) because the population of household decision makers is infinite, and its distribution across the two urban areas was unknown. The second level used random sampling to achieve equal representation of household decision makers from each market outlet (Kothari, 2004).

The key informants were chosen using purposive sampling based on their role in the common bean value chain. They included common bean traders, processors, and private and public certification agencies. The selection of focus group discussions participants, who included consumers, followed Brewis's (2014) convenience sampling approach, where consumers were selected because they were the easiest for the researcher to access. In addition, these discussions adhered to the principles proposed by Khan and Abedin (2022). The discussions were led by a proficient moderator who could effectively initiate the discussions by employing open-ended questions that are well-structured, unbiased, and presented in a logical sequence. Moreover, the moderator explicitly communicated the rules of the discussion and created an environment that fostered confidence among participants.

3.2.5 Data

The household survey questionnaire attached in Appendix E was organized into three primary components with a similar structure as that of Otieno and Ogutu (2020). The beginning part consisted of socio-demographic questions. The second part comprised questions to gather information on household decision makers' purchasing and consumption habits. The third part consisted of the choice experiment tasks, contingent valuation procedure and the choice ranking tasks. Each household decision maker was randomly assigned to one profile. In each profile, household decision makers were presented with a series of four choice cards, each containing two alternatives, along with the status quo. Maintaining the status quo reflected a shopping choice for household decision makers who may not prefer to consume certified high-iron common bean grains.

Pilot testing of the data collection instruments was conducted at the Iten urban centre in Elgeyo Marakwet County, Kenya, which shares characteristics similar to those of the Kapenguria and Chepareria urban centers. A total of 38 questionnaires were distributed by the

researcher, constituting approximately 10% of the required sample size for the study. The pretest of the choice experiment questionnaire on household decision makers revealed that a respondent could complete up to four choice tasks. The results of the pilot study were used to adjust and correct the questionnaires and design of the choice and ranking experiment.

For the household survey only participants who were the principal family food buyers were eligible to participate in the survey, following a similar approach as Mameno *et al.* (2023). A minimum age requirement of 23 years was set for household decision-makers to minimize the sampling of students, who often prioritize low prices due to financial constraints (Van Der Merwe *et al.,* 2010). This criterion ensured that the sampling focused on individuals who were more likely to be financially independent and had completed their formal education (KNBS, 2019a). The household decision makers were interviewed at market outlets to obtain their preferences and information on age, sex, years of education, household size and household income.

The study also collected data by conducting, two focus group discussions in two primary market places, namely Chepareria and Kapenguria, as well as four key informant interviews with common bean trader, processor, private certification agency, and public certification agency. These discussions and interviews aimed to investigate the opinions regarding the attributes of certified high-iron bean grains that may be incorporated into the choice experiment. An inclusion-exclusion criterion was used to select the participants in that; to be included one had to be at least aged 23 years, and only household decision makers who are residents in the urban areas of the West Pokot sub-County were eligible to participate. Each focus group discussion consisted of six to eight people.

To conduct this study, the requisite research permits from the National Commission for Science, Technology and Innovation and Egerton university's ethics permit were sought and approved, attached in Appendix D. To enhance data collection, enumerators with an understanding of the Pokot local language and who had a minimum of a bachelor's degree or a higher diploma were selected and trained to collect primary cross-sectional data as well as conduct choice experiments using a semi structured questionnaire and choice cards attached in Appendix E and F, respectively. Following Otieno (2011) suggestions for carrying out a choice experiment in a developing country such as Kenya, face-to-face interviews were favoured over other survey methodologies. This preference for face-to-face interviews is attributed to its capacity to ease the elucidation of questions and choice tasks for household decision makers and guarantee the participation of the relevant household members in the survey.

To mitigate hypothetical bias, the participants were instructed to approach the choice scenarios as though they were purchasing certified high iron beans (Haghani *et al.*, 2021). To ensure proper understanding of market outlets enumerators provided clear and relevant descriptions of market outlets to the household decision makers (Moore, 1990). They were also instructed to make truthful responses, with the understanding that there were no correct nor incorrect answers (López-Galán & de-Magistris 2019; Whittington *et al.*, 1992). The coded dataset was analysed using the STATA 17 computer program (StataCorp, 2021). An example of a choice card is presented in Table 3.2.

To maintain data accuracy, household decision makers were asked to instruct their household members to refrain from participating in the interview if they came across any enumerators in the field. Before each interview, the enumerators asked whether the respondent or any household members had been interviewed about certified high-iron common beans during the study period. This approach enhanced the data reliability by preventing duplicate interviews within the same household.

Table 3.2: Example of a Choice Card Used in the Choice Experiment

Attributes	**Option 1**	**Option 2**	**Neither option 1 nor option 2**
Certification body	Public certification body	Participatory guarantee systems	
Labelling approach	Mandatory	Voluntary	
Level of processing	Low	Precooked beans	
Certification body	Private certification body	Joint public and private certification bodies	
Price per Kilogram	310 KES	280 KES	

Which of the following certified high-iron common bean grains attributes do you prefer?

3.2.6 Econometric Modelling of Factors likely to Influence Consumer Preference for Certified High-Iron Common Bean Grains

The present study utilized the contingent choice experiment method, originally proposed by Louviere and Hensher (1982) and further developed by Louviere and Woodworth (1983), to examine household decision makers' preferences for attributes associated with certified high-iron bean grains. The contingent choice technique is a stated preference method

used to evaluate goods that are not extensively traded in the market and cannot be effectively assessed by revealed preference approaches, as discussed by Louviere *et al.* (2000). The rationale for selecting this particular method is based on the fact that certified high-iron common bean grains are a new product on the market, and there is a need for additional market data regarding certified high-iron beans.

To ensure the choice experiment was tailored to the study setting information on potential certified high iron bean attributes obtained from key informants and focus group discussants were augmented with information from literature (Mangham *et al.,* 2009). Five certified high iron bean attributes of policy relevance were included to the choice experiment. The initial certified high iron bean attribute pertains to certification. This encompassed, public certification bodies and participatory guarantee systems. The second certified high iron bean attributes were private certification and joint public and private certification of high-iron common beans.

Another key characteristic was the practice of affixing labels to certified high-iron common bean grains, which informs consumers about the product's quality (Hernandez-Fernandez *et al.,* 2021). Labelling was categorized into mandatory and voluntary labelling approaches. The third attribute pertained to the level of processing, which was categorized into two types; precooked certified high iron common beans that do not require cooking and low processed certified high iron common beans that need to be cooked (Alphonce *et al.,* 2020).

Finally, the price was factored in to determine the degree to which household decision makers could be willing to pay for a premium or a discount for the attributes (Sánchez-Toledano *et al*., 2017). In line with the suggestions of Olynk *et al*. (2010), the price levels applied in the CE design were set around the mean price for the *Nyota* common beans a high iron common bean variety in West Pokot. The retail price for *Nyota* beans was KES**Error! Bookmark not defined.** 220 per kilogram during the period of the survey. The price was then increased at a rate of 15% to account for proposed price adjustments resulting from certification, as viewed by the processor. The pricing attribute was configured with three levels, namely, KES**Error! Bookmark not defined.** 250, KES**Error! Bookmark not defined.** 280, and KES**Error! Bookmark not defined.** 310.

The subsequent phase entailed the development of choice cards, which were created by considering the identified attributes and respective levels (Meyerhoff *et al.,* 2018). JMP software was employed to construct choice sets because of it has robust experimental design packages. A full factorial design for the five provided attributes and their corresponding levels yields a combination of (2 × 2 × 2 × 2 × 3). This combination generated 48 certified high-iron

common bean grains alternatives. The presentation of forty-eight choice sets was deemed excessive for the household decision makers. To minimize the number of choice cards. A (D) optimum fractional factorial design was employed since it has been shown to decrease the standard errors of parameters and yield unbiased estimates (Hoyos & Mariel, 2010). The ultimate design consisted of 16 paired profiles, which were randomly blocked into four blocks using the JMP statistical design software. This configuration enhances the quality of choice data while preserving the breadth of options available (JMP, Version 17). This approach enhances household decision makers' cognitive ability and mitigates respondent fatigue (Kuhfeld, 2005). The design had a high D-efficiency of 99.33%. Additionally, the variance matrix might produce accurate estimates, as indicated by the choice experiment design's A-efficiency measure of 98.62%

In the analysis of choice experiment data, mixed logit models are commonly used. In the mixed logit model, following Revelt and Train (1998), the utility that household decision maker *k* obtains from selecting alternative *m* on choice occasion *t* is provided in equation 6;

$$U_{kmt} = \beta_n X_{kmt} + \varepsilon_{kmt} \quad (6)$$

where U_{kmt} is the utility that consumer *k* derives in choosing alternative *m* in choice scenario *t*. β is the coefficient to be estimated, X_{kmt} is the vector for certified high-iron common bean attributes, and ε_{kmt} is the error term for consumer *k* choosing alternative *m* in choice set *t*. In unlabelled choice experiment designs, such as the current study, where there is no uniform certified high iron bean attributes option that would otherwise be regarded as a "status quo," the choice design allowed for a nonpurchase option to ensure that the choice experiment design is complete in representing rational consumers' choice space (Veldwijk *et al.*, 2014). Owuor *et al.* 2022; Otieno and Ogutu (2020) are two examples of empirical research that have used the "opt-out" option and excluded the alternative specific constant term. As a result, our study did not require the inclusion of an alternative specific constant in the model, and our conclusions are valid like those of those studies. The specification of the choice probability equation is represented as:

$$L_{klt}\left(\beta_n\right) = exp\frac{exp\beta_n X_{klt}}{\sum_{j\in c} exp\beta_n X_{kmt}} \quad (7)$$

Under the assumption that an individual's *n* preferences β_n remain consistent over repeated decision scenarios but vary across different individuals, the probability becomes:

$$G_n(\beta_n) = \prod_t L_{kmt}((\beta_n\theta)) \quad (8)$$

Equation 10 represents the unconditional probability of the set of decisions made by household decision maker *n*;

$$P_n(\theta) = \int G_n(\beta_n) f(\beta_n \theta) d\beta_n \quad (9)$$

Equation 9 contains two significant sets of parameters. The first set, denoted as β_n, consists of a vector of parameters that are specific to each individual *n*. These parameters represent the individual's unique tastes, which can vary among individuals. The second set, denoted as θ comprises parameters that characterize the distribution of the estimates specific to each individual, such as the mean and the covariance of β_n. The intention of the mixed logit model is to accurately determine the value of θ. To address this issue, the most commonly used method is simulation of the choice probability. This is necessary because the integral in Equation 10 cannot be computed, as there is no known closed mathematical formula. The model's log likelihood is denoted as follows:

$$LL(\theta) = \sum_n (SP_n(\theta)) \quad (10)$$

$P_n(\theta)$ is estimated by aggregating the randomly chosen values of β_n. Given particular values of the parameters θ, a value of β_n is randomly selected from its distribution and denoted as $G_n(\beta_n)$. Equation 11 below expresses the estimated choice probability as the average of $G_n(\beta_n)$ after multiple draws are calculated repeatedly:

$$SP_n(\theta) = \left(\frac{1}{R}\right) \sum_{r=1}^{R} G_n(\beta_n^{r|\theta}) \quad (11)$$

where *R* denotes how many times β_n has been replicated. SP_n is the simulated likelihood of individual n adopting a particular sequence, and $\beta_n^{r|\theta}$ is the r-th draw from the $f(\beta_n \theta)$ distribution. To maximize the log-likelihood function, simulations with 150 Halton draws were conducted. Halton draws were preferred because they have significantly greater efficiency than random numbers (Train, 2000). The expression for the simulated log likelihood function is represented in equation 12:

$$SLL(\theta) = \sum_n (SP_n(\theta)) \quad (12)$$

3.3 Results and Discussion

Table 3.3 presents all the variables that were used for the study and how they entered the models. The price variable represented the purchasing price for certified common beans. It was captured as the price per kilogram, as it is the most commonly used method for packaging certified cereal products in the Kenyan food markets.

Table 3.3: Description and Measurement of all Variables Used in the Study

Variables	Description and Measurement	
Dependent Variables		
Preference	1= if household decision maker prefers an alternative of certified high-iron common bean grains attributes in a choice set; 0= Otherwise	
Willingness to pay	1 = Yes and; 0 = No responses in the first stage and second stages, and -9 for household decision makers who did not have the second stage	
Preference for market outlets	Ranking of supermarkets, cereal shops, open air and telebased market outlets from the most preferred to least preferred '1' to '4'	
Independent Variables		**Expected Sign**
Age	Age of the household decision maker in years (Discrete)	±
Sex	Sex of the household decision maker; 1=Male; 0=Female (Dummy)	±
Education	Years of education of the household decision maker (Discrete)	±
Household size	Number of household members (Discrete)	±
Household members < 5 years	Household proportion under five years (Continuous)	+
Household between 6 to 18 years	Household proportion between 6-18 years (Continuous)	±
Income	Proportion of monthly income allocated to food items (Continuous)	±
Occupation status	1= Household decision maker is formally employed; 0= Otherwise	±
Heard of high iron common beans	1= Household decision maker has heard of high iron common beans; 0=Otherwise (Dummy)	±
Nutrition information	1=Household decision maker has received nutrition information; 0=Otherwise (Dummy)	±
Market information	1=Household decision maker has received market information; 0=Otherwise (Dummy)	±
Heard of anaemia	1= Household decision maker has heard of anaemia; 0=Otherwise (Dummy)	±
Heard of stunting	1= Household decision maker has heard of stunting; 0=Otherwise(Dummy)	±

Table 3.3: Description and Measurement of all Variables Used in the Study (Continued)...

Trust on nutritional claims	1= Household decision maker trusts nutritional claims of high iron beans; 0=Otherwise (Dummy)	±
Trust on certification bodies	1= Household decision maker trusts certification bodies; 0=Otherwise (Dummy)	±
Awareness of certification	1= Household decision maker is aware of food certification; 0=Otherwise (Dummy)	±
Certification body one	1 = Household decision maker prefers certification of high iron beans by a private body; 0 = joint public and private certification bodies (Dummy)	-
Certification body two	1 = Household decision maker prefers certification of high iron beans by a public body; 0 =Participatory guarantee systems (Dummy)	-
Labelling approach	1= Household decision maker prefers mandatory labelling of high iron common beans; 0= Voluntary labelling of high iron beans (Dummy)	+
Level of processing	1= Household decision maker prefers precooked certified high iron beans; 0 = Lowly processed certified high iron beans that need to be cooked before consumption (Dummy)	+
Perception on service quality	1=Household decision maker perceives service quality is important in making purchase decision; 0=Otherwise (Dummy)	+
Perception on Pricing	1=Household decision maker perceives pricing is important making purchase decision; 0=Otherwise (Dummy)	±
Beans at home	1=Household decision maker had beans at home during the survey period; 0=Otherwise (Dummy)	±
Price	The prices of certified high iron common beans; KES 250, KES 280 and KES 310 per Kilogram (Continuous)	±

3.3.1 Descriptive Statistics

Table 3.4 shows descriptive statistics about the socio-demographic profiles of household decision makers. To find significant differences between males and females, a t-test was employed for continuous variables and for a chi-squared test for categorical variables. Male decision makers had much higher average years of schooling (13) than female decision makers, who had around (12) years. This shows that there is still a sex discrepancy in educational attainment for this demographic, with more males having more years of schooling.

Table 3.4: Socio-Economic Characteristics of Household Decision Makers

Variables		Male	Female	
Continuous variables		**Mean**		**t-value**
Age of the household decision maker		40.51	41.90	1.50
Years of schooling of the household decision maker		13.27	12.43	-2.64***
Proportion of monthly income allocated to food items		0.36	0.38	1.03
Number of household members in the household		5.00	5.00	-0.38
Household proportion below 5 years		0.24	0.27	1.30
Household proportion between 6 to 18 years		0.46	0.48	0.34
Categorical variables	**Total**	**Percentage**		**χ2 value**
Sex of the household decision makers	384	36.45	63.55	384***
Household decision makers with access to market information	71	20.71	17.21	0.72
Household decision makers with access to nutrition information	189	34.29	57.79	19.66***
Household decision makers who were aware of food certification	247	73.57	59.01	8.21***
Household decision makers who were aware of anaemia	349	92.14	90.16	0.42
Household decision makers who were aware of stunting	371	96.43	96.72	0.02
Household decision makers who were aware of high iron common beans	125	22.86	38.11	9.43***

*** denote significance level at 1% level

From Table 3.4, the majority of the household decision makers were female constituting (63%) while male household decision makers accounted for (36%), suggesting that women are the primary decision-makers when it comes to food purchase. Additionally, female household food makers (57%) had more access to nutrition information than male household decision makers (34%). This is due to women's traditional roles as family food planners, which encourages greater attention to nutritional information from a various of sources. Furthermore, awareness of food certification was significantly greater among male household decision makers (73%) than among female household decision makers (approximately 59%). This could be attributed to higher levels of education among male decision makers as indicated in Table 3.4. Higher levels of education have been associated with greater awareness of food

certifications. Compared with male household decision makers, female household decision makers also had a significantly greater awareness (38%) of the existence of high iron beans than male household decision makers (22%). The high awareness among females reflects their stronger orientation to decisions on nutrition and health-enhancing foods on behalf of their households.

3.3.2 Household Decision Makers' Preferences for Certified High-Iron Common Bean Grains Attributes

Table 3.5 displays Household decision makers' preferences for certified high-iron common bean grains attributes in the base model. All utility parameters for attributes were entered into the model as random parameters (Hole, 2007). From the magnitude of the standard deviations relative to the mean coefficients. On average 90% and 14% of household decision makers preferred certification of these beans by a public body and a private body respectively, whereas 91% preferred mandatory labelling, 12% preferred precooked beans, and 54% preferred low prices. These figures were given by the formula $\Phi(-b_k / s_k)\times 100$ where Φ is the cumulative standard normal distribution while b_k and s_k are the mean and the standard deviation, of the k^{th} coefficient in Table 3.5. The likelihood ratio statistic (LR $\chi 2$ (4) = 176.18, Prob> $\chi 2$=0.0000), was significant at the 1% level. This implies that the mixed logit model captures additional information on the observed data compared to the constrained model.

Table 3.5: Household Decision Makers' Preferences for Certified High-Iron Common Bean Grains Attributes

	Mean effects			**Standard deviation**		
Attributes	**Coeff.**	**Std. Err**	**P>z**	**Coefficient**	**Std.Err**	**P>z**
Price per kilogram in KES	-2.0721	0.3631	0.000***	0.5907	0.1074	0.000***
Private certification	-2.7857	1.1074	0.012**	1.7355	0.8884	0.051*
Mandatory labeling	1.1679	0.4621	0.012**	1.8749	1.1013	0.089*
Public certification	2.8921	1.2625	0.022**	5.5907	2.2731	0.014**
Precooked certified high-iron common beans	-1.2495	0.4894	0.011***	1.7503	0.8133	0.031**

, * denote significance level at 5% and 1% level, respectively

The coefficient of price (-2.0721) was negative and low, demonstrating that household decision makers preferred low prices. This suggests, that a slight change in price did not affect

their preferences for other attributes. The highest coefficient was (2.8921), indicating that certification of high-iron beans by a public body was the most preferred attribute by household decision makers. The second most preferred attribute was mandatory labelling of high-iron common beans (1.1679), followed by lowly processed certified high iron common beans (-1.2495) and, finally, certification of high iron common beans by a private body, with a coefficient of (-2.7857).

Household decision makers exhibited a negative preference for private certification over joint public and private certification for certified high-iron beans, as indicated by the negative and significant coefficient. The reason for this could be that household decision makers perceive private certification of food products as less credible indicators of safety and quality compared to certification by public agencies. These results are consistent with the findings of Owuor *et al.* (2022), who similarly found that urban consumers in Nairobi preferred orange-fleshed sweet potato juice certified through joint public–private bodies over those solely certified by a private body. Hoffmann and Moser (2017) contend that private certification with weak oversight carries risks of fraud and dissemination of false information. The results also show a positive and significant coefficient for mandatory labelling of high-iron common beans. This suggests that mandatory labelling of high-iron common beans can drive the purchase intent of iron bean-based value chains. Household decision makers also likely view labelling as a credible signal of enhanced nutritional quality. This aligns with findings from Ahmed *et al.* (2020), who found that consumers prefer snacks with nutrition fact labels listing enhanced iron content.

Contrary to our expectations, that participatory guarantee systems would be preferred by these group of consumers due to its simplistic bureaucratic procedures. Household decision makers surprisingly displayed a positive preference for public over participatory guarantee certification systems. One reason for this could be that household key decision makers view government-administered certification as a more legitimate and credible indicator of safety and quality controls than other certification by participatory guarantee systems. Vroegindewey *et al.* (2021) shares a similar finding in the urban markets of Ethiopia, where they find that consumers prefer government-backed certification for local ingredients in processed foods. Participatory guarantee systems are built on a foundation of trust, social networks and knowledge exchange among producers and consumers where they take collectively take responsibility for ensuring the integrity of products verified by the participatory guarantee systems. Owing to this complexity it is difficult to implement the Participatory guarantee systems (Kaufmann *et al.,* 2020). Additionally, as observed in Tanzania, Cannon *et.al* (2019)

opines that there is difficulty in changing mindsets consumers regarding participatory guarantee systems and are still unfamiliar with the and do not see it as a viable and authentic alternative.

Household decision makers had a negative preference for precooked certified high iron beans. This finding contradicts that of Ugen *et al.* (2017), who found an increased preference for precooked beans in Kenya. One plausible explanation for this finding could be the availability of cheaper cooking energy sources (such as wood charcoal) near the urban areas of West Pokot County compared to other major urban setups in Kenya. As a result, households can easily acquire charcoal at lower prices to cook lowly processed certified high iron beans. Preferences in the preparation of these beans could also explain this phenomenon, where household decision makers would prefer to buy raw beans and cook them rather than buy already cooked beans where they have no control regarding the preparation.

Despite the existence of highly processed bean products with short cooking times in the Kenyan food market, the estimated consumption of processed beans stands at 19% for the overall population and rises to 30% among urban dwellers which is quite low (Wambua *et al.,* 2016). However, the existing processed bean products are often not affordable for most consumers, leaving many without access to the benefits of these primary processed beans (IDRC, 2014). For instance, canned beans produced in Kenya cost around KES 390-450 per kilogram, which is over three times higher than the price of unprocessed dry beans, typically ranging from KES 200-300 per kilogram. Additionally, other processed options, such as chilled beans, require refrigeration, posing a further constraint for many consumers. Consequently, the inadequate demand for processed bean products has deterred private sector investment in bean processing (Babirye *et al.,* 2023).

3.3.4 Sources of Preference Heterogeneity

Table 3.6 presents the results of the mixed logit model with interaction terms. To examine possible sources of preference heterogeneity, interactions between random parameters and household decision makers' characteristics were examined. The interactions between the following variables were tested: age and public certification, education and public certification, sex, and precooked certified high iron common beans. Ultimately, the results for age, and public certification, education and public certification showed preference heterogeneity. Several of the coefficients' estimated standard deviations are significant and large relative to the mean (Hole & Kolstad, 2012). This implies a substantial amount of heterogeneity in the preferences for certified high-iron common bean grains attributes. That is, household decision makers do

not have similar preferences regarding any of the attributes that affect their decision to consume certified high-iron common bean grains.

Table 3.6: Mixed logit Estimates for the Model with Interactions Between Explanatory Variables and Attributes

Variables	Mean effects		Standard deviations	
	Coefficient	Std.Err	Coefficient	Std.Err
Age × Public certification	3.2695***	1.2252	0.7523***	0.4399
Education × Public certification	0.2255***	0.0820	0.1043**	0.0464
Sex × Precooked certified high iron common beans	-0.7847**	0.3185	-0.1844	0.4930

, * denote significance level at 5% and 1% level, respectively

This study revealed that the interaction between age and public certification yielded a significant positive coefficient at the 1% level. This shows that age increased the preference for public certification of high-iron common beans. This could be attributed to the notion that older people may trust government regulations and certification systems more, believing that products certified by the government have met certain standards and are safe for consumption. Xuan (2021) shares a similar finding, showing that older and primary food shoppers in the household had a greater preference for all types of certified shrimp certified by the Vietnamese government.

Furthermore, the results show that the interaction between education and public certification yields a significant positive coefficient at the 1% level. This implies that an increase in years of schooling increased the preference for public certification of high-iron common beans. A possible explanation is that highly educated individuals often have better access to information, allowing them to make more informed decisions. As a result, they have more information on the benefits of public certification, such as improved consumer protection, environmental sustainability, or adherence to ethical standards, than other certification systems. This finding corroborates the findings of Forleo and Palmieri (2023), who found that consumers' preferences for certified tuna increased with their education level.

The interaction between sex and precooked certified high-iron common bean grains showed a significant positive effect. This means that male household decision-makers were more likely to prefer precooked certified high-iron common beans. It is possible that male household decision-makers prefer precooked common beans due to their perceived

convenience and time-saving benefits. Highly processed foods typically require less preparation time, which can be appealing for individuals with busy schedules or those who prioritize convenience. This finding conforms with the results of Lutomia *et al.* (2021), who found that male consumers were 30% more likely to prefer precooked high-iron beans than female consumers.

3.4 Conclusions

This study employed a choice experiment method to provide insights into consumer preferences for various certified high-iron common beans attributes. A mixed logit model determined potential sources of heterogeneity across household decision makers and their preferences for certified high-iron common bean attributes. Notably, household decision makers had high preferences for consuming certified high-iron common bean with regard to factors such as age and education. This suggests that common bean consumers in West Pokot, Kenya, have varying preferences for certified common bean attributes.

Based on the study results, it was concluded that household decision-makers showed a positive preference for mandatory labelling and certification of high-iron beans by a public body. Additionally, household decision makers showed a negative preference for precooked beans and certification of beans by a private body. From the analysis, we also conclude that household decision makers attach the most value to mandatory labelling and the certification of high-iron common beans by a public body. By labelling high-iron common beans with relevant information, such as nutritional content or other vital details, differentiating high-iron common bean from conventional varieties could become more accessible.

CHAPTER FOUR

CONSUMER WILLINGNESS TO PAY FOR CERTIFIED HIGH IRON BEANS AMONG URBAN HOUSEHOLDS IN WEST POKOT COUNTY, KENYA

Abstract

Certification of high-iron common beans is an effective technique for informing consumers of the credence trait of a product. Nevertheless, the certification of the product alters characteristics, such as appearance and labelling, potentially impacting consumer acceptance. As such, the study surveyed household decision makers to determine the willingness to pay for certified high-iron common bean grains and the underlying determinants in the urban areas of West Pokot County, Kenya using one- and one-half bound contingent valuation method. The data were collected from 384 household decision makers selected through a stratified multistage sampling technique using a pretested semi structured questionnaire. Data were analysed using a semi double bounded logit model in R computer software. Relative to the prices of uncertified *Nyota* high-iron beans household decision makers were willing to pay an average price premium of KES 281 per kilogram for certified high iron common bean grains. The willingness to pay was significantly influenced by age of the household decision maker, the proportion of monthly income allocated to food items, access to nutrition information, trust in certification agencies and awareness of food certification by the household decision maker. Interventions on implementing lower pricing and enhancing trust in certification agencies and awareness levels of high iron common beans could be appropriate. Prices may gradually be raised once trust and familiarity with high iron common beans, have diffused among consumer segments.

4.1 Introduction

The world is experiencing rapid urbanization. By 2050, the United Nations predicts that approximately two-thirds (68%) of the global population will reside in urban areas (UNDESA, 2018a). The majority of this increase, approximately 90%, will occur in small metropolitan areas in Africa and Asia (FAO, 2017). While this urban migration presents various opportunities, it also brings significant challenges concerning food security and access. Households residing in urban areas of low- and middle-income countries, such as Kenya, are expected to be vulnerable. This vulnerability stems from the fact that they allocate a substantial portion of their earnings to purchasing food, rendering them susceptible to changes in food prices (Brinkman *et al.,* 2010; Cohen & Garrett, 2010). The volatility of food prices immediately impacts diet quality by compelling households to replace nutritious fresh foods with less nutritious but more affordable staples (Bloem & De Pee, 2017)

Urban migration leads to a notable shift in individuals' dietary inclinations as they transition from traditional staple foods to more convenient alternatives such as rice, bread, and meals consumed outside the home (UNHSP, 2020). Additionally, they tend to consume heavily processed foods (Reardon *et al.,* 2021; Steyn *et al*., 2012). The long-term implications of reduced access to affordable, nutritious foods and balanced diets will disproportionately affect susceptible demographics, including women, children, and elderly people (Devine & Lawlis, 2019). Furthermore, disparities in child malnutrition and mortality within urban areas are becoming increasingly evident in comparison to disparities between rural and urban regions. This can be attributed to the expansion of impoverished communities (Fotso, 2006).

Urbanization, the commercialization of agri-food value chains, and dependence on purchased commodities all contribute to the deterioration of food and nutritional security in low-income neighbourhoods (Raschke & Cheema, 2008). This calls for a need to find a sustainable method of supplying nutritious food (Nadeem *et al.,* 2021). The nutrition and development community must assist the burgeoning food sector in manufacturing nutritious food that is of excellent quality and can be obtained at reasonable prices.

The CGIAR HarvestPlus Programme has spearheaded nutritional research on the biofortification of common beans with iron to alleviate iron deficiencies (HarvestPlus, 2022). However, as de Brauw and Bulte (2021) highlights, ‘‘consumers cannot differentiate a high-iron bean from a normal bean based on their appearance alone’’. The lack of product differentiation poses a significant challenge, particularly for economically disadvantaged consumers who may be more likely to choose the high-iron variety without the added value of a credence attribute (de Brauw & Bulte, 2021). This raises concerns about the potential

exclusion of vulnerable populations from the benefits of the high-iron bean value chain, especially those reliant on purchasing goods from the market (Abate *et al.,* 2021).

Food literacy is pivotal for enhancing food security because it addresses the limited understanding of food labelling, product characteristics, and food selection among households experiencing food insecurity (Butcher *et al*., 2019). In this context, certification systems are increasingly being utilized to regulate food chains (Veldstra *et al*., 2014) and to guide consumers in making purchases (Janssen & Hamm, 2012; Thøgersen *et al*., 2019). Abate *et al*. (2021) established a model that outlines four prerequisites for certifying grains in African agricultural markets. One of which is that downstream participants in the value chain, such as consumers, must be willing to pay an additional amount for grains of higher quality. While there is empirical evidence available on the willingness pay for biofortified staple crops, limited research has been conducted on consumers' WTP for the certification of biofortified food products in urban areas of Kenya. To bridge the aforementioned knowledge gap, this study investigated factors likely to influence consumers' WTP for certified high-iron bean grains in the urban areas of West Pokot County.

4.2 Materials and Methods used to Analyse Factors Likely to Influence Willingness to Pay for Certified High Iron Bean Grains

4.2.1 Study Area, Sampling Procedure and Data Collection

The research was carried out in the urban areas of Kapenguria and Chepareria in West Pokot County (refer to Section 3.2.1). The sample size was determined using the Kothari (2004) method and distributed proportionally across the two urban areas as outlined in section (3.2.3). household decision makers were chosen using stratified multistage sampling technique, as detailed in (Section 3.2.4). Data were collected following the procedure as outlined in section (3.2.5). The coded data were analysed using the DC choice package and marginal effects package in the R computer program (Aizaki *et al.,* 2022; Team, 2010).

4.2.2 Econometric Modelling for Factors Likely to Influence Willingness to Pay for Certified High-Iron Common Bean Grains

Based on the one and one half bound contingent valuation questions posed to household decision makers. The following responses were obtained; ('yes' 'yes,' 'yes' 'no,' and 'no'). A 'yes' 'yes' indicated acceptance of the first and second bids, respectively. This bid was increased to premiums of 10%, 20%, 30%, 40% and 50% above the average price. A ('yes'

'no') indicated a household decision maker's intermediate WTP. This means acceptance of the first bid and rejection of the second bid. A ('no') indicated refusal to pay for the first bid.

Dichotomous choice estimation models, such as probit and logit models (Bishop & Heberlein, 1990; Boyle, 2017), are commonly used to analyse dichotomous responses. The spike model (Kriström, 1997) is also an option, especially when dealing with asymmetric WTP distributions and numerous zero responses. However, given the relatively few zero responses in this study, this model was not used. While the single-bounded logit model is a viable option, it is statistically less efficient compared to other models (Hanemann *et al.,* 1991). Although the double-bounded dichotomous choice model captures more information on household decision makers' WTP amounts than single-bounded models (Lusk & Hudson, 2004), moving from a single bound to one-and one-half bound shows more efficiency gains than moving from a single bound to a double bound dichotomous choice model (Cooper *et al.,* 2002). Therefore, this study opted for a one-and one-half-bound dichotomous choice to estimate the WTP.

The semidouble-bounded logit model is used to analyse one and one half-bounded dichotomous choice responses. In the model specification, the first bid (B^1) was assumed to be equivalent to zero to indicate price equality between certified high-iron common bean grains and uncertified *Nyota* bean grains, a high-iron bean variant, which reduces the starting point bias. The subsequent bid (B^2), or the premium bid, was contingent on the first bid and was to be assigned to the household decision maker only if he would be willing to buy at a price higher than the initial bid amount. The second bid (B^2) and the initial bid (B^1) allow for setting the lower and upper bounds constraints on the unobservable household decision maker's true WTP. The probabilities of these occurrences ('yes,' 'yes,' 'yes,' 'no,' and 'no') are indicated as π^{yy}, π^{yn}, and π^{n}, respectively, and are a function of the initial bid B^1 and a higher premium bid after the initial "yes" response, B^2. The empirical specification is shown in equation 13.

$$R1 \; + \; R2 = \beta_0 + \beta_i X_i + \varepsilon \,|\, Lower\ Bid \; + \; Higher\ Bid \tag{13}$$

where *R*1 denoted a binary response variable for the bid in the first stage and *R2* for the bid in the second stage. *R*1 contains yes or no to the bid in the first stage. *R2* contains yes, no, none to the bid in the second stage or 1 for yes, 0 for no, and -9 for none. β_o and β_i represent the parameters that were estimated, $\boldsymbol{\varepsilon}$ was the random variable accounting for unobserved factors with the last part contains the lower and the higher bids that the household decision maker faced (Aizaki *et al.,* 2022). The probabilities of the occurrences are shown in equation 14.

$$\pi^{yy}\left(B_i^1, B_i^2\right) = P\left(B_i^1 \le maxWTP \le B_i^2\right) = P\left(B_i^2 \le maxWTP\right) = 1 - G\left(B_i^2\ i;\theta\right)$$
$$\pi^{yn}\left(B_i^1, B_i^2\right) = P\left(B_i^1 \ge maxWTP \le B_i^2\right) = G\left(B_i^2\ i;\theta\right) - G\left(B_i^1\ i;\theta\right); and \quad (14)$$
$$\pi^{n}B_i^1 = P\left(B_i^1 \ge maxWTP\right) = G\left(B_i^1\ i;\theta\right)$$

where $G(B; \theta)$ represents the cumulative distribution function, assumed to be a logistic of the individuals' true maximum *WTP* with parameter vector θ to be estimated (Hanemann *et al*., 1991). Equation (15) is estimated using a log likelihood function as follows:

$$lnL(\theta) = \sum_{i=1}^{N} (d_i^n ln\mu^n(B_i^1) + d_i^{yn} ln\mu^{yn}(B_i^1 B_i^2) + d_i^{yy} ln\mu^{yy}(B_i^2) \quad (15)$$

where d_i^n, d_i^{yn}, and $d_i^{yn}d_n$· are binary-valued indicator variables. It takes a value of one if the respective responses are chosen and zero otherwise. A logit model was adopted to determine the effects of the factors influencing WTP. Overall probabilities were calculated at the mean values using the estimated intercept (β_0), coefficients (β_i), and the explanatory variables (x_i), as follows:

$$P(B < maxWTP) = 1 - \frac{1}{1 + \exp(\beta_0 + \beta_i x_i)} \quad (16)$$

The independent variables used in the analysis of the factors influencing the willingness to pay for certified high-iron common bean grains included socioeconomic, institutional, and product characteristics, and were drawn from previous research studies (Aseete *et al*., 2018; Banerji *et al*., 2016; Bett *et al*., 2013; Chelang'a *et al*., 2013; Jada *et al*., 2023; Nuani *et al*., 2022; Oparinde *et al*., 2019; Phiri *et al*., 2017; Rizwan *et al*., 2022)

4.3 Results and Discussion

4.3.1 Descriptive Statistics

Table 4.1 displays the descriptive statistics of the variables utilized in the study. A t-test was used to analyse continuous variables, while a chi-square test was used for categorical variables to determine significant differences between males and females. The variables education, awareness of food certification, access to nutrition information were significant as discussed in section Table 3.4 (3.3.1). The Chi-square results revealed a significant association in trust placed on nutritional claims high iron beans between males and female household decision makers. Female household decision makers had a significantly high trust (88.93%) than male household decision makers (85.71%). This gender gap in trust suggests that women may tend to prioritise healthy eating more and pay closer attention to food labelling of

nutritional claims of credence foods. Urala *et al.* (2003) share a similar finding where women trusted the information on nutritional claims of functional foods more than men did.

Table 4.1: Socio-Economic Characteristics of Household Decision Makers

Variables		**Male**	**Female**	
Continuous variables		**Mean**		**t-value**
Age of the household decision maker in years		40.51	41.90	1.50
Years of schooling of the household decision maker		13.27	12.43	-2.64***
Proportion of monthly income allocated to food items		0.36	0.38	1.03
Household proportion below 5 years		0.24	0.27	1.30
Categorical variables	**Total**	**Percentage**		**χ2 value**
Sex of the household decision makers	384	36.45	63.55	384***
Household decision makers with access to nutrition information	189	34.29	57.79	19.66***
Household decision makers who were aware of food certification	247	73.57	59.01	8.21***
Household decision makers who were aware of anaemia	349	92.14	90.16	0.42
Household decision makers who were aware of stunting	371	96.43	96.72	0.02
Household decision makers who were aware of high iron common beans	125	22.86	38.11	9.43***
Household decision makers who trusted certification bodies	269	72.14	68.85	1.83
Household decision makers who trusted nutritional claims of high iron beans	333	88.93	85.71	3.43*

, * denote significance level at 5% and 1% level, respectively

Women constituted the majority of household decision-makers (63%), significantly outnumbering male decision-makers (36%). This implies women play a significant role in household purchasing decisions. Access to nutrition information was significantly greater for female household decision makers than for male household decision makers, with approximately (57%) of female decision makers having access to nutrition information compared to approximately (34%) of male decision makers. This disparity can be attributed to

the traditional gender roles in many societies, where women often assume primary responsibility for food procurement, preparation, and feeding family members. This role necessitates a deeper understanding of nutrition and dietary needs, leading women to actively seek out nutrition information from various sources, such as food labels (Aigbokhaode *et al.*, 2015). Additionally, awareness of food certification and awareness of high-iron common beans was significant as discussed in Table 3.4 section (3.3.1)

4.3.2 Krinsky and Robb Confidence Intervals of the Mean WTP

Table 4.2 shows summary statistics on the WTP amounts. The overall mean WTP was KES**Error! Bookmark not defined.** 282 per kilogram. When the influencing variables are factored in, the truncated mean is estimated to be approximately KES 279 per kilogram. This represents an approximately 27% price premium based on *Nyota* bean (a high iron bean variety) prices of KES 220 per kilogram. Finally, an adjusted truncated mean, which accounts for the impact of outliers on the mean, is approximately KES 304 per kilogram. The minor differences between the overall, truncated, and adjusted truncated means suggest that zero responses do not heavily skew the distribution (Duffield & Patterson, 1991).

Table 4.2: Krinsky and Robb Simulated Confidence Intervals in KES

Estimates	Estimate	Lower bound	Upper bound
Mean	281.87	275.75	288.86
Truncated Mean	279.87	274.58	285.22
Adjusted Truncated Mean	304.19	288.18	331.31
Median	279.76	273.95	286.11

4.3.3 Factors likely to Influence Consumers' WTP for High-iron Common Beans

A semidouble-bounded logit model was estimated to determine the factors likely to influence consumers' WTP for high-iron common beans among West Pokot subcounty urban households. The estimated marginal effects and their corresponding standard errors and p-levels of significance are presented in Table 4.3. The likelihood ratio test (LR $\chi 2$ (10) = 252.68, Prob> $\chi 2$=0.0000) was significant at 1 percent level. This implies that the semidouble-bounded logit model captures additional information on the observed data compared to the constrained model. The pseudo-R squared was 0.39. This suggests that the independent variables of the model adequately explain the variability in the WTP.

Table 4.3: Semidouble-Bound Logit Model Results on Factors Influencing WTP

Variable	dy/dx	Coeff.	Std. Err	P values
Age	0.0137	0.1241	0.0017	0.0000***
Education	0.0153	0.0440	0.0049	0.0016***
Household proportion below 5 years	0.0195	0.1761	0.0180	0.1439
Aware of anemia	-0.0437	-0.4298	0.0399	0.4942
Aware of stunting	0.0713	0.5750	0.0786	0.9687
Income	-0.2375	-0.7296	0.0939	0.0191**
Access to market information	0.0451	0.4341	0.0290	0.1626
Access to nutrition information	0.0562	0.5109	0.0267	0.0345**
Trust in certification bodies	0.1399	1.1558	0.0310	0.0249**
Trust on nutritional claims of high iron	0.0428	-1.4160	0.0327	0.1907
Aware of food certification	0.1473	1.2255	0.0297	0.0000***
Aware of high iron common beans	0.0889	0.8725	0.0244	0.4017

, * denote significance level at 5%, and 1% level, respectively

The age of the household decision maker positively influenced WTP at the 1% significance level. Older individuals are more likely to pay higher prices for certified high-iron beans than younger individuals. This inclination could be attributed to the fact that as people age, they become more health conscious, and thus demonstrating a greater willingness to allocate their food budget to products that support their health. These results are consistent with the findings of Zhang *et al*. (2012), who observed that elderly consumers had greater WTP for certified organic and safe fresh products. However, it contradicts with the findings of Hossain *et al*. (2021), who reported that age had a negative effect on WTP for certified chicken. This could be because some elderly people may have perceived certified chicken as less healthy and nutritious.

The results show that the years of education of the household decision-maker yield a significant coefficient of 1%. This implies that an increase in years of schooling increased the willingness to pay a premium for certified high-iron common bean grains. This is a welcoming finding as it implies, that highly educated individuals often have better access to information,

allowing them to make more informed decisions. As a result, they have more information on the benefits of certification, such as improved consumer protection, environmental sustainability, or adherence to ethical standards, than other certification systems. However, it also highlights that some major nutrition education campaigns would be required when introducing the certified product to ensure widespread understanding and acceptance. This finding corroborates that of Forleo and Palmieri (2023), who found that consumers' willingness to pay for certified tuna increased with their education level. In a different study Xu *et al.* (2019) revealed that consumers with higher levels of education had a higher willingness to pay for food with information on animal welfare, lean meat essence detection, and traceability. The proportion of monthly income that household decision makers allocated to food items was significant and negatively affected household decision makers' WTP, with a probability of decreasing WTP by 23.75 %. This suggests that households with higher food expenditure were less willing to pay a premium for certified beans. Urban poor households in low- and middle-income countries (LMICs) tend to spend a large part of their income (up to 70%) on food, making them particularly vulnerable to malnutrition (Bloem & De Pee, 2017; Cohen & Garrett, 2010; Kumar *et al*., 2009). This effect is pronounced in West Pokot, where the monetary poverty rate is 57.3%, and the multidimensional poverty rate is 82%. This statistic is higher than the national rates of 35.7% and 57.3%, respectively (KNBS, 2020). These high poverty levels in West Pokot may explain the observed negative effect on WTP for certified high-iron common bean grains. Similarly, Abate *et al.* (2021), speculates that if the unobserved trait in high iron beans is positive ,separating the market for the positive attribute through means such as certification will likely lead to higher prices for high iron beans. This would make relatively poor consumers not afford and therefore would likely consume the beans without the positive trait, this necessitates provision of discounts to consumers.

Household decision-makers with access to nutrition information were significantly more likely to pay higher prices for certified high iron common bean, demonstrating a marginal effect of 5.6 %. Access to nutritional information reduces uncertainty about a product's nutritional qualities and allows consumers to assess its value in light of personal health motivations or broader dietary trends. Oparinde *et al*. (2019) confirmed these findings and reported that nutritional information positively affected the WTP for high-iron bean varieties. The fact that nutritional information is readily available in conventional markets increases consumers' intentions to buy (Boyle & Bishop, 1985). These results also mirror those of De Groote *et al*. (2018), who found that consumers who had access to nutritional information were WTP a price premium for instant fortified pearl millet products.

Household decision-makers who trusted certification agencies were more willing to pay for certified high iron beans. Trust in certification agencies increases willingness to pay a premium by 13.47% . This implies that certification by recognized public agencies is likely viewed as a reliable indicator of the product's quality. Household decision makers may feel more assured that certified high iron beans meet certain nutritional standards or safety regulations, making them more inclined to invest in these products. Banerji *et al*. (2016) reported a comparable finding, where trust in national agencies (public) increased the WTP for high-iron pearl millet. These findings are consistent with research by Truong *et al*. (2022), who revealed that people who distrust food certification choose not to buy certified food. This decision stems from their scepticism toward food certification organizations, as they believe that certification does not ensure compliance with food standards.

Household decision-makers' who were aware of food certification significantly influenced willingness to pay, increasing it by up to 14.73%. This finding may indicate that higher awareness brings about greater consumer expectations regarding the value of certified food products. This could be attributed to the fact that awareness of certification likely enhances consumers' perception of certified high-iron common beans. This finding corroborates that of Timpanaro *et al.* (2020), who found that awareness of food certification agencies increases the valuation of biofortified products. Likewise, Janssen and Hamm (2012) found that higher awareness levels of organic certification increase consumers' WTP.

4.4 Conclusions

This study utilized a semidouble bound logit model to assess the factors that likely influence the WTP for certified high-iron beans. The findings indicated a mean WTP of KES 281 per kilogram. The findings from this study reveal that household decision makers allocate a significant portion of their monthly income to food items, which has a negative effect on WTP. In contrast, access to nutritional information by the household decision maker, trust in nutritional claims on high-iron common beans increased WTP and trust in public certification bodies. It is concluded that there is a potential market for certified high iron bean products in the studied area.

CHAPTER FIVE

URBAN CONSUMER PREFERENCE FOR MARKET OUTLETS FOR CERTIFIED HIGH-IRON COMMON BEANS IN WEST POKOT COUNTY, KENYA

Abstract

The growth in population and income, along with urbanization, is leading to an increase in the consumption of high-value foods in developing countries. However, consumers, struggle to access nutrient-dense meals due to the development, introduction, pricing, distribution, and marketing strategies that often overlook their social and economic circumstances. In contributing towards addressing this challenge, the study conducted a quasi-ranking experiment in urban areas of West Pokot County to assess the socio-economic, institutional, and product variables that influence the preference for certified high iron common bean market outlets. A stratified multistage sampling technique was used to collect a sample of 384 household decision makers and a rank-ordered probit model for analysis. Findings revealed that the local open-air market was the most preferred outlet (44.99%), followed by cereal shops (25.47%) and supermarkets (21.80%), while telebased outlets were the least preferred outlets (7.73%). Furthermore, the key decision-maker's sex, education level, occupation status, income allocated to food items, awareness of food certification, perception on service quality, and distance to the nearest market, significantly influenced the preference for market outlets. Implementing interventions that could ensure the right market outlets are stocked with certified high iron common bean would improve the availability and accessibility of these certified high iron common beans. Additionally, since traditional retail open-air markets are still consumers' most preferred avenue for sourcing certified high iron common beans, policymakers could give further thought to improve services in the open-air market outlets.

5.1 Introduction

There has been increased urbanization over the past few decades Africa and Asia. According to forecasts from the United Nations, it is anticipated that over two-thirds of the global population would reside in urban areas by the year 2050 (UNDESA, 2018b). A significant proportion of the newly relocated urban population is anticipated to reside in peri-urban areas (Huijstee *et al.,* 2018). With this in mind, urban food insecurity has emerged as a significant obstacle for low-income urban residents in Africa and other developing nations due to the rise in urbanisation (Battersby, 2017a; Chivandire *et al.*, 2021)

Taking the case of common beans, consumer data from Kenya suggests that there is an anticipated increase in demand of 168%, which is consistent with the pattern observed at the household level in Africa (Schiek *et al*., 2021). Concurrently, consumption of processed foods, is expected to increase particularly in major urban centres (Baker *et al*., 2020; Bren d'Amour *et al*., 2020;). These processed foods often lack nutritional value (high in fat, sugar and salt) and can be unhygienic (Global Panel on Agriculture *et al.,* 2016; Makinde *et al*., 2020). This is expected to impact the nutritional quality of diets and the double burden of malnutrition (Popkin *et al.,* 2020). Food stores have responded to the increasing demand for legumes by expanding their range of products and offering alternative forms, such as ready-to-eat options. Additionally, marketers have implemented marketing strategies with an aim of distinguishing themselves from other traders (Brunori *et al*., 2016), such as using informative food labels, offering various delivery options, providing pre-packaged fresh produce, and introducing unique food products. These strategies aim to expand market share and enhance the overall consumer experience for fresh produce.

A retail revolution in Africa and Asia has resulted in the gradual disappearance of traditional marketplaces and the emergence of large and small food stores and online channels, which has transformed the food industry landscape (Ramesh *et al.,* 2023). While e-commerce is growing, online grocery confronts several hurdles, including high loading times, transaction issues, payment security, and almost no food goods (Varughese & Thomas, 2024). The rise of modern marketing channels in many developing nations can be related to the growing urbanisation and nutrition transition (Meng *et al.,* 2014; Reardon *et al.,* 2015). In sub-Saharan Africa, food distribution primarily occurs through informal channels like open-air markets, kiosks, and street vendors. However, there is a growing preference for formal marketplaces, such as supermarkets, which now account for over 10% of Kenya's food retail industry and over 20% in major African urban centers. As formal value chains grow, they impact costs, quality, and safety standards (Jayne *et al.,* 2018; Nickanor *et al.,* 2021). The transition from

informal market connections to value chains has led to an emphasis on implementing more stringent agreements and timetables for product delivery (Pingali *et al.,* 2019).

Although formal markets have expanded in numerous nations in sub-Saharan Africa, specifically Kenya and South Africa, as well as in substantial parts of South Asia, it is projected that informal markets will continue to exist in most areas (Neven *et al*., 2009; Pingali *et al*., 2019; Skinner 2018). Despite perceived complexity of informal markets, they remain to be the most efficient means of reaching impoverished consumers (Demmler, 2018; Giroux *et al*., 2021), as a large proportion of the urban poor rely substantially on open-air markets to access food (Hannah *et al.,* 2022). Enhancing the availability of cost-effective and superior diets via outlets that consumers prefer will effectively address the issue of malnutrition,

Healthy foods are found in the many market places of Kenya. Despite their availability, low-income customers frequently often struggle to access nutrient-dense meals due to the development, introduction, pricing, distribution, and marketing strategies that often overlook their social and economic circumstances (Tacoli, 2017). It is on this foregoing that this study studies factors likely to influence consumers preference for existing and alternative market outlets. The study's findings will also offer significant empirical support for marketers to adapt their offerings in order to align with consumer demands. Additionally, it will provide pertinent insights to potential investors who are contemplating entering the high iron bean food industry by employing appropriate product-promotion tactics, specifically about the aspects that impact consumers' preference for purchase outlets.

5.2 Materials and Methods Used to Analyse Factors likely to Influence Urban Consumer Preference for Market Outlets for Purchasing Certified High-Iron Common Bean Grains

5.2.1 Study Area, Sampling Procedure and Data Collection

The research was carried out in the urban centers of Kapenguria and Chepareria in West Pokot County, as detailed in section (3.2.1). A sample size of 384 household decision makers was determined using Kothari (2004) approach and distributed proportionally across the urban centers of Kapenguria and Chepareria as described in section (3.23). The household decision makers were selected using stratified multistage sampling technique, as described in (Section 3.2.4). Data were collected following the procedure as outlined in section (3.2.5). The coded data were then transferred to the Stata 17 computer program for econometric analysis (StataCorp, 2021).

5.2.2 Econometric Modelling of Factors Likely to Influence Consumer Preference for Market Outlets for Purchasing Certified High-Iron Common Bean Grains

The dependent variable in modelling consumers' preference takes on the rank of the 'n' purchase places from most preferred to the least preferred, '1' through 'n'. The four purchasing outlets that were ranked, were as follows: (1) supermarkets, (2) open air markets, (3) cereal shops, (4), tele-based outlets. There are numerous methods available for modelling rank-ordered data. The multinomial logit model, proposed by McFadden (1973), and the conditional logit model. Both models utilize the most preferred choice from the set of possibilities as the dependent variable, without considering any further information from other preference rankings. Additionally, the multinomial logit model assumes that the residuals follow an identical and independent distribution. Therefore, it breaches the assumption of Independence of Irrelevance, resulting in impractical predictions. Consequently, the conditional logit and multinomial logit models were not utilized.

The rank-ordered logit model, developed by Beggs *et al*. (1981), was also deemed appropriate for analysis because it considers the whole ranking of the alternatives. This allows for a greater amount of information to be included, resulting in more accurate parameter estimations (Fok *et al.*, 2012). Moreover, this model remains unaffected by biases stemming from an individual's inability to rank alternatives. Nevertheless, the assumption of Independent and Identically Distributed errors stays true in model. Another limitation is the underlying assumption that an individual possesses the ability to evaluate and rank all available options. This assumption is unlikely when there are numerous choices available for ranking, some of which may be unknown to an individual (Fok *et al.*, 2012). As a result, this model was abandoned. In response, Fok *et al.* (2012) developed a latent-class rank-ordered logit model to address unobserved preference heterogeneity in individuals' ranking abilities, a factor not accommodated by multinomial, rank-ordered, or latent-class rank-ordered logit models.

The mixed rank-ordered logit model and the rank-ordered probit model relaxes the independence of irrelevant alternatives assumption. This enables the modelling of preference heterogeneity among individuals (Calfee *et al*., 2001). However, the high cost of acquiring the Nlogit software required for constructing the mixed rank-ordered logit model led to its abandonment. As an alternative the rank ordered probit choice model was adopted. Utilizing rank-ordered probit models necessitates the utilization of numerous fold integrals, which can be time-consuming, particularly when there are numerous ranking possibilities (Beggs *et al*., 1981). In this study, there were limited options for ranking alternatives. When rankings were not fully completed, the options that were not ranked were treated as the lowest choices for that

person, to simplify the analysis (Greene, 2019). The probit model specifies utility with an observed and an unobserved component. We let U_m represent the utility of a household decision maker for alternatives m (1, 2, ..., M), as represented by equation 17;

$$U_m = \beta' x_m + \varepsilon_m \tag{17}$$

The vector x_m represents individual-level features specific to the alternative, with a size of D x 1. β represents the column vector of coefficients, while ε_m is the error term assumed to conform to a multivariate normal distribution, characterised by a mean of 0 and a variance of Ω. Let r represent a distinct ordinal arrangement of the alternatives. Thus, r^1 represents the first alternative, r^2 represents the subsequent alternative, and so forth. R^r represents the scenario in which the alternatives are ranked in the specific order r by the household decision maker (Nair *et al*., 2019). Within the framework of random utility maximisation, the probability of R_r can be represented as in equation 18:

$$P(R_r;\beta) = P\left(U_{r^2} - U_{r^1} < 0, U_{r^3} - U_{r^2} < 0, \ldots\ldots..., U_{r^{K-1}} < 0\right) \tag{18}$$

The aforementioned probability in equation 21 can also be regarded as the likelihood value for a specific ranking observation, denoted as r. The process of calculating the probability function for the rank ordered probit choice model is as follows: A matrix of construct (K X D) $x = (x_1, x_2, \ldots, x_K)$. Let M represent the mask matrix of dimensions (K-1) ($\times K$) which when pre-multiplied with U produces the vector utility differences that should be less than zero. To create mask matrix M corresponding to a ranking sequence r and depth d. The first row of this matrix consisted of zeros, except for a -1 in the column corresponding to the individual's first preference and a 1 in the column corresponding to their second preference. In the second row, there a value of -1 is placed in the column corresponding to the individual's second choice, and a value of 1 in the column corresponding to his third choice (Nair *et al*., 2019). A representation of the mask matrix with the ranking sequence (3, 2, 1, 4) is expressed in equation 19.

$$M_r = \begin{bmatrix} 0 & 0 & -1 & 1 \\ 1 & -1 & 0 & 0 \\ -1 & 0 & 0 & 1 \\ 0 & 0 & 1 & -1 \end{bmatrix} \tag{19}$$

The symbol M_r denotes the transformation matrix associated with the chosen ranking order r. The probability of a ranking sequence, denoted as r, up to a certain rank depth, d, in the context of a rank ordered probit choice model can be represented as follows:

$$\tilde{P}_{ROP}(R_r, \beta, d) = F_{K-1}(0_{K-1}; \mathrm{M}x\beta, \mathrm{M}\Omega\mathrm{M}') \tag{20}$$

The expression, $F_{K-1}; (0_{K-1}; \mu, \Sigma)$ refers to the cumulative multivariate normal distribution function of a K–1 dimensional vector, computed at the truncation point vector $0_{K\text{-}1}$ (a vector of zeros of dimension (K–1) with mean μ and variance–covariance matrix **Σ**. We let S_r represents the event where the individual selects alternative r^i from a group of alternatives in a specific sequence.

$$P(S_r^{r^l};\beta) = P\begin{pmatrix} U_{r_I^1} - U_{r^i} < 0, U_{r^2} - U_{r^i} < 0, ..., U_{r^{l-1}} - U_{r^l} < 0, \\ U_{r^{l+1}} - U_{r^i} < 0, U_{r^{l+2}} - U_{r^i} < 0 ....., < U_{r^i} - U_{r^K} < 0 \end{pmatrix} \tag{21}$$

the conditional probability of preferring of an unranked alternative at any given rank depth while accounting for attenuation of coefficients with rank depth can be expressed in relation to the ranking probabilities as in equation 21:

$$\tilde{P}_{HR}(R_r, \beta, d, \mu) = \tilde{P}(R_r; \mu_1\beta, 1)\prod_{l=2}^{d} \frac{\tilde{P}\left(R_r; \mu_l\beta, l\right)}{\tilde{P}\left(R_r; \mu_l\beta, l-1\right)} \tag{22}$$

replacing the generic ranking probability function $\tilde{P}(R_r, R_r\beta, l)$, in Equation (22) with that of the ROP model, P_{ROP} (from Equation 21), the probability function for the HROP model is represented in equation 23;

$$\tilde{P}_{HROP}(R_r; \beta, d, \mu) = \tilde{P}_{ROP}(R_r; \mu_1\beta, 1)$$

$$P\left[U_{ir_{i1}} > U_{ir_{i1}} > \ ... \ > U_{ir_{i1}}\right] = \prod_{l=2}^{d} \frac{\tilde{P}_{ROP}\left(R_r; \mu_1\beta, 1\right)}{\tilde{P}_{ROP}\left(R_r; \mu_1\beta, l-1\right)} \ f\left(\beta_i \ | \mu, \sigma\right) d\beta \tag{23}$$

where the probability density function of βi, denoted as, $f\ (\beta i\ |\mu,\ \sigma)$, is assumed to follow a normal distribution. This distribution differs across population, with a mean of μ and a standard deviation of σ. (Hensher & Greene, 2003). The function is a multivariate integral and does not have an explicit mathematical expression. Hence, the estimation of the parameters necessitates the use of a simulation technique. The log-likelihood function was optimised by employing a monte carlo simulation with a maximum of 100 Halton draws. Halton draws have significantly higher efficiency compared to random numbers, as demonstrated by Train (2000).

5.3 Results and Discussion

5.3.1 Descriptive Statistics

Table 5.1 displays results about the preferences of households for various market outlets. The local open-air market was the most preferred option, with a preference rate of 44.99%. Cereal stores followed with a preference rate of 25.47%, while supermarkets came in third with a preference rate of 21.80%. Telebased outlets were the least chosen option, with a

preference rate of 7.73%. The abundance of local open-air stores and cereal shops in Kapenguria and Chepareria likely contributes to their high preference. In addition, local open-air outlets are situated in central places in the urban areas, providing access to a variety of food items.

Table 5.1: Households Decision Makers Preferences for Different Market Outlets in Percentages

Outcome	Margin(Percentages)	Standard errors	Z	P>z
Open air markets	44.99	0.0245	18.320	0.000***
Cereal shops	25.47	0.0213	11.950	0.000***
Supermarkets	21.80	0.0172	12.640	0.000***
Telebased outlets	7.74	0.0135	5.730	0.000***

***indicates significance level at 1%

The descriptive statistics of the variables used in the assessing preference for market outlets are presented in Table 5.2. A t-test was used to analyse continuous variables, and a Chi-square test was used for categorical variables to identify significant differences between male and female household decision makers. Education, awareness on food certification were significant as discussed in section Table 3.4 in section (3.3.1). Male household decision makers had significantly greater access to market information compared to female decision makers, with around (27%) of male decision makers having access to market information, in contrast to approximately (17%) of female decision makers. Male household decision makers had significantly greater access to market information compared to female decision makers, with around (27%) of male decision makers having access to market information, in contrast to approximately (17%) of female decision makers.

There were also notable gender differences regarding, perception on service quality when ranking a market outlet, with (56%) male household decision makers while (47%) perceiving it as important. Additionally, perception on product freshness holds significant importance for female decision makers when ranking a market outlet, with females (78%) while (70%) of male decision makers perceiving it as important.

The estimated marginal effects from the rank ordered probit choice model analysis, standard errors and the p-level of significance are presented in Table 5.3. The wald statistics (Wald $\chi 2$ (40) = 113.33, Prob> $\chi 2$=0.0000) was significant at 1% level. This implies that the explanatory power of the independent variables had a strong effect. Table 5.3 also shows

marginal effects of changes in regressors on predicted probabilities at each level of the market outlet.

Table 5.2: Socio-Economic Characteristics of the Households Decision Makers

Variables		Male	Female	
Continuous variables		**Mean**		**t-value**
Age of the household decision maker		40.51	41.90	1.49
Household size		5.00	5.00	-0.38
Years of schooling of the household decision maker		13.27	12.43	-2.63***
Proportion of monthly income allocated to food items		0.36	0.38	1.03
Distance to the nearest market outlet in kilometres		3.87	3.98	0.48
Categorical variables	**Total**	**Percentages**		**χ2 value**
Sex of the household decision makers	384	36.45	63.55	384***
Household decision makers with access to market information	71	27.14	17.21	5.32**
Household decision makers who were formally employed	174	46.43	44.67	0.11
Household decision makers who were aware of food certification	247	73.57	59.02	8.21***
Household decision makers who had beans at home at the time of survey	245	59.29	66.39	1.95
Household decision makers who trusted nutritional claims of beans	333	88.93	85.71	3.43*
Household decision makers who trusted certification bodies	269	72.14	68.85	1.83
Household decision makers who perceived service quality as important	196	56.43	47.95	2.56**
Household decision makers who perceived pricing as important	212	54.29	55.74	0.07
Household decision makers who perceived product freshness as important	289	70.00	78.28	3.27*
Household decision makers who perceived shopping hours as convenient	108	30.00	25.00	1.13

*, **, *** denote significance level at 10%, 5% and 1% level respectively

5.3.2 Factors likely to Influence Preference of Market Outlets

Sex is positive and significant at 10% level. This implies that males are more likely to purchase agricultural products from telebased outlets than females. The marginal effect shows that being a male increases the probability of purchasing agricultural products from supermarkets by 3.52%. In developing countries, women are usually in charge of food shopping and managing food expenditure (Aigbokhaode *et al.,* 2015). Thus, they usually purchase food products from local/open-air markets and farm gates where food could be relatively cheaper. Men, on the other hand, primarily do not consider food shopping as their primary responsibility. Thus, they are likely to shop agricultural products from telebased outlets with greater convenience, orderliness, conducive environment and good customer care. These make shopping telebased outlets easier for men compared with traditional open-air markets.

The effect of education on market outlet preference was significant. Higher levels of education were associated with a 23.38% increase in the likelihood of ranking supermarkets as the most preferred option. Acquiring a more advanced education is crucial for individuals to enhance their capacity to assess many options and make sensible decisions by selecting the most desirable one. The emphasized finding indicates that consumers with a higher level of education are assumed to possess extensive knowledge about market outlet prices and other characteristics that aid them in determining where to make their purchases (Bannor *et al.,* 2022; Okello *et al.,* 2012; Pham, 2020). The argument explains that well-informed persons can obtain high-quality knowledge from multiple sources, impacting their decision-making process.

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Table 5.3: Rank Ordered Probit Choice Model Results on Factors Influencing Preference for Market Outlets

Variable	Cereal shop		Open air market		Supermarket		Telebased outlet	
	dy/dx	Robust Std. err	dy/dx	Robust Std. err	dy/dx	Robust Std. err	dy/dx	Robust Std. err
Log of age	0.0888	0.0920	-0.1068	0.1085	0.0268	0.0719	0.0448	0.0432
Sex	0.0106	0.0369	0.0032	0.0441	-0.0491	0.0294	0.0352*	0.0194
Log of household size	0.0243	0.0132	-0.0120	0.0172	-0.0024	0.0099	-0.0098	0.0067
Log of education	-0.1269	0.0748	-0.0861	0.0991	0.2338***	0.0610	-0.0207	0.0390
Income	0.2094*	0.1136	0.2184	0.1501	-0.2638***	0.0941	-0.1643**	0.0647
Log of distance	-0.0519**	0.0308	0.1161***	0.0362	-0.0980***	0.0215	0.0337**	0.0169
Aware of food certification	-0.0676*	0.0371	-0.0120	0.0522	0.0879***	0.0316	0.0083	0.0200
Access to market information	-0.0166	0.0417	0.0038	0.0556	0.0333	0.0352	-0.0128	0.0232
Occupation status	0.0768**	0.0367	-0.1260***	0.0433	0.0527*	0.0301	0.0035	0.0189
Pricing	0.0147	0.0370	-0.0298	0.0452	-0.0064	0.0288	0.0216	0.0192
Service quality	-0.0197	0.0376	-0.1186***	0.0483	0.1279***	0.0296	0.0104***	0.0198
Beans at home	0.0202	0.0370	-0.0159	0.0446	-0.0413	0.0293	0.0371	0.0190
Trust in certification bodies	0.0432	0.0383	0.0829	0.0503	-0.0383	0.0322	0.0013	0.0210

Std.err.; Denotes Standard errors Number of cases; 1536

Wald $\chi 2$ (40) =113.33, Prob> $\chi 2$=0.0000*** Log simulated-pseudolikelihood = -953.418

*, **, *** denote significance level at 10%, 5%, and 1% level, respectively

The influence of the share of income allocated to food items on market outlet preference was threefold. An increase in the proportion of income allocated to food items had a statistically significant and positive effect on consumers' preference for cereal shops. Specifically, an increase in this proportion led to a 20.94% increase in the likelihood of choosing a cereal shop. While open-air market pricing is commonly seen as more economical and most preferred in many African urban areas (Gido *et al.,* 2016; Hannah *et al.,* 2022), more is needed to encourage household decision makers to prefer open-air marketplaces. The likely explanation for this finding could be that those who allocate a large proportion of income to food items only sometimes have access to sufficient cash. During such times, they need to find alternative ways to obtain food, such as on credit. Therefore, cereal shop retailers usually have close relationships with their customers, facilitating the process of selling goods on credit (Koech *et al.,* 2022).

On the other hand, an increase in the proportion of money spent on food products resulted in a 26.38% decrease in the probability of ranking supermarkets as the most preferred option and a 16.43% decrease in the probability of ranking telebased outlets as the most preferred option. Supermarket prices for agricultural commodities are generally higher than prices in other market outlets. This is likely because supermarkets add extra value to agricultural products by cleaning, cutting them into convenient sizes, packaging, labelling, and processing them, which is not typically done in open-air markets (Bannor *et al.,* 2022). These prices are affordable to high-income consumers, whose income allocation to food items is relatively low. Furthermore, telebased outlets incur additional transaction costs for consumers regarding transportation and search costs. Therefore, households who allocate more of their income to food would not prefer them.

Distance had a threefold effect. Firstly, an increase in the distance to the nearest market by one kilometre increased the likelihood of ranking open-air market outlets as the most preferred option by 11.61% and telebased outlet by 3.37%, respectively. Secondly, an increase in distance by a kilometre reduced the probability of ranking supermarkets and cereal shops as the preferred choice by 5.19% and 9.80%, respectively. Supermarkets and cereal shops in urban regions are primarily situated in big towns, which are often distant from residential areas. This lack of proximity reduces their accessibility and thus makes them less preferred as market outlets. Gido *et al.* (2016) and Maruyama and Wu (2014) found that consumers preferred buying at traditional market outlets near their homes rather than modern market outlets that demand more travel time. Therefore, the closer the market outlet is, the higher the probability

of using it, and vice versa. This implies that supermarkets in a specific geographic region may impact the probability of purchasing from them.

The effect of occupation status is significant and positive for supermarkets and cereal shops and negative for open-air markets. The marginal effect shows that household decision-makers who were formally employed increased the probability of ranking supermarket and cereal shops choice by 5.27% and, 7.68%, respectively. Conversely, the marginal effect indicates that being formally employed decreased the probability of ranking open-air market outlet choice by 12.60%. Typically, individuals who receive a fixed salary are employed in the formal sector. Additionally, those who receive a fixed salary tend to have greater education and income than those who work in the informal sector. This higher socioeconomic status makes it more likely for formally employed consumers to purchase agricultural products from supermarkets and cereal sops. Another study revealed that individuals with fixed salaries preferred supermarkets when purchasing fresh veggies (Shafiwu *et al.,* 2018).

The perception of household decision makers regarding service quality in shopping was significant and led to different preferences for market outlets. Household decision-makers who considered service quality important when choosing a market outlet had a 12.79% and probability of ranking supermarket outlets and telebased outlets as their preferred choice. This implies that consumers who prioritize service quality are more likely to prefer supermarkets and telebased outlets over open-air markets. This suggests that service quality is a significant factor influencing consumer preferences, with higher service quality driving consumers towards more structured and possibly more convenient shopping environments like supermarkets and telebased outlets. These outlets likely provide better customer service, convenience, and a more organized shopping experience, which appeals to consumers who prioritize service quality. Other studies by Abrahams (2010), Battersby (2017a), and Zhong *et al.* (2019),find supermarkets are envisioned as symbols of modernity and are associated with good service. The widespread adoption of cell phones has facilitated purchasing, making it a convenient and effortless experience to consumers to make food purchases the arrangement of product pickup and delivery straight to a specified address, likely explains this finding (Abate *et al*., 2023).

Household decision-makers who considered service quality important had a 11.86% probability of not ranking open air markets as their preferred choice. The open-air markets might be perceived as less reliable in terms of the quality of service they provide, which makes them less attractive to these consumers. The arrangement of key basic facilities is important for functionality of market. In this regard the open-air market is normally characterised by

disorganisation and poor service. In a study by Kitonyi (2023) on functionality of Gikomba open air market in Kenya finds majority of consumers were unsatisfied with the condition of the open-air market due to poor quality of service.

5.4 Conclusions

The study assessed the factors that likely influence urban households' preference for market outlets in Kenya. The findings revealed that local open-air markets were the most preferred market outlets, followed by cereal shops, while supermarkets and telebased outlets were the least preferred market outlets. The econometric analysis showed that the proportion of income allocated to food items, education level and occupation status of the household decision maker, distance to the nearest market, perceptions on service quality significantly influenced preference for market outlets.

Household decision makers who allocated a significant amount of their income on food items preferred cereal shops. On the other hand, highly educated household decision makers less preferred cereal shops. While open air markets were preferred by household decision makers who were distantly located and those who considered service quality to be important in making purchase decisions. However, formally employed household decision makers less preferred open-air markets.

CHAPTER SIX

GENERAL DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

6.1 Critical Review

The use of stated preference methodology has significantly improved understanding of consumer behaviour in hypothetical scenarios given widespread applicability of the stated preference methodology across diverse disciplines. By employing contingent choice experiment, contingent valuation, and contingent ranking methodology, real market behaviour was predicted. This approach has proven to be adaptable in addressing challenges arising from the ever-evolving technological landscape of food product marketing. As product lines expand and evolve, the introduction of new features or the replacement of outdated ones becomes inevitable (Louviere *et al.,* 2000). Therefore, utilizing stated preference data to anticipate market responses to such changes was crucial. Furthermore, by incorporating the perspectives of key common bean value chain stakeholders, provided a better understanding of various aspects of certifying high-iron common bean grains. Once again, the versatility of stated preference methodology to estimate econometric models in predicting real market behaviour that align with the underlying economic theory.

The study utilized semi-double bounded logit models to evaluate the willingness to pay for certified high iron common beans. By employing the semi-double bounded logit, the inefficiency measure of double-bounded logit models was addressed, as highlighted by (Cooper *et al.,* 2002). Traditionally, the multinomial logit model has been widely used for assessing the choice of existing alternatives (Okello *et al.,* 2012; Slamet & Nakayasu, 2016; Shafiwu *et al.,* 2018). However, a significant drawback is that this model uses the most preferred choice from the set of possibilities as the dependent variable, without considering additional information from other preference rankings and choices. The adopted ranking methodology in modelling represents a significant advancement in effectively utilizing rank-ordered data. These models provide a means to effectively analyse rank-ordered data and recognize that decisions are often relative (Nair *et al.,* 2019).

6.2 Consolidated Discussion of the Results

Overall, a review of the research showed approximately two-thirds of the households' decision makers were women, suggesting that women are the primary decision-makers when it comes to food purchase. This could be explained by the fact that women primarily decide what to eat and where to buy. The study revealed that, with an average age of 41, the majority of the household decision makers sampled were middle-aged, with an average of 12 years of

education suggesting that the consumption of these beans is more significant among middle-age urban inhabitants. The mixed logit model examined factors likely to influence consumer preferences for certified high-iron common bean grain attributes. Age and education were identified as heterogeneous factors. Household decision makers preferred the government certification of high-iron common beans and mandatory labelling of high-iron common beans. On the other hand, households showed negative preferences for precooked beans and certification of high-iron common beans by a private body.

Consumer willingness to pay for certified high-iron common bean grains was analysed with a semidouble-bounded logit model. Household decision makers were willing to pay KES 281 per kilogram of certified high-iron common bean grains. Age, education, trust in nutritional claims of high iron beans, access to nutrition information, and awareness of food certification all influenced household decision makers' willingness to pay. For instance, enhanced consumer awareness of food certification among household decision makers influenced positively consumer willingness to pay for certified high-iron common bean grains. Through enhanced awareness, decision-makers know the importance of the certification of food products, enabling them to incorporate high-iron common beans in meals.

The preference for market outlets for purchasing certified high-iron common bean grains among urban residents was analysed using a rank-ordered probit choice model. The study's results indicated that open air market outlets were the most preferred outlets, followed by cereal shops, while supermarkets and telebased outlets were the least preferred market outlets. Similarly, Gido *et al.* (2016) and, Shafiwu *et al.* (2018) find that open air market was the most promising avenue for purchasing food. Factors such as, occupation status, proportion of income allocated to food items, distance to the nearest market, and perceptions of service quality influenced preferences for market outlets. Notably, the perceived importance of product service quality played a crucial role in shaping these preferences. The poor quality of service offered in open air markets is likely to have contributed to negative effect on the appeal of open-air market outlets.

6.3 Conclusions

The study revealed that households preferred lower prices, mandatory labelling and joint public–private certification of certified high-iron beans. However, they showed a negative preference for precooked beans and a private body certification of high-iron common beans. Additionally, relative to the price prices of *Nyota* high iron common bean variety consumers were willing to pay an average price premium of KES 281 for certified high-iron common bean

grains. The traditional market outlets open air market and cereal shops are still the most preferred, while supermarkets and telebased outlets are the least preferred market outlets. Therefore, policy-makers could further consider transforming traditional market outlets, thereby enhancing producer and consumer welfare.

6.4 Recommendations

Based on the findings presented above, the following strategies and policies may be developed.

i. The government could strengthen its product quality information regulations by adopting mandatory labelling and certification of high-iron beans via a joint public and private certification approach or solely government certification. Finally due to the heterogeneity of preferences among this group of consumers. It is important for bean investors, government and non-governmental organizations to segment consumers into different classes based on individual characteristics such as age and education and not treat all consumers as homogenous when designing strategies for, marketing of high iron beans.

ii. To enhance consumer awareness of high-iron common beans for low-income earners, effective consumer awareness campaigns could be undertaken. The consumer awareness strategy could boost nutritional knowledge, enabling consumers to identify and purchase products that fit their preferences. Awareness efforts could involve a multi-sectoral approach from KALRO, HarvestPlus, PABRA, GAIN and consumer organizations to the Kenyan government through relevant ministries.

iii. To enhance efficient and functional and operational success of the open-air markets, it is important for the government to improve services within the open-air market space.

6.5 Areas of Further Research

Considering this study was hypothetical, there is need for similar future research that could consider an incentive-compatible procedure with discounts provided for real products to be purchased by household decision makers. Additionally, the assessment of preferences for other quality measurement indicators, such as traceability information and cues (brand name, manufacturer name, and store name), could provide more information. The anticipated results could inform future consumer purchasing behaviour concerning preferences for certified high-iron common bean grains. Moreover, the findings could inform the formulation of relevant policies, the development and strengthening of a high-iron common bean value chain in Kenya.

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APPENDICES

Appendix A: Multicollinearity Test for Variables in Assessing Preferred Market Outlets

Variable	VIF	1/VIF
Education	1.240	0.808
Trust in certification	1.240	0.810
Proportion of income allocated to food items	1.230	0.816
Awareness of food certification	1.170	0.854
Beans at Home	1.150	0.870
Occupation status	1.120	0.894
Distance to the nearest market	1.120	0.897
Age	1.110	0.897
Service Quality	1.110	0.899
Sex	1.090	0.915
Access to Market Information	1.060	0.941
Household Size	1.050	0.950
Purchase frequency Index	1.040	0.960
Mean VIF	**1.13**	

Appendix B: Multicollinearity Test for Variables Used in Assessing Willingness to Pay

Variable	VIF	1/VIF
Education	1.460	0.687
Aware of anemia	1.360	0.733
Proportion of income allocated to food items	1.350	0.741
Age	1.350	0.743
Trust to certification bodies	1.280	0.779
Trust nutritional claims	1.270	0.787
Aware of high iron common bean	1.130	0.888
Household members below 5 years	1.120	0.891
Access to nutrition information	1.110	0.897
Aware of stunting	1.100	0.913
Aware of food certification	1.070	0.931
Mean VIF	**1.22**	

Appendix C: STATA and R Outputs

```
Mixed logit model                                 Number of obs =  2,964
                                                  LR chi2(5)    = 176.18
Log likelihood = -563.09995                       Prob > chi2   = 0.0000
```

ResponseIndicator	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
Mean						
PrivateCertification	-2.785706	1.107431	-2.52	0.012	-4.95623	-.615181
Labelling	1.167852	.462197	2.53	0.012	.2619626	2.073741
LevelofProcessing	-1.249514	.489391	-2.55	0.011	-2.208702	-.290325
Certification	2.892077	1.262473	2.29	0.022	.4176747	5.366479
mprice	-2.072123	.3630503	-5.71	0.000	-2.783689	-1.360557
SD						
PrivateCertification	1.73551	.888394	1.95	0.051	-.0057104	3.47673
Labelling	1.874898	1.101366	1.70	0.089	-.2837393	4.033536
LevelofProcessing	-1.750334	.8133587	-2.15	0.031	-3.344488	-.1561808
Certification	5.590688	2.273182	2.46	0.014	1.135332	10.04604
mprice	-.5909741	.1074366	-5.50	0.000	-.8015461	-.3804022

```
The sign of the estimated standard deviations is irrelevant: interpret them as
being positive

.
end of do-file
```

```
Formula:
R1 + R2 ~ (Age)^3 + HHHProp5 + (Educ)^2 + Awaraanaemia + AwarCert + Awarstunting +
    log(PropInc) + TrustCert + TrustnutriHICB + MktInfo + NutriInfo + Awarstunting +
    AwarHICB | log(BL) + log(BH)

Coefficients:
                  Estimate Std. Error z value  Pr(>|z|)
(Intercept)       61.00321    5.02777  12.133 < 2.2e-16 ***
Age                0.12420    0.01671   7.432 < 2.2e-16 ***
HHHProp5           0.17860    0.16137   1.107  0.268409
Educ               0.13833    0.04402   3.143  0.001674 **
Awaraanaemia      -0.43052    0.42794  -1.006  0.314401
AwarCert           1.22652    0.23616   5.194 < 2.2e-16 ***
Awarstunting       0.57651    0.57272   1.007  0.314117
log.PropInc.      -0.73273    0.33062  -2.216  0.026677 *
TrustCertYes       1.15650    0.24151   4.789     2e-06 ***
TrustnutriHICBYes -0.41651    0.34367  -1.212  0.225538
MktInfoYes         0.43373    0.29898   1.451  0.146861
NutriInfoYes       0.51077    0.24418   2.092  0.036458 *
AwarHICB           0.87349    0.26404   3.308  0.000939 ***
log(bid)         -12.56455    0.96219 -13.058 < 2.2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Distribution: log-logistic
Number of Obs.: 384
Log-likelihood: -358.383782

LR statistic: 194.306 on 1e+01 DF, p-value: 0.000
AIC: 744.767564 , BIC: 800.076560
```

```
> mod <- oohbchoice(R1 + R2 ~  (Age)^3 + HHHProp5 + (Educ)^2 + Awaraanaemia + AwarCert + Awarstunting + log(PropInc) + TrustCe
+ NutriInfo +Awarstunting + AwarHICB | log(BL) + log(BH), data = Donald_Data)
> avg_slopes(mod)
Error in avg_slopes(mod) : could not find function "avg_slopes"
> library(marginaleffects)
> avg_slopes(mod)

          Term             Contrast Estimate Std. Error      z Pr(>|z|)     S    2.5 %
 Age            mean(dY/dX)           0.01372   0.001724   7.96   <0.001  49.1  0.01035
 AwarCert       mean(1) - mean(0)     0.14732   0.029695   4.96   <0.001  20.4  0.08912
 AwarHICB       mean(1) - mean(0)     0.08899   0.024498   3.63   <0.001  11.8  0.04097
 Awaraanaemia   mean(1) - mean(0)    -0.04373   0.039749  -1.10   0.2712   1.9 -0.12164
 Awarstunting   mean(1) - mean(0)     0.07139   0.078444   0.91   0.3628   1.5 -0.08236
 BH             mean(dY/dX)           0.00000         NA     NA       NA    NA       NA
 BL             mean(dY/dX)          -0.00592   0.000405 -14.60   <0.001 158.0 -0.00671
 Educ           mean(dY/dX)           0.01529   0.004843   3.16   0.0016   9.3  0.00579
 HHHProp5       mean(dY/dX)           0.01974   0.017983   1.10   0.2724   1.9 -0.01551
 MktInfo        mean(Yes) - mean(No)  0.04505   0.028976   1.55   0.1200   3.1 -0.01175
 NutriInfo      mean(Yes) - mean(No)  0.05629   0.026641   2.11   0.0346   4.9  0.00407
 PropInc        mean(dY/dX)          -0.23750   0.100743  -2.36   0.0184   5.8 -0.43496
 TrustCert      mean(Yes) - mean(No)  0.13996   0.030940   4.52   <0.001  17.3  0.07932
 TrustnutriHICB mean(Yes) - mean(No) -0.04277   0.032661  -1.31   0.1903   2.4 -0.10679
   97.5 %
```

Mixed logit model — Number of obs = 3,058
LR chi2(4) = 235.62
Log likelihood = -511.27749 — Prob > chi2 = 0.0000

ResponseIndicator	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
Mean						
Price	-.1427338	.033193	-4.30	0.000	-.2077909	-.0776767
PrivateCertification	-2.624235	.6608961	-3.97	0.000	-3.919568	-1.328902
Labelling	1.362752	.3986074	3.42	0.001	.581496	2.144008
LevelofProcessing	-1.311021	.3650083	-3.59	0.000	-2.026424	-.5956183
Certification	3.159704	.7894796	4.00	0.000	1.612352	4.707055
SD						
PrivateCertification	-1.658728	.6360614	-2.61	0.009	-2.905385	-.4120704
Labelling	1.500519	.7137569	2.10	0.036	.1015808	2.899456
LevelofProcessing	-1.624852	.5936637	-2.74	0.006	-2.788411	-.4612923
Certification	5.978742	1.484312	4.03	0.000	3.069544	8.88794

The sign of the estimated standard deviations is irrelevant: interpret them as being positive

. estat ic

Akaike's information criterion and Bayesian information criterion

Model	N	ll(null)	ll(model)	df	AIC	BIC
.	3,058	-629.0878	-511.2775	9	1040.555	1094.785

Expression: Pr(PurchaseOutlet), predict(pr1)
dy/dx wrt: Ageln Gender Educln Occpnstatus MktInfo HHSize PropInc Distanceln AwarCert Pricingg Beansathome Ser

	Delta-method dy/dx	std. err.	z	P>|z|	[95% conf.	interval]
Ageln						
_outcome						
CerealShop	.0888187	.0920721	0.96	0.335	-.0916394	.2692767
Openairmarket	-.1068884	.1085107	-0.99	0.325	-.3195655	.1057886
Supermarket	-.0268198	.0701961	-0.38	0.702	-.1644015	.110762
TeleBasedOutlet	.0448986	.0432149	1.04	0.299	-.0398011	.1295983
Gender						
_outcome						
CerealShop	.010651	.0369082	0.29	0.773	-.0616877	.0829898
Openairmarket	.0032268	.0441746	0.07	0.942	-.0833539	.0898075
Supermarket	-.049124	.0294952	-1.67	0.096	-.1069335	.0086855
TeleBasedOutlet	.0352506	.0194747	1.81	0.070	-.0029191	.0734203
Educln						
_outcome						
CerealShop	-.1269243	.074815	-1.70	0.090	-.273559	.0197104
Openairmarket	-.0861446	.0991037	-0.87	0.385	-.2803843	.1080951
Supermarket	.2338243	.0610109	3.83	0.000	.1142451	.3534035
TeleBasedOutlet	-.0207089	.0390485	-0.53	0.596	-.0972426	.0558248
Occpnstatus						
_outcome						
CerealShop	.0768326	.0367709	2.09	0.037	.0047629	.1489023
Openairmarket	-.1260155	.0433285	-2.91	0.004	-.2109378	-.0410933
Supermarket	.0527421	.0301096	1.75	0.080	-.0062715	.1117558
TeleBasedOutlet	-.0035538	.0189051	-0.19	0.851	-.0406072	.0334996

MktInfo						
_outcome						
CerealShop	-.0166094	.0417973	-0.40	0.691	-.0985305	.0653118
Openairmarket	-.0038609	.055633	-0.07	0.945	-.1128994	.1051777
Supermarket	.0333446	.0352062	0.95	0.344	-.0356582	.1023474
TeleBasedOutlet	-.0128721	.0231886	-0.56	0.579	-.0583209	.0325767
HHSize						
_outcome						
CerealShop	.0242763	.0131774	1.84	0.065	-.001551	.0501036
Openairmarket	-.0120739	.0172247	-0.70	0.483	-.0458337	.021686
Supermarket	-.0023886	.0099502	-0.24	0.810	-.0218907	.0171135
TeleBasedOutlet	-.0098198	.0067104	-1.46	0.143	-.022972	.0033323
PropInc						
_outcome						
CerealShop	.2094984	.1136945	1.84	0.065	-.0133388	.4323357
Openairmarket	.2184445	.1501028	1.46	0.146	-.0757517	.5126406
Supermarket	-.2638273	.0941429	-2.80	0.005	-.4483439	-.0793107
TeleBasedOutlet	-.1642521	.0647934	-2.54	0.011	-.2912449	-.0372593
Distanceln						
_outcome						
CerealShop	-.0518858	.0308114	-1.68	0.092	-.1122751	.0085035
Openairmarket	.1161271	.0362006	3.21	0.001	.0451753	.1870789
Supermarket	-.0980094	.0215723	-4.54	0.000	-.1402903	-.0557284
TeleBasedOutlet	.0337649	.0169815	1.99	0.047	.0004818	.0670481
AwarCert						
_outcome						
CerealShop	-.067557	.0371121	-1.82	0.069	-.1402953	.0051813
Openairmarket	-.0120217	.0522131	-0.23	0.818	-.1143574	.090314
Supermarket	.0879445	.0316743	2.78	0.005	.0258641	.1500249
TeleBasedOutlet	-.0083475	.0200095	-0.42	0.677	-.0475653	.0308703

Pricingg						
_outcome						
CerealShop	.0146502	.037024	0.40	0.692	-.0579155	.0872159
Openairmarket	-.0298207	.0452406	-0.66	0.510	-.1184906	.0588492
Supermarket	-.0064351	.0287185	-0.22	0.823	-.0627224	.0498522
TeleBasedOutlet	.0216128	.0192761	1.12	0.262	-.0161676	.0593932
Beansathome						
_outcome						
CerealShop	.0201701	.0369073	0.55	0.585	-.0521668	.092507
Openairmarket	-.0159361	.0446407	-0.36	0.721	-.1034302	.0715581
Supermarket	-.0413747	.0292645	-1.41	0.157	-.0987322	.0159827
TeleBasedOutlet	.037147	.0190707	1.95	0.051	-.0002309	.0745249
ServiceQuality						
_outcome						
CerealShop	-.0197036	.0376822	-0.52	0.601	-.0935595	.0541522
Openairmarket	-.1186652	.0483119	-2.46	0.014	-.2133549	-.0239755
Supermarket	.1279896	.0296147	4.32	0.000	.0699459	.1860334
TeleBasedOutlet	.0104114	.0198525	0.52	0.600	-.0284988	.0493216
TrustCert						
_outcome						
CerealShop	.0432387	.0383176	1.13	0.259	-.0318624	.1183398
Openairmarket	-.0829107	.0502952	-1.65	0.099	-.1814876	.0156661
Supermarket	.0383435	.0322272	1.19	0.234	-.0248207	.1015076
TeleBasedOutlet	.0013349	.0210179	0.06	0.949	-.0398594	.0425291

Appendix D: Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **473092**

Date of Issue: **12/January/2024**

RESEARCH LICENSE

This is to Certify that Mr.. Donald Kiprono Kirwa of Egerton University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Westpokot on the topic: CONSUMER PREFERENCES AND WILLINGNESS TO PAY FOR CERTIFIED HIGH-IRON COMMON BEANS (Phaseolus vulgaris L.) IN WEST POKOT SUBCOUNTY, KENYA for the period ending : 12/January/2025.

License No: **NACOSTI/P/24/32337**

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See overleaf for conditions

Appendix E: Household Questionnaire

A. Questionnaire Identification

I am **Kirwa Donald,** pursuing a Master of Science degree in Agricultural economics at Egerton University. I am researching on **Consumer preference and willingness to pay for certified high-iron common bean grains in West Pokot County, Kenya.** The purpose of this study is purely academic.

INFORMED CONSENT.

I humbly request you to take part in this interview since the information you will provide will assist in meeting my study objectives. I assure you that your information will be treated as confidential as possible. Thank you.

Signature……. Date…….

Name of interviewee …….....

Questionnaire number ……...……

Name of interviewer/Enumerator……

B. Geographical Location of the Household Decision Maker.

Ward …….....

Location …….....

C. Key Demographic characteristics of the household decision maker on food items *Tick where appropriate)*

1.0 Sex of the decision-maker.

1 = Male, ☐ 0 = Female, ☐

1.1 Age of the decision-maker (in years) …….....

1.2 How many years have you spent on your schooling/education? …….....

1.3 How many members are there in your household?.....

1.4 What is the age distribution in years of your household members? *(Select appropriately in the table below)*

Age Ranges	Females	Males	Total
0-5			
6-18			
19-50			

1.5 From what sources do you earn your income?

1=Formal Employed, ☐ 2=Informal employment, ☐ 3= Both ☐

1.6 Please specify other sources of income?.....

1.7 What is your annual average income?..... (In KES)

1.8 What proportion of your annual income do you allocate to food items? …… (In KES).

D. Household's Socio-Economic and Institutional Characteristics *(Tick where appropriate)*

2.0 Are you aware that high-iron common beans exist?

1=Yes, ☐ 2=No, ☐

2.1 Are you aware that anaemia exists?

1=Yes, ☐ 2=No, ☐

2.2 Are you aware that stunting exists?

1=Yes, ☐ 2=No, ☐

2.3 Are there any pregnant/breastfeeding women at home now?

1=Yes, ☐ 2=No, ☐

2.4 If **yes** in 2.3 How many……?

2.5 Do you have any information concerning the benefits of consuming high-iron common beans?

1=Yes, ☐ 2=No, ☐

2.6 If **yes** in question (2.5) above, what was the source of the nutrition information?

1.	Personal communication i.e., family, friends, fellow consumers	
2.	Nutritional experts (Experts in food, nutrition, and dietetics)	
3.	Mass media i.e., Tv, Radio, magazine, newspaper, Internet, web sites	
4.	Social media i.e., Twitter, Facebook, WhatsApp, texts	

2.7 Do you have any information concerning the certification of food products available in the market?

1 = Yes, ☐ 2 = No ☐

2.8 Do you trust the nutritional claims of high iron common beans? If **yes** proceed to 2.9

1 = Yes, ☐ 2 = No ☐

2.9 On a scale from 1 to 5 how much do you feel you can trust on nutritional claims of high iron bean over normal beans with no credence attributes?

1= to a very small extent/not at all, **2**= to a small extent, **3**= neither to a small or great extent, **4**= to a great extent, **5**= to a very great extent

Levels	**1**	**2**	**3**	**4**	**5**
Trust on nutritional Claims of high-iron common bean					
Trust on nutritional claims of normal common bean					

2.10 Do you trust the institutions certifying bodies of food products? If **yes** proceed to 2.11

1 = Yes, ☐ 2 = No ☐

2.11 On a scale from 1 to 5 how much do you feel you can trust the participatory guarantee system over public certification?

1= to a very small extent/not at all, **2**= to a small extent, **3**= neither to a small or great extent, **4**= to a great extent, **5**= to a very great extent

N. o	**Certification Body**	**1**	**2**	**3**	**4**	**5**
1.	Participatory Guarantee Systems					
2.	Public					

2.12 Do you have any information concerning the availability of high-iron common beans in the market?

1 = Yes, ☐ 2 = No ☐

2.13 If **yes** in question (2.12) above, what was the source of the market information?

1.	Personal communication, i.e., family, friends, fellow consumers	
2.	Nutritional experts (Experts in food, nutrition, and dietetics)	
3.	Mass media, i.e., Tv, Radio, magazine, newspaper, Internet, websites	
4.	Social media, i.e., Twitter, Facebook, WhatsApp, texts	

2.14 Do you belong to any social group?

1 = Yes, ☐ 2 = No ☐

2.15 How frequently do you purchase beans?

1.	Everyday	
2.	Once a week	
3.	Several times a month	
4.	Once a month	

2.16 How frequently do you consume beans?

1.	Once a day	
2.	More than twice a day	
3.	1-2 times a week	
4.	3-5 times a week	
5.	Once a month	

2.17 Do you have beans at home now?

1 = Yes, ☐ 2 = No ☐

2.18 What is the quantity……(kilogram)?

2.19 Where do you source your common beans?

1=Market ☐ 2=Own Production Both ☐

2.20 What is the distance from your area of residence to the nearest common bean market?

……..... (Distance in Kilometres).

2.21 How much time do you spend when moving from your area of residence to the market for common bean?.....(In walking minutes).

Appendix F: Discrete Choice Experiment

4.1 Consumer preference

The following choice cards are designed based on the certified high-iron beans attributes and their levels. For each choice card containing two options of the certified high-iron common bean grains attributes and an opt-out option indicating when a household decision maker would not be willing to choose the alternative. A household decision maker can only select one option from the three choice options. The choice situations will be repeated four times for each household decision maker. At each repetition, the attributes of the certified high-iron common bean grains will be slightly different in each choice card. This choice experiment aims to determine the optimal option for certified high-iron common bean grains.

PROFILE 1

Choice set 1

Attributes	**Option 1**	**Option 2**	**Neither 1 nor 2**
Private Certification	No	Yes	
Labelling approach	Voluntary	Mandatory	
Level of processing	Precooked beans	Low	
Public Certification	Public	PGS	
Price	280	310	
Which of the following certified high-iron common bean grains attributes do you prefer?			

Choice set 2

Attributes	**Option 1**	**Option 2**	**Neither 1 nor 2**
Private certification	No	Yes	
Labelling approach	Mandatory	Voluntary	
Level of processing	Precooked beans	Low	
Public certification	PGS	Public	
Price	280	250	
Which of the following certified high-iron common bean grains attributes do you prefer?			

Choice set 3

Attributes	Option 1	Option 2	Neither 1 nor 2
Private certification	Yes	No	
Labelling approach	Voluntary	Mandatory	
Level of processing	Precooked beans	Low	
Public certification	Public	PGS	
Price	280	310	
Which of the following certified high-iron common bean grains attributes do you prefer?			

Choice set 4

Attributes	Option 1	Option 2	Neither 1 nor 2
Private certification	No	Yes	
Labelling approach	Mandatory	Voluntary	
Level of processing	Low	Precooked beans	
Public certification	PGS	Public	
Price	280	310	
Which of the following certified high-iron common bean grains attributes do you prefer?			

PROFILE 2

Choice set 1

Attributes	Option 1	Option 2	Neither 1 nor 2
Private certification	Yes	No	
Labelling approach	Mandatory	Voluntary	
Level of processing	Precooked beans	Low	
Public certification	PGS	Public	
Price	310	280	
Which of the following certified high-iron common bean grains attributes do you prefer?			

Choice set 2

Attributes	Option 1	Option 2	Neither 1 nor 2
Private Certification	No	Yes	
Labelling approach	Voluntary	Mandatory	
Level of processing	Low	Precooked beans	
Public Certification	PGS	Public	
Price	310	280	
Which of the following certified high-iron common bean grains attributes do you prefer?			

Choice set 3

Attributes	Option 1	Option 2	Neither 1 nor 2
Private Certification	No	Yes	
Labelling approach	Voluntary	Mandatory	
Level of processing	Low	Precooked beans	
Public Certification	Public	PGS	
Price	310	250	
Which of the following certified high-iron common bean grains attributes do you prefer?			

Choice set 4

Attributes	Option 1	Option 2	Neither 1 nor 2
Private Certification	No	Yes	
Labelling approach	Mandatory	Voluntary	
Level of processing	Low	Precooked beans	
Public Certification	Public	Public	
Price	250	310	
Which of the following certified high-iron common bean grains attributes do you prefer?			

PROFILE 3

Choice set 1

Attributes	**Option 1**	**Option 2**	**Neither 1 nor 2**
Private Certification	Yes	No	
Labelling approach	Mandatory	Voluntary	
Level of processing	Low	Precooked beans	
Public Certification	Public	PGS	
Price	250	310	
Which of the following certified high-iron common bean grains attributes do you prefer?			

Choice set 2

Attributes	**Option 1**	**Option 2**	**Neither 1 nor 2**
Private Certification	No	Yes	
Labelling approach	Mandatory	Voluntary	
Level of processing	Precooked beans	Low	
Public Certification	Public	PGS	
Price	250	280	
Which of the following certified high-iron common bean grains attributes do you prefer?			

Choice set 3

Attributes	**Option 1**	**Option 2**	**Neither 1 nor 2**
Private Certification	Yes	No	
Labelling approach	Mandatory	Voluntary	
Level of processing	Low	Precooked beans	
Public Certification	PGS	Public	
Price	280	250	
Which of the following certified high-iron common bean grains attributes do you prefer?			

Choice set 4

Attributes	Option 1	Option 2	Neither 1 nor 2
Private Certification	Yes	No	
Labelling approach	Voluntary	Mandatory	
Level of processing	Precooked beans	Low	
Public Certification	PGS	Public	
Price	250	280	
Which of the following certified high-iron common bean grains attributes do you prefer?			

PROFILE 4

Choice set 1

Attributes	Option 1	Option 2	Neither 1 nor 2
Private Certification	No	Yes	
Labelling approach	Mandatory	Voluntary	
Level of processing	Precooked beans	Low	
Public Certification	Public	PGS	
Price	310	250	
Which of the following certified high-iron common bean grains attributes do you prefer?			

Choice set 2

Attributes	Option 1	Option 2	Neither 1 nor 2
Private Certification	No	Yes	
Labelling approach	Voluntary	Mandatory	
Level of processing	Low	Precooked beans	
Public Certification	PGS	Public	
Price	280	310	
Which of the following certified high-iron common bean grains attributes do you prefer?			

Choice set 3

Attributes	Option 1	Option 2	Neither 1 nor 2
Private Certification	Yes	Yes	
Label	Mandatory	Voluntary	
Level of processing	Low	Precooked beans	
Public Certification	Public	PGS	
Price	310	280	
Which of the following certified high-iron common bean grains attributes do you prefer?			

Choice set 4

Attributes	Option 1	Option 2	Neither 1 nor 2
Private Certification	Yes	No	
Label	Mandatory	Mandatory	
Level of processing	Low	Precooked beans	
Public Certification	Public	PGS	
Price	280	250	
Which of the following certified high-iron common bean grains attributes do you prefer?			

Appendix G: Contingent Valuation Procedure

5.1 Willingness To Pay

Imagine you are purchasing high-iron common dry beans at your local market. You can choose between two types of high-iron common beans. One is high-iron common beans that have not been certified and you cannot ascertain that they contain high amounts of iron. There is another common bean that has been certified high-iron common and it has been ascertained it is high-iron common bean. Imagine that you are in a market purchasing certified high-iron common. You will be asked a purchase 1 kilogram of certified high-iron common bean grains whose price will be somewhere in the range of 220 KES and KES 330.

a) Would you be willing to purchase certified high-iron common bean grains if they were offered at the same market price as non-certified dry common beans?
   1) **Yes** (go to b) 2. **No** ()

b) Would you be willing to buy certified high-iron common bean grains if they were offered at a price of more than the non-certified common beans? (1) **Yes** (2) **No** (*Circle response*)

c) If **yes**, how much premium would you be willing to pay? Please randomly pick the premium bids at which you are willing to purchase them.

Premium bids offered	**Amounts in KES**	**Yes**	**No**
10%	242		
20%	264		
30%	286		
40%	308		
50%	330		

d) Why are not you willing to buy high-iron common beans at a lower price……

Appendix H: Contingent Ranking Experiment

6.1 Consumer preferences for market outlets

6.2 Which is your most preferred purchase place for high-iron common beans? Rank from the most preferred to the least preferred.

Description of the market Outlets

Supermarkets; A self-service store that offers a large variety of foods, household products, and beverages. These foods can be highly processed, refrigerated, and frozen.

Open air market; This is a traditional retail outlet that is characterized by the sale of merchandise over the counter, offering a limited variety of brands, unprocessed staples, other features include offering in small packaging, and individual ownership of the respective outlet.

Cereal stores; This is a retail outlet that is characterized by the sale of a wide variety of cereals in both a processed and unprocessed state.

Tele-based Outlet; This is market outlet where a household decision maker rings or messages their preferred retailer to send them a given quantity of certified high-iron beans.

Purchase Outlets	**Rank**
Supermarket	☐
Open air market	☐
Cereal shops	☐
Telebased outlet	☐

You should not provide the same rank for two or more purchase places.

6.3 On a scale from 1 to 4 what are your perception regarding the following in making purchase outlet decision.

1= Unimportant, **2**= Slightly Important, **3**= Important, **4**= Very Important

1=Not Convenient, **2**= Slightly Convenient, **3**= Convenient, **4**= Very Convenient

	1	**2**	**3**	**4**
Pricing				
Product freshness				
Shopping hours convenience				
Service Quality				

Appendix I: Focus Group Discussion Tool

7.1 Introduction

The respondents for this Focus Group Discussion shall be a small group of 6 – 8 household decision makers found in the market places of West-Pokot sub-County.

Objectives

The main aim of the focus group discussion is to obtain some general information on to reach a consensus on the most relevant attributes that matter most to consumers when choosing certified high-iron common bean grains. These attributes may encompass various aspects, including taste, nutritional content, price, and certification, labels. The information gathered from the Discussion will be kept confidential and will only be used for purposes of understanding what attributes consumers value can inform marketing strategies and product development. Everyone's opinions are very important and you are all encouraged to participate fully in this discussion. The discussion will require about 1 hour to complete. I now request your permission to begin the discussion.

Facilitator: ……...

Date of the discussion……...

Location of the discussion……...

Questions for discussion

i. What kind of beans are grown in this area?.....

ii. What kind of beans are found in the markets in this area?.....

iii. Do you consider differentiating different varieties of beans a problem in the market?.....

iv. Suppose certified high-iron beans was introduced in the market what kind of attributes high iron common beans or characteristics do you believe are crucial that consumers would consider? the attributes should be specific, measurable, and relevant to the common beans in question…….....

v. Which of the features you have mentioned should be made compulsory (a MUST) for every one? …….....

vi. Which ones could be optional? …….....

vii. What about Origin, Grading, Cooking time, freshness …….....

viii. What are the possible levels for each of these features? .....

ix. What are about the following levels of these features?.....

x. Are there any attributes that are highly debated or need further clarification ?.....

Attributes	Definition of attributes	Levels
Additives	Use of additives such as preservatives to enhance shelf life	Yes and no
Label	Provision of information on nutritional contents of high-iron common beans	Yes and no
Level of processing	High processed common beans that need not to be cooked and low processed that need to be cook	High and Low
Certification	Which institution should inspect and certify the High iron common beans	Public and PGS
Price	Price of certified high iron common bean per Kilogram in KES	250, 280, 310

xi. What are your thoughts on the proposed attributes?

…….....

xii. Each member of the group will be given four choice situations to consider and make choices individually?

…….....

xiii. What was the experiences with the choice tasks? Were the choices easy or difficult to make?.....

xiv. While you were making choices, were you comparing all the features or were there specific features that you were looking for? ……..……...

xv. Are there any features that you ignored? …….....

Thank you for participating

Conclusion

Thank you for your valuable input in selecting attributes for the certified high-iron common bean grains choice experiment. Your expertise and insights are crucial to the success of this project. We look forward to the next steps and working together to make this research a success.

Appendix J: Key Informant Interview Tool

The main aim of the key informant interview is to obtain some general information on to reach a consensus on the most relevant attributes that matter most to consumers when choosing certified high-iron common bean grains. These attributes may encompass various aspects, including taste, nutritional content, price, and certification, labels. The information gathered from the interview will be kept confidential and will only be used for purposes of understanding what attributes consumers value can inform marketing strategies and product development. Your opinion is very important. The interview will require about 1 hour to complete. I now request your permission to begin the interview.

Date …….....

Location: (Indicate: County, sub-County, ward) …….....

Name of Key Informant …….....

Occupation of key informant…….....

i. What kind of beans are sold/found/grown in West Pokot region? …….....

ii. At what price are these beans sold? .....

iii. What does it cost to certify or process beans? .....

iv. What would you say are the most preferred attributes for certified common beans among consumers? .....

v. What would you say are the most disliked attributes for certified common beans among consumers? .....

vi. Is the market meet demand for the processed common bean?.....

vii. How has the demand for processed common bean been changing over the years?.....

viii. What opportunities exist to increase consumer demand for processed common bean? …….....

ix. What potential threats or challenges could impede efforts to increase consumer demand for processed common beans?.....

Thank you for participating

Appendix K: Publication Abstract for Objective One

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Consumer preference and willingness to pay for certified high-iron beans among urban households in West Pokot County, Kenya

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ABSTRACT

Enhancing transparency in the food system through product certification assures consumers to make informed nutritional choices. A choice experiment was conducted to evaluate household decision makers' preferences for certified high iron common beans. A stratified multistage sampling technique was adopted to select 384 respondents, and data was collected using a pretested semi-structured questionnaire. Mixed logit model results showed households had a positive preference for certification of high iron common beans by public bodies and mandatory labelling but a negative preference for highly processed high iron beans and the certification conducted by a private body. Age and education were identified as heterogeneous factors. Relative to the prices of uncertified Nyota high-iron beans, households were willing to pay premiums for public certification and mandatory labelling but required discounts for highly processed and high iron beans certified by a private body.

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Appendix L: Publication Abstract for Objective Two

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CONSUMERS' WILLINGNESS TO PAY FOR CERTIFIED HIGH IRON BEANS

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Abstract

This study surveyed household decision makers to determine the willingness to pay (WTP) a premium price for certified high-iron common beans and the underlying determinants in the urban areas of West Pokot County, Kenya. The data were collected from 384 respondents selected through a stratified multistage sampling technique using a pretested semi structured questionnaire. A one-and-one-half bounded contingent valuation method was utilized to assess WTP. The data were analyzed in R Software. Household decision makers were willing to pay an average price premium of Kenya Shillings 281 per kilogram. WTP was significantly influenced by age, the proportion of monthly income allocated to food items, access to nutrition information, relative trust in nutritional claims, relative trust in certification agencies and awareness of food certification. Interventions for implementing lower pricing and enhancing the trust and awareness levels of public certification agencies could be appropriate. Prices may gradually be raised once trust and familiarity with high iron common beans, have diffused among consumer segments.

Keywords: *Food certification; high-iron common beans; urban consumers; willingness to pay*
Jel Codes: *D12, D91, R20*