ECONOMIC DETERMINANTS OF HOUSEHOLD INCOME FROM FARM GATE DRY MAIZE GRAIN SALES AMONG SMALL-SCALE MAIZE FARMERS IN KEIYO NORTH SUB-COUNTY, KENYA

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DECLARATION AND APPROVAL

Declaration by the student

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DEDICATION

I dedicate this academic work to my sponsor, Prof. Henrietta Moore, and the entire Structural Health Monitoring (SHM) Foundation team, as well as my family members, for their support and encouragement. I say a big thank you!

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ABSTRACT

The growth rate in the agricultural sector has been slow in recent times, as shown in the national governments' bulletins on the performance of various agricultural sub-sectors. Farm gate maize prices have been unstable and sometimes fluctuate to levels too low to cover farmers' production costs, sparking much debate. This has exposed maize farmers in Keiyo North Sub-County to skewed pricing mechanisms that sometimes work against them. Therefore, this study was conducted to examine the economic Determinants of household income from farm gate dry maize grain sales among small-scale maize farmers in Keiyo North Sub-County, Kenya. The specific objectives were to determine how socioeconomic, marketing, institutional, and pricing factors affect household income among small-scale maize farmers. The study was guided by the Random Utility Maximization (RUM) theory, and both descriptive and cross-sectional research designs were used. Data was collected from a sample of 232 small-scale maize farmers out of a target population of 4,107 farmers, using a multi-stage sampling technique. Data collection was done with questionnaires and analyzed using descriptive and inferential statistics. Multiple Linear Regression was employed to analyze objectives one to four. Descriptive results showed that 46.9% of the small-scale maize farmers were aged 41 to 50 years. About 31.13% had attained primary education. Further, 41.51% had between 5 and 10 years of farming experience. The average land size under maize was 2 acres. The mean annual maize output per acre was 41 bags, with an average of 33 bags sold. The average price of a 90 kg bag of maize was Ksh 2,993. Over half (57.55%) of the farmers belonged to groups, 50.47% had access to extension services, 67.92% did not access credit, and 78.77% had access to market information. The regression analysis on socio-economic factors revealed that age, education level, and land size were statistically significant at the 1% level, with positive coefficients of 0.604, 0.782, and 0.308, respectively. Farming experience was significant at the 5% level with a positive coefficient of 0.329. Marital status and family size were significant at the 5% and 1% levels, with negative coefficients of 0.281 and 0.098, respectively. The analysis of marketing factors indicated that maize output and maize price were significant at the 1% level, with positive coefficients of 0.003 and 0.015. Regarding institutional factors, group membership, credit access, and extension access were significant at the 1% level, with positive coefficients of 2.723, 2.999, and 1.595. Pricing factors showed that maize sales and maize price were significant at the 1% level, with coefficients of 0.001 and 0.018. Access to market information was significant at the 5% level, with a positive coefficient of 0.282. Consequently, the researcher concluded that improving farmer education and strengthening household farming skills through extension services would increase maize production and, ultimately, household income. Additionally, increasing market information would help farmers sell their maize at favorable prices, and allocating more land for maize cultivation could boost output, thereby improving farmers' welfare through higher income. Improving road infrastructure would also help farmers access markets more easily, lower transportation costs, and leave more money in their pockets.

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ADC	Agricultural Development Corporation
ARCH-M	Autoregressive Conditional Heteroscedastic in Mean
ASDSP	Agriculture Sector Development Support Programme
CGAIR	Consortium of international Agricultural research centres
CIDP	County Integrated Development Plan
CRE	Correlated Random Effects
EAC	East African Community
FAO	Food and Agriculture Organization of the United Nations
FAO-AMIS	Food and Agriculture Organization-Agricultural Market Information System
FAOSTAT	Food and Agriculture Organization Statistics
GDP	Gross Domestic Product
IFAD	International Fund for Agriculture Development
IITA	International Institute of Tropical Agriculture
KNBS	Kenya National Bureau of Statistics
MAI	Mean Annual Increment
MOA	Ministry of Agriculture
MT	Metric Tonne
NCPB	National Cereals and Produce Board
NACOSTI	National Commission for Science, Technology and Innovation
SDG's	Sustainable Development Goals
SHM	Structural Health Monitoring
SSA	Sub Saharan Africa
USD	United States Dollar
USDAFAS	United States Department of Agriculture Foreign Agricultural Service

DEFINITION OF TERMS

Dry Maize Grain: refers to the dried maize grain to a less than 15% moisture content for longer storage period and reduce conditions favourable for pest and disease infestations

Farm Gate Price: this is the price of dry maize grain at which small scale farmers in Keiyo North sell to middlemen and it is normally lower than the market price

Maize price heterogeneity: refers to the variability or diversity in the prices at which maize is bought or sold within a particular market or geographical area. This means that different farmers may receive different prices for their maize produce, even though they are selling the same commodity.

Household Income: These are the returns that a farmer gets from the sale of dry maize grain produce in Keiyo North Sub county in a certain defined period of time having employed the factors of production.

Price variability: refers to the fluctuation or changes in the price of maize over a specific period of time. Maize farmers experience price variability as the market demand and supply dynamics, as well as other external factors, influence the price they receive for their maize produce.

Costs of maize production: refers to the costs of all the inputs involved in maize production

Small-scale farmers: Farmers growing maize on less than 2 acres of land.

Socioeconomic characteristics: refers to the small-scale farmer factors and includes gender, age, education qualification, sex of household head, and farm size of the small-scale farmers.

CHAPTER ONE
INTRODUCTION

1.1 Overview

This chapter presents the background of the study, statement of the problem, general and specific objectives, research questions, justification, significance, scope, limitations, and assumptions of the study.

1.2 Background Information of the Study

Maize (Zea mays) originated from the Andean region of Central America, and it is one of the significant cereal crops for both human and animal consumption, Food and Agriculture Organization Statistics (FAOSTAT, 2014). Maize is the third preferred traded cereal worldwide after wheat and rice. Its production is estimated to be 828 million tonnes. Different varieties are used for human consumption, animal feed, and as input for industrial processing and manufacturing, and therefore, this cereal crop has successfully spread around the globe with particular relevance in Latin America and Sub-Saharan Africa (Abbassian, 2007).

In terms of production, the United States is the largest producer, producing 42% of the total maize production in the world (Food and Agriculture Organization, FAO, 2015). It is one of the world's leading crops cultivated over an area of about 142 million hectares with a production of 637 million tons of grain (FAOSTAT, 2014). In the second half of the twentieth century, steady progress was made in increasing per capita maize availability in the world (Food and Agriculture Organization, 2009). However, despite the increase in maize production, hunger and food insecurity are still major problems that beset the world (Garratt, 2015).

In 2017, global maize production added up to 1.04 billion tonnes, of which close to 15 percent were traded on international markets. Over the last few years the global stock-to-use ratio was around 25 percent which had a stabilizing effect on international maize prices (FAO-AMIS, 2017). In 2016/2017, a total of 140 million tonnes (13 percent of total production) of maize were traded internationally, generating an estimated global trade volume of roughly USD 25 billion (USDA FAS, 2017). The United States of America, the Federative Republic of Brazil, the Argentine Republic, and Ukraine are the largest exporters accounting for around 90 percent of

total maize exports. This makes maize the second most traded agricultural commodity after wheat. Overall, maize represents one-third of international cereal trade (FAO-AMIS, 2017).

In Africa, maize production was introduced from the north, across Sub-Saharan Africa, by the Arab traders, as well as along the coast by the Portuguese in the 16th century. It was grown in the Mediterranean of Egypt and thereafter, to the inland areas of western Africa, as argued by Porteres (1955). In Africa, maize occupies approximately 24% of the farmland, and the average yield stagnates at around 2 tons/hectare/year (International Institute of Tropical Agriculture (IITA, 2019). The largest African maize producer is Nigeria, with over 33 million tons, followed by South Africa. The top twenty maize producers in Africa are presented in Table 1.1.

In Sub-Saharan Africa (SSA), the agricultural sector employs up to 70% of the labor force and contributes 65% to Gross Domestic Product (GDP). In the Eastern and Southern parts of Africa, where maize is the most important staple crop and the main source of calorie intake, households receive up to 20% of their income from maize production and spend more than 15% of their total household expenditure on maize alone (Chauvin et al., 2017). Given its significance in production and traditional consumer preferences, total annual consumption ranges between 50 kg and 129 kg per person.

Table 1.1Maize Production in Africa

Country	Production (Tonnes)	Area Harvested	Yield Hg/Ha
Nigeria	7,800,000	4,700,000	16,595
South Africa	7,338,738	2,551,800	28,759
Egypt	7,045,000	868,000	81,163
Ethiopia	4,000,000	1,468,000	27,248
Malawi	3,444,700	1,688,500	20,400
Tanzania	3,400,000	3,000,000	11,333
Kenya	3,240,000	1,600,000	20,250
Mozambique	1,579,400	1,505,400	10,491
Zambia	1,366,158	872,800	15,652
Uganda	1,262,000	844,000	14,952

Source: FAO (2017)

Regionally, Eastern African countries have taken maize production as an important aspect of development. Maize production was introduced in the East African region in the 16th century by the Portuguese, with the main producing countries being Tanzania, Kenya, and Uganda (Miracle, 1965). According to Mutunga et al. (2003) maize production in Eastern Africa is partially disconnected from global trends. This stems from maize's status as a staple food crop in East Africa, where it accounts for nearly half of the calories and protein consumed (Macauley and Ramadjita, 2015). While maize is not as significant component of the Ugandan diet as a staple food crop, it has grown significantly to be a cash crop for income generation and household livelihood. Uganda has taken advantage of its enormous resource for the production of maize commodity within EAC and it has become a leading exporter of white maize to Kenya and other countries in the region. In addition to Kenyan demand and Ugandan supply, a second significant characteristic that shapes the EAC maize market is the prominence of maize flour exports.

In the period 2011-2015, Tanzania, followed by Kenya, were consistently the biggest producers of maize in the region with the former producing 6 million Metric Tonnes (MT) of maize and the latter producing 2.85 million MT in 2015 (Kilimo trust, 2017). In the year 2015, cumulatively, the East African Community (EAC) countries produced 9.89 MT of maize. However, in the same year 2015, the East African Community (EAC) as a region, had a maize deficit of 2.7 MT with Kenya accounting for 82% of the deficit and Rwanda and Burundi to a smaller extent. Although collectively, the EAC is a maize surplus region, the deficit status is caused by inter alia export of maize to more lucrative markets outside EAC such as Congo and South Sudan for Uganda and increasing demand for maize in the animal feeds industry (Kilimo trust, 2017A). According to the same article of Kilimo Trust (2017A), maize consumption in East Africa is mainly concentrated in Tanzania, Kenya, and Uganda.

Maize in Kenya is the major staple commodity; nationally it plays an important role in food security, the feed industry and central crop in agriculture while at the household level maize is both a source of food and income (Gitau and Meyer, 2018). Naseem et al. (2018), argued that maize has been grown in Kenya since at least the 16th century when it was introduced by the Arab traders along the coastal areas. Production was expanded further with the arrival of the European settlers. By the mid-20th century, nearly 44% of agricultural land was under maize

cultivation, a proportion that has not changed much to date. Formal development of the seed industry in Kenya began in the mid-1950s when the colonial government initiated a maize research program in western Kenya (Naseem et al., 2018). Since then, the industry has gone through distinct development phases, including the introduction of the new maize varieties that can be delineated by productivity growth (Naseem et al., 2018). Over time, the Kenyan farmers have been provided with some of the new and alternative maize seed varieties that have enabled them to improve their production. These seed varieties include; ADC 600-23A, KH600-14E, KH 600-15A, KH600–16A, 600–15A, H614D, H6213, H629, H628, H6213, KH 500-33A, WH505 and KH 500-13A. The Kenya Seed Company's popular varieties for medium-altitude zones include H624, H524, H525, and H526. Other varieties include H513, H515, H516, H517, H518, H519, H520, H521, and H522 (Cereal Growers Association, 2019).

Maize is grown by 98 percent of Kenya's 3.5 million smallholder farmers, and in 2012, Kenya produced 3.8 million tons of maize on 2.2 million ha. Small and medium-scale farmers produce about 75 percent of the nation's maize crop, while large-scale farmers (farms over 25 acres) produce the remaining 25 percent. Even though maize is grown in almost all agro-ecological zones in Kenya, the highest productivity is in the high potential and central highland zones, while the lowest productivity is in the lowland regions of Kenya. An inter-zonal variation has been attributed to better soils, rainfall, access to agricultural extension services as well as the adoption of technologies such as hybrid maize and fertilizers (Karanja et al., 1998). However, Kenya has lost its competitiveness in maize production to the neighboring regions due to the high cost of maize production caused by climate change (Nyoro et al., 2004).

The Kenyan government has been intervening extensively in maize markets through trade and marketing policies, even during the so-called liberalization period, and has reinforced its intervention in the last ten years. According to Jayne et al. (2006), only 30 percent of their nationwide sample households in rural Kenya are net sellers of maize, and roughly 50 percent of all the maize sold is from fewer than 3 percent of households. Thus, the increased maize price due to the National Cereals and Produce Board (NCPB) activities has benefited a small number of small-scale maize farmers who are net sellers of maize, as well as large-scale commercial maize farmers. The increased maize price, however, is like a tax imposed on urban consumers

and small-scale maize farmers who are net buyers of maize. Thus, the Kenyan government faces a classic "food price dilemma," where it is pressured to keep maize price high for net maize sellers while it is pressured to do the opposite for urban consumers and net-maize-buyer farmers (Kilimo Trust, 2017).

Prices of maize and products at all levels in the marketing channel were decontrolled fully in 1995. There was a substantial price increase and fluctuation in the post-liberalization era (1994-98). There were wider disparities between the open market prices in deficit and surplus areas (Nyangito, 1997). In 1995, prices offered outside the NCPB were relatively lower (KSh 400 to 550) than the floor price of KSh 600 per 90 kg bag set by NCPB (Nyangito, 1997). Consumer prices showed a similar trend, although they were higher than producer prices, except in 1996 when they were lower. As shown in Table 2, import parity prices increased rapidly from KSh 550 per 90 kg bag in 1992 to KSh 1,190 in 1993. These declined to KSh 1,141 and KSh 798 in 1994 and 1995, respectively, due to large global supplies. Import parity prices rose to KSh 1,376 in 1996. This price movement during these years benefited mainly urban consumers and farmers and consumers in deficit areas. Conversely, producers in surplus areas and consumers in deficit areas suffered. Despite the higher price offered by NCPB, only 36% of marketed maize was sold through this outlet compared to 64% in the private sector. The strict NCPB conditions of 100% clean maize dusted with insecticide, in new bags and with a moisture content of 12% discouraged farmers from selling maize to the Board. Despite the fact that "price" is an important factor in production, marketing, processing, and consumption, there are no proper mechanisms and forums for setting the price of maize. Various stakeholders try to optimise prices through political pressure and noise, threats and advocacy without objective and factual justification for the prices demanded. Indeed, stabilization of producer maize prices remains a big riddle due to instability in production and uncertainty in market outlets (Nyangito, 1997 and 1998; Argwings-Kodhek, 1999a; Nyoro, 1992). Nyangito (1997) has suggested the use of buffer stock, buffer funds and compensation funds to deal with price fluctuation. Argwings-Kodhek, (1998 and 1999a) indicated that the majority of maize producers prefer the liberalised marketing system to the controlled one. The system is easy, free, and payment is prompt. The conclusion is simplistic since preference depends on market condition i.e. seasonal and spatial prices, national and global maize supply and demand levels and other buyers and sellers in the market.

Maize marketing and trade policy in Kenya have been dominated by two major challenges. The first challenge being how to keep farm prices high enough to provide production incentives for farmers while at the same time keeping them low enough to ensure poor consumers have access to food (Mbithi, 2000). The second major challenge has been how to effectively deal with food price instability, which is frequently identified as a major impediment to smallholder productivity growth and income generation (Mbithi, 2000; Mose et al., 2007, and Olwandeet al., 2009). In January 2009, while responding to the food crisis and allegations, the Kenyan government lifted the import duty on maize and allowed importers to buy maize from the international market (Mbithi, 2000). One way to address the food price dilemma is to reduce the farm-market price spread, which measures the price gap between the farm-gate price that farmers receive and the market price that consumers pay (Nyoro et al., 2004). If the farm-market price spread is reduced, maize farmers can receive a higher farm-gate price, while keeping the market price constant (Nyoro et al., 2004). The farm-market price spread can be reduced by reducing the transportation and transaction costs of trading maize through investing in transportation infrastructure and developing competitive market institutions. In normal years, 25-35 percent of total marketed maize is sold directly to the NCPB by medium and large producers. Smallholder producers sell 96 percent of their maize to private traders/brokers or consuming households.

In Elgeyo Marakwet County, agriculture generates revenue for more than 78 percent of the households, mostly through engagement in crop and/or livestock husbandry activities, while more than 80% of the households derive their livelihood from the sector (CIDP 2018). Across the rural Elgeyo Marakwet County, maize is widely eaten as a staple crop, comprising an integral part of the economy and culture of the people. It is most commonly eaten in its milled form, Ugali, which is served as a firm, cooked dish and often becomes the main source of food for those in the most rural of areas. Much of the maize is bought in its grain form and milled locally, as commercial prices can often reach even twice as high as local costs for meal. The local nature of the milling across Keiyo North Sub-County and the high demand for ugali both contribute immensely to the agricultural sector of the economy of the county. According to Elgeyo Marakwet CIDP (2018), the demand for maize within the county exceeded 6 thousand tons, driving much of the need for the milling process required to create Ugali. This was a 6.7%

increase from the previous year and, more importantly, a precursor to the 6% projected growth rate in grain production over the year 2019.

While great demand for personal consumption exists, maize milling could also affect the county on an institutional level, as well. Elgeyo Marakwet County's largest grain trader, private grain buyers, already buy between 40,000-50,000 tons of maize per year from local smallholders (MOA 2019). Yet, even this represents only 5% of the total population of local smallholders (MOA 2019). With such high demand and great need for milling services, Elgeyo Marakwet County has the potential to become a regional grain belt in the larger Economic block of North Rift, Kenya (MOA 2019). Not only is there a possibility that the can become a source of national demand for grain, but also that it could sustain a rapidly growing poultry industry in Elgeyo Marakwet county through its use as feed (ASDSP 2016).

Keiyo North Sub-County produces the highest amount of maize in the Sub-County, accounting for over 60% of the maize produced in the County (MOA 2019). Most of this maize is harvested and sold at the farm gate to maize brokers who would then transport it to markets in Eldoret and other towns as Kisumu, Nairobi, and Mombasa (MOA 2019). The sub-county accounts for 24 tonnes of the maize produced in the county. Over 80% of this maize is from the smallholder farmers (MOA 2019).

Marketing of maize in the sub-county is done by the brokers who buy maize in small quantities and transport it through Vans and small lorries to nearby towns as Eldoret, and sell it to millers or NCPB for strategic purposes (Kilimo Trust 2017). Prices offered depend on the distance where the farmer, the state of the road, the harvest season, among other factors (MOA 2019). This uniform way of accessing farmers' produce has resulted in heterogeneity in dry maize prices across the sub-county.

It’s clear from Table 1.2 on the average annual maize production per acre for 2015-2020 that Keiyo North Sub-County produces more maize per acre than its counterparts, Keiyo South, Marakwet West, and Marakwet East, respectively. This is seen from the number of 90 Kg bags of maize produced per acre per year. Maize does very well in two wards of the Sub-County,

namely, Kamariny and Kapchemutwo, which border Uasin Gishu County, which is known to be one of the main maize-producing counties in Kenya (CIDP 2018).

Table 1.2: Average Annual Maize Production 90 Kg Bag Per Acre, for 2015-2020

Sub-County	2015	2016	2017	2018	2019	2020
Keiyo North	18	20	19	21	19	22
Keiyo South	16	15	16	15	18	15
Marakwet West	12	11	12	15	14	14
Marakwet East	15	14	15	14	13	13

Source: Ministry of Agriculture, Elgeyo Marakwet County, Annual Report (2020)

Instability in the price of dry maize is an important source of risk in Elgeyo Marakwet County. This is particularly true for the poor households in Keiyo North Sub-County of Elgeyo Marakwet. One factor that contributes to the strong link between maize price volatility/variability and risk for the poor Keiyo North households is that they allocate a large share, often more than 60 percent, of their budgets to food, so a given variability in food prices has a large effect on purchasing power (FAO et al. 2014). Retail farm gate maize price in Keiyo North Sub-County varies from month to month throughout the year. Farmers in Keiyo North Sub-County produce maize on a small scale. The majority of the farmers sell their dry maize grains at the farm gate due to various reasons that include paying school fees for their children and defendants and buying basic household goods necessary for daily living (MOA, 2020). They produce in one season and harvest also at the same time due to the prevailing ecological conditions and established weather conditions prevailing in the area (MOA, 2020).

1.2.1 Maize Marketing/Pricing in Keiyo North Sub-County

The selling of dry maize grains in Keiyo North Sub-County is carried out through the various maize marketing channels. However, local maize brokers are the main buyers at farm gate. According to MOA (2020), dry maize price variability has been the norm as was captured during the period 2015 to 2019 cropping season. The current average farm-gate price of a 90 Kg maize bag in Keiyo North Sub County offered by middle men is Kshs. 2300 as opposed to prices between Ksh.2800 and Kshs. 3000 being the selling price by the middlemen who sell to maize millers. Based on this calculation, small holder farmers are losing approximately Kshs. 500 per

90 Kg bag of dry maize after handling and transportation costs have been factored in. The Iten market in the Sub County is unstructured and thus much of the maize is transported to Eldoret market either for milling, storage, or moved to other markets as Nairobi or beyond (MOA 2019). At present, there exists a single market, and the middlemen who came to fill the gap after the fall of the NCPB. The middlemen move the commodity using vans (pick-ups) as they are required to traverse the interior parts of the Sub-County in search of maize (MOA 2019). Maize Markets in the Sub-County include: Iten town, Bugar, and Tambach. Maize prices in these markets exhibit a heterogeneous trend since ecological conditions and distances vary, e.g., in Tambach, prices are at Ksh. 2500 while in Bugar and Iten at Ksh. 2200.

1.2.2 Challenges of Maize Production in Keiyo North Sub-County

The maize sector in Keiyo North Sub-County has faced several challenges that include high cost of inputs, lack of soil sampling, marketing, value addition, competition, pests and diseases, lack of aggregation, and continued land subdivision. Food and nutritional insecurity in the entire county is high, with 73.3 percent of the households being food insecure, and this is worsened by the high poverty levels, which stand at 57% as compared to the national average of 46% (GoK, 2013). About 55% of the county population experiences seasonal food insecurity caused by overreliance on rain-fed agricultural production coupled with poor storage and distribution systems (GoK 2013).

1.3 Statement of the Problem

Small-scale maize production plays an important role in the economy and livelihoods of many rural households in Keiyo North Sub-County (MOA, 2020). According to the Elgeyo Marakwet County Ministry of Agriculture Report (2016), the majority of smallholder farmers produce maize for food and income generation. Keiyo North sub-County is predominantly a maize-growing region in the County, with 90% of the farmers engaging in maize production (MOA, 2020). However, these farmers are located in the interior parts of the sub-county and are forced to sell their dry maize grains to middlemen who fetch low returns due to several factors. Over-reliance on maize by several households for income has exacerbated food and nutritional insecurity in the county, with 73.3 percent of the households being food insecure, and worsened by the high poverty levels, which stand at 57% compared to the national average of 46 % (GoK

2013). This phenomenon has been going on for some time now. According to MOA (2020), dry maize price variability has been the norm in the Sub-County. The average farm-gate dry maize grain price per 90kg bag, as offered by local maize brokers, for the years 2017, 2018, 2019, 2020, and 2021, was Kshs. 2,000, 2,200, 2,600, 2,300, and. 2,100 respectively, depicting an unstable price variability throughout the years. This variability in dry maize grain prices runs across households and in the whole of the Keiyo North Sub-County. On the other hand, the cost of production has maintained a steady upward trajectory that has left many smallholder maize farmers in jeopardy of providing food and earning good incomes to guarantee sustained production of maize. Therefore, planning for investments by households has been hampered, as the prices of maize cannot be determined with certainty after harvesting, which affects the allocation of income to the needs of the farmer. With much effort employed by the County Government and its partners on diversification and productivity, little progress has been made in making farmers realize stable incomes due to heterogeneity in farm gate maize prices (CIDP 2013-2017). The basis on which the yearly price change hinges is not clearly defined, and therefore, there is a need to do more research to demystify this problem. This has resulted in a lot of debate at the farm level, the Sub-County, the County, and at the National level. It is against this backdrop, therefore, that this study sought to investigate the determinants of farm-gate dry-maize grain output on household income among small-scale maize farmers in Keiyo North, Elgeyo Marakwet County, Kenya.

1.4 Objectives

1.4.1 General Objective

The general objective of this study was to analyze the determinants of farm-gate dry-maize grain output on household income among maize farmers in Keiyo North Sub-County, Elgeyo Marakwet County, Kenya.

1.4.2 Specific Objectives

The study was to address the following specific objectives:

(i) To determine the socio-economic factors affecting dry maize grain output on household income among small-scale maize farmers in Keiyo North, Elgeyo Marakwet County,

(ii) To determine the marketing factors affecting dry maize grain output on household income among small-scale maize farmers in Keiyo North, Elgeyo Marakwet County,

(iii) To determine the institutional factors affecting dry maize grain output on household income among small-scale maize farmers in Keiyo North, Elgeyo Marakwet County.

(iv) To determine pricing factors affecting dry maize grain output on household income among small-scale maize farmers in Keiyo North, Elgeyo Marakwet County.

1.5 Hypotheses of the Study

The study tested the following hypotheses;

H_{01}: Socio-economic factors have no significant effect on household income among small-scale dry maize farmers in Keiyo North, Elgeyo Marakwet County.

H_{02}: Marketing factors have no significant effect on dry maize grain household income among small-scale maize farmers in Keiyo North, Elgeyo Marakwet County.

H_{03}: Institutional factors have no significant effect on household income among small-scale maize farmers in Keiyo North, Elgeyo Marakwet County.

H_{04}: Pricing factors have no significant effect on household income among small-scale maize farmers in Keiyo North, Elgeyo Marakwet County.

1.6 Justification of the Study

Dry maize grain at the farm gate has continued to exhibit price variability behavior for a long period of time in Keiyo North Sub-County, with no study having been done to justify this phenomenon. Understanding the importance of dry maize grain pricing factors shall be of great benefit to a majority of small-scale maize farmers in Keiyo North Sub-County and the entire County for their planning purposes. Small-scale maize farmers will be in a position to explain why they are not able to meet their income levels from their maize production, given their optimal production levels. It will also be of benefit to all maize value chain actors in adjusting to the way they handle their businesses in the maize sector.

1.7 Significance of the Study

The study findings and recommendations shall be presented to the national government and the County government of Elgeyo Marakwet to initiate and implement favorable policies in the

future that target dry maize grain pricing levels. This will, in turn, bring out the position of the maize farming business among all maize value chain actors and harmonize the relationship between the maize producers, traders, and consumers, thus encouraging stakeholder participation in maize pricing initiatives. Stable prices will mean that farmers will be carrying out an agribusiness venture that will not only guarantee their stable incomes and livelihoods but also guarantee their prosperity in terms of long-term investments and contribute to the creation of employment, especially in rural areas. Recommendations of the study will have a bearing on reforms and development in the maize sector, especially in the improvement of maize farm gate prices for smallholder farmers. In this way, it will contribute to Kenya's Vision 2030 on the economic pillar that aims at improving the prosperity of all Kenyans through increasing their incomes from their farm products, thus increasing Gross Domestic Product (GDP) from the current 5 percent to 10 percent by 2030. At the local level, small-holding maize farmers are poor because of the low farm gate prices offered to them by the buyers. Social Development Goals (SDGs), Goal 1 and Goal 2 propose to end poverty in all its forms everywhere and end hunger, achieve food security, improve nutrition, and promote sustainable agriculture, respectively, and doing so will transform the lives of small-scale farmers. The study will strive to be an authority on issues of maize farming and farm gate price incentives in its strong recommendations, and so making this thesis a resource in academic frontiers.

1.8 Scope of the Study

This study mainly focused on Keiyo North Sub-County, Elgeyo Marakwet County and the data was collected with the aid of structured questionnaires. The study employed descriptive and cross-sectional survey research designs. A total of 232 small-scale farmers were selected to participate in the study. The study mainly targeted small-scale maize farmers growing maize on 0.1 and less than 2 acres of land. The research work focused on the determinants of farm gate dry maize grain household income among small scale maize farmers in Keiyo North Sub-County, Elgeyo Marakwet County, Kenya. Maize farmers in Keiyo North Sub-County are categorized into large scale maize farmers who grow maize on 5 acres of land and above, medium scale maize farmers practicing maize farming on 2-5 acres of land and small-scale farmer who grow maize on between 0.1 acre and less than 2 acres of land.

1.9 Limitations of the Study

The present study was not free from limitations. According to Best and Khan (2008), limitations are conditions beyond the control of the researcher that may place limitations on the conclusion of the study and its application to other situations. In this study, the first limitation was geographical, owing to the terrain of the region. The researcher had to navigate through the rough terrain of the region in order to be able to collect the data. Secondly, the researcher anticipated encountering non-responsive respondents, but fortunately, all the 98 small-scale farmers selected provided sufficient maize information. Language was not a barrier since the researcher and enumerators understood the local language. However, some respondents were not easily found at home in the morning hours, and enumerators had to interview other farmers, then come back in the afternoon or evening, which was a really time-consuming and tiresome exercise too.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter presents the theoretical literature associated with the present study. It presents the literature review on the social and economic factors affecting maize production, institutional, marketing, and technical issues in maize production, and studies on price heterogeneity, theoretical framework, the conceptual framework, and finally, the knowledge gaps.

2.2. Theoretical Literature

Maize is a staple crop in Kenya and hence bears important implications for poverty alleviation and food security attainment. Maize production, productivity, and profitability are crucial for alleviating food insecurity both at the household and national levels. In the recent past, a lot of factors have negatively affected maize productivity and profitability. Some notable changes in the agrarian sector, macroeconomic challenges, and climate variability are some of the problems that can be blamed for the poor performance of the Kenyan agricultural sector, specifically maize. In the past three decades, the government of Kenya has experienced a decline and unsustainable production. Specifically, the study aims to describe smallholder maize producers in Keiyo North Sub-County and analyze the determinants of household income based on previous studies.

2.2.1Review of Empirical Studies on Maize in Kenya

Maize is one of the most researched agricultural enterprises in Kenya owing to its economic importance as a widely grown crop, the main staple and source of income for the majority of the rural population in the country. Several economic studies have broadly emphasized policy implications occasioned by public policy reforms or biophysical and socio-economic constraints to increased maize productivity in Kenya as shown by the following studies. Nyangito and Ndirangu (1997) investigated farmers' response to market reforms in Trans Nzoia District using descriptive analysis of data collected from 60 small-scale maize farmers and established that maize output decreased by 30 percent largely due to low producer prices prompted by market liberalization. Consequently, interventions to improve predictability and productivity in the maize sub-sector have failed due to emergence of new trade blocks between countries and the

comparative advantage of other maize-producing nations. These included price stabilization policy, increased flow of market information, a floor pricing system that assures minimum returns to farmers, better market and credit access, and government subsidization of prices for key farm inputs. Omamo (1998) analyzed the reasons explaining the observation that farmers continued to grow maize despite its little economic significance in Siaya District using a general agricultural household model adapted to include the cost of trade. The study concluded that households facing prohibitive transport costs in product markets continued to produce maize as a normal substitution strategy for food importation from other areas. The author, therefore, recommended that the improvement of rural infrastructure could reduce the costs of exchange and motivate farmers to specialize in cotton production so as to benefit from the potential positive efficiency effects of reforms in Kenya.

Wangia et al. (2002) reviewed maize marketing in Kenya, tracing the extent of implementation and impacts of liberalization on stakeholders between 1989 and 1999. They established that the implementation of the market liberalization process was unsystematic, occasioning a major vacuum, which was filled by an ill-prepared private sector after the complete withdrawal of the government. This led to price instability for most agricultural produce, which reduced farmers' incentives to increase maize output. The study recommended the formation of farmer marketing organizations, the provision of market information, and credit services.

Marketing organizations would aid the farmers to come together and put their produce together in order to attract buyers; thus, knowledge of cooperative movements here is important. Market information is key since it directs the five questions to be answered by the farmers, these being: what, when, how much, for whom, and how to produce. All these are fundamental to the production of any commodity. Credit services come in handy when capital is needed to run the enterprise. Without capital, enterprises tend to face challenges when it comes to confronting issues requiring finances.

Nyoro (2002) assessed the evolution of maize marketing systems in the post-liberalization period using the Structure-Conduct-Performance framework and established that only 29-34 percent of maize-producing households in Kenya were net maize sellers. For instance, Trans Nzoia District,

one of the key areas for the current study, recorded more than 22- 50 percent, while Vihiga had in excess of 70 percent of households as net maize buyers. This study raised a crucial policy question as to whether most smallholders gained or lost from policies aimed at increasing maize prices. The study concluded that a large section of rural households purchase maize and are, in fact, hurt by higher maize prices caused by inefficient production, soil degradation, or misguided maize support prices. Moreover, the study recommended increased support for the formation of farmer marketing groups, among other policy interventions.

Karanja et al. (2003) analyzed a 15-year of price data using the Autoregressive Conditional Heteroscedastic in Mean (ARCH-M) model with a view to determining the effects of economic reforms on instability of producer prices in Kenya. The findings of the study confirmed that real producer prices for maize decreased significantly due to severe price instability in post-reform commodity prices. While referring to Nyoro et al. (2004) study, Karanja et al. (1998) argued that policies aimed at lowering maize prices in food-deficient rural areas would release vast resources from food systems to be reallocated in other higher return activities for better payoffs. Even though they acknowledged the paradox in concurrently lowering consumer food prices and improving producer prices, they still suggested that greater efficiency levels in production and marketing would not only enhance farm productivity but also lower transaction costs.

Karugia et al. (2003) examined the effects of liberalization on efficiency of the maize marketing system in Kenya using co-integration analysis of data collected from 234 traders in Nairobi, Trans Nzoia, Migori, and Mbeere Districts. The study found that market efficiency was enhanced by liberalization policy, though the opportunity for more efficiency gains depended on the removal of institutional, infrastructural, and policy bottlenecks in maize marketing. The study recommended that the formation of farmer-assisted marketing 23 groups could increase farmers' share of the market price of maize, lower marketing costs, and enhance their access to credit.

Mose et al. (2004) studied the impact of market liberalization on maize production and marketing in Trans Nzoia District and found that declining maize yields could be explained by the trend in competing enterprises at the farm level. The study found that the cultivation of Napier grass for dairy production was increasing at the expense of maize cultivation in the

district. While in agreement with other empirical studies on low maize productivity, the authors again confirmed that more than one-third of farmers in Trans Nzoia District were net buyers of maize grains. The observed trend was blamed on adverse relative prices between maize grains and fertilizers during the post-reform era, leading to sub-optimal use of purchasable inputs at the farm level.

Since the majority of the population in developing countries like Kenya live in rural areas and mainly depend on agriculture as their source of livelihood, participation of these households in agricultural markets is expected to positively affect their welfare outcomes. It is based on this expectation that governments in these countries have promoted policies aimed at ensuring overall commercialization of smallholder agriculture (Siziba et al., 2011; Macharia et al, 2014). These policies are aimed at increasing the ability of smallholder farmers to participate in markets as output sellers and input buyers. Most commonly used policy instruments include producer price supports and import tariffs aimed at increasing producer prices, particularly for the main staple grains. The first assumption in this approach has been that higher producer prices will not only increase the income of producers and subsequently improve their welfare but will also induce a positive supply response in subsequent seasons. Secondly, policymakers pursuing this kind of approach assume that all smallholder farmers are a homogeneous group that will be affected by the policy uniformly.

However, there is little empirical evidence, if any, to support the argument that high producer prices of main staples will improve the welfare of market participating households despite the fact that many developing countries continue to pursue this policy (Jayne et al., 2001). Similarly, agricultural market participation literature has shown that smallholder farmers are heterogeneous with great differences in terms of size, access to markets, agro-ecological conditions, and other characteristics, including their capacity to innovate (Jayne et al., 2001). Therefore, a given policy will affect these farmers differently. For example, in output markets of staple grains, smallholder producers find themselves operating in one of the three market regimes, i.e., either as net sellers, net buyers or autarkic (Goetz, 1992; Bellemare and Barrett, 2006; Barrett, 2008). Net sellers are those who sell in the market more than what they buy. On the other hand, net buyers are those who buy from the market more than what they actually sell. Autarkic are those who are self-

sufficient, or the amount they sell in the market is equal to the amount they buy again from the market. Therefore, the relative position of the households in these market regimes is bound to affect their welfare outcome in response to a given market policy instrument.

While a substantial amount of effort has been directed to understanding factors that determine smallholder participation in markets as sellers per se, little literature exists on why farmers find themselves participating in markets as either net sellers, autarkic, or net buyers. Identifying and analyzing factors that determine households' participation in different market regimes is critical in designing carefully targeted policy interventions to ensure that the majority of rural farmers and even non-food-producing urban consumers benefit from smallholder market participation. While the initial descriptive work of Jayne et al. (2001) elaborated on how high producer prices are detrimental to the majority of smallholder maize farmers in Kenya because the majority of them are net buyers, there has been no quantitatively rigorous analysis of this important issue in Kenya.

2.2.2 The Literature Review on the Socio-Economic Factors

In a study of factors influencing the adoption of protected tomato farming practices, Shadiadeh et al (2012) used multiple regression analysis to examine socio-economic characteristics of the farmers. The study established that family size, farming experience, and level of education influenced the adoption of protected tomato farming practices. Similarly, Singha et al. (2012) used multiple regression analysis to determine the socioeconomic factors influencing technology adoption of different land-based enterprises by farmers. Land size, education level, and annual income were found to influence the adoption of technologies and practices by vegetable and rice farmers. Xaba and Masuku (2013) also used multiple regression analysis in a study in Swaziland to determine factors affecting the productivity and profitability of vegetable production. The study found that the productivity of vegetable farmers was significantly and positively related to selling price and gender. Agwu et al (2012) used multiple regression analysis in a study in Nigeria to estimate the socio-economic determinants of commercialization among smallholder farmers. The study established that household size, income, farming experience, farm size, distance to market, and membership in associations significantly influenced commercialization among the smallholder farmers.

Ngozi et al. (2009), while using multiple regression analysis in a study of diversity and production methods of fluted pumpkin by vegetable farmers in Nigeria, found that plot size had a positive relationship with pumpkin yields. Adebisi-Adelani and Oyesola (2013) used linear regression analysis to investigate socio-economic factors influencing adaptation strategies of horticultural farmers in Nigeria. Income and age were found to be significant. Sani et al. (2014) also used multiple regression analysis to determine socio-economic factors influencing farmers' adoption of dual-purpose cowpea production technologies. Education level, household size, farming experience, and social participation were found to be significant.

In a study in Nigeria, Nwaiwu et al. (2012) used multiple regression analysis to assess socio-economic determinants of the productivity of garden egg producers. Age of the farmer and farm size were major determinants of garden egg productivity. Ayoola et al. (2011) used regression to investigate the socio-economic factors influencing rice production among farmers in Nigeria. Land, farmers' experience, and age were found to influence rice productivity. Wambugu et al. (2010), using a regression model in a study in Western Kenya, found that social capital had a positive effect on the performance of rural producer organizations.

Gender equity is one of the priority areas identified in the Sustainable Development Goals (SDGs). Meinzen-Dick et al. (2011) observed that if gender is not considered in agricultural extension, research, and development systems, it will be hard to increase production so as to meet the demands of future generations. Gender equity in agriculture is a development issue that will benefit men, women, and society at large. Gender differences are important factors for agricultural production, where management and ownership rights are defined by culture. According to a study by Ndinomupya (2010), the educational level of the farmer was found to be significant and positively influencing market choice and participation. This is attributed to the roles such as enhancement of managerial competencies and successful implementation of improved marketing practices that education plays (Marenya and Barret, 2009). The more the education level achieved, the higher the chances of choosing a more profitable marketing channel due to knowledge exposure. Vijay et al. (2009) observed a significant and positive relationship between education and choice of modern milk channels.

Ndinomupya (2010) deduced that farm size determines the quantity of the produce and, therefore choice of the marketing channel. Large farm size increases farmers' propensity to participate in modern markets and provides more grazing land (Hangara et al., 2011). This is because large farm size is considered to be an indicator of wealthier farmers who produce large volumes of milk, implying lower risks in modern market participation (Woll et al., 2008).

2.2.3 Literature Review on Institutional Factors

Access to extension services is an important institutional factor affecting agricultural production. Ayinde et al. (2010) in their study in Nigeria stated that those accessing extension advice enable farmers to get first-hand information on new agricultural innovations and techniques that would ensure increased sorghum production in Nigeria. Furthermore, Haile et al. (2018) argue that advisory services rendered to households can help them improve their average performance in the overall farming operation as the service widens the household's knowledge concerning the use of improved agricultural inputs and agricultural technologies. Agricultural extension policy in Kenya has suffered the following setbacks: aging and reduced staffing and funding for operations, lack of participatory technology development, and poor packaging and information dissemination. The policy lacks the capacity to control conflicting messages to the farmers, such as unnecessary competition, duplication of efforts, and general lack of synergy among these extension providers in Kenya (Kibbet et al., 2005).

Kenya's experience of using unsuccessful approaches to deliver services to farmers has taught policymakers that in order to be effective, extension agents should avoid top-down planning and implementation of interventions to farmers' problems in favor of demand-driven and farmer-led, participatory approaches. These include Farming Systems Approach, Rapid Rural Appraisal (RRA), Participatory Rural Approach (PRA), Focal Area Development Approach (FADA), and Farmers' Field Schools (Kibbet et al., 2005).

Access to credit is an important institutional factor affecting agricultural production. According to the study by Nchare (2007), credit reduces the financial difficulties farmers face at the beginning of the crop year, thus enabling them to buy inputs and to have resources to prepare their land on time before planting. In Nchare's study on the analysis of factors affecting the

technical efficiency of Arabica coffee producers in Cameroon, results showed that access to credit had a negative influence on technical inefficiency (Nchare, 2007). According to Oladeebo and Oladeebo (2008), the availability of adequate and timely credit helps farmers in expanding the scope of operation and adoption of new technology, as well as enhancing the purchase and use of some improved inputs that are not available on the farm.

Access to finance is essential for the further development of maize farming enterprises: for example, successful marketing depends upon the purchase of containers for processing and packaging of products. Credit is necessary for maize farming associations running collection centers, buying products from producers, and selling on in bulk. However, significant financial assets are not essential for maize farming at the subsistence level. A good maize farming project will work to ensure that all available capital assets are taken into consideration, without dependence on any that are not. For example, too many projects have depended on the importation of the beeswax foundation used in frame hives: this is impossible for beekeepers without financial assets (Bourdieu, 1984).

In poor societies, a lack of credit is a major constraint to everyone concerned with selling and buying maize. Beekeepers with maize to sell expect to receive cash from the maize-collection center or private-sector traders; otherwise, they prefer to sell their maize in small quantities in markets to obtain an instant but low cash return. People buying maize need access to credit during the maize season. Lack of credit leads to insignificant volumes of maize available for sale, no interest from traders, and a stagnant industry (Nahapiet, 1998).

Membership in a SACCO or a farmers group is among the institutional factors that play a crucial role in helping small-scale farmers to succeed in their quest to engage in a profitable venture. Farmers' organizations help them to participate in group activities, as they may tend to share ideas on profitable enterprises and adopt them as well as engage in market activities of input acquisition or selling of produce, and thereby improve their profits. Consequently, organized farmer groups are promoted as useful avenues for increasing farmer productivity and for the implementation of food security and other development projects (Lenis, 2012).

Mburu et al. (2007) found that membership in farmer marketing organizations influences farmers' choice of marketing channel. Similarly, membership in a farmer group significantly determines participation in modern markets (Vijay et al., 2009). Farmer organizations such as cooperatives are very vital in market adoption and participation because they enable farmers to make necessary investments (Artukoglu and Olgun, 2008). These investments help farmers to obtain quality produce, access financial resources, farming practice education, and marketing information that enable them to venture into innovations.

2.2.4 Literature Review on Marketing Factors

Distance to the market translates into market accessibility and ease of output transfer by market actors (time taken to reach the nearest urban market). This has a direct impact on the volume of agricultural produce farmers avail to the market. Alene et al. (2008) found a negative relationship between the quantity supplied and distance to the market, implying that as the distance increases away from the farm, there is a decline in the transacted quantities by farmers. Omiti et al. (2009) concluded that distance to the market significantly reduces the percentage of milk sold, particularly in the rural areas. This reflects the influence of transaction costs in terms of distance and cost of information. They further confirmed the role of marketing costs as a hindering factor to market supply volumes.

Access to market and availability of market are bound to reduce marketing costs on matters such as transport and other transaction costs, and offer a favorable price for mushrooms (Wachira, 2012; Anyiro and Oriaku, 2011). Market access may be analyzed in terms of the distance in kilometers to the market, reflecting the marketing costs that one incurs in the course of accessing the market and thus thought to have a negative effect on productivity as it reduces the profits that might be obtained from marketing farm outputs (Wachira, 2012). Marketing of a commodity is an important part of every production process. No production can be called economic until it reaches the consumer and the producer gets their share of the consumer's rupee. It normally implies physical transfer of goods along with economic transfer of goods (Beetz and Kustudia, 2004).

Transport affects agricultural marketing because it is the only means by which farmers can transport their produce to the market. Poor road infrastructure in the rural areas has resulted in low productivity, low income, and a fall in the standard of living of rural residents and a high rate of poverty (Aloba 1986). When the distance of the farm to the market is far and the road is rough, perishable crops may be destroyed and farmers may run at a loss. It is against this background that this study examines the impact of road transport on agricultural production in Ilorin East Local Government of Kwara State, Nigeria. Improvement of rural roads results in elimination of frequent road closures during rainy seasons, reduction in vehicle operating costs, and increased traffic volume, ownership of motorized vehicles, access to market and social services, and improvement in passenger services (World Bank,1996).

Villages with Good road infrastructure have a significantly improved situation in terms of agricultural production and incomes compared to the villages with poor road infrastructure (Raisuddine and Hossain,1990). The improvements of feeder roads, bridge construction, and rural road routine and spot maintenance result in increased participation of vendors at local markets, increased variety of available agricultural products, and the geographic size of markets for agricultural products (Lucas et al, 1990). Good road accessibility significantly reduces farm gate prices of manufactured goods and increases farm gate prices of agricultural goods (Torbjorn and Bharat, 2012).

Head loading can play a considerable role in the marketing of agricultural produce. Siebe (1999) observed in Makete in Tanzania that more people used a footpath to travel to a local market than by vehicle on a comparable road. Some villages preferred to transport a large proportion of their produce by walking instead of selling it to traders with trucks. This is because the traders would pay them less than they receive at the market. A foot path improvement in Makete was found to reduce travel times, increase transport loads, and reduce accidents. This caused stronger market integration and reduced rural isolation. Siebe (1999), however, found out that transport by walking is restricted by the weight carried or distance to market if more than a half-day walk is involved.

Households with poor access to roads are confronted with wider price bands and are less likely to participate in markets, so policies towards integrating remote areas with urban areas through infrastructure development are needed (Torbjorn and Bharat, 2012). This raises speculations that the poor road network, among other factors, could be contributing to huge price fluctuations in Giaki Location. Provision or improvement of transport services results in a reduction of transport cost and /or travel time, which in turn leads to increased production. Similarly, Bhalla (2000) argued that the marginal cost decreases as a result of improved transportation. In line with this, improving transport in Giaki Location will likely raise the profit margins of the sorghum farmers. World Bank (1994) terms transport as one of the factors of production. Local farmers of Giaki Location may benefit from the improvement of roads because of the reduction in the cost of transporting agricultural products to markets.

2.3 Literature Review on Technical Issues or Factors Affecting Maize Production

It has been widely anticipated that agricultural technology development and adoption would trigger a "Green Revolution" in Africa. Unfortunately, the large increases in yield and production that characterized the "green revolution" in Asia are yet to be witnessed in Sub-Saharan Africa (see Adekambi et al., 2009). This makes it imperative to investigate why the large yield increases associated with improved seed varieties and/or inorganic fertilizer at the experimental plot level have not been replicated in the farmers' fields. Consequently, a number of studies have traced the impact of improved technologies on crop yield at the farm level.

In Kenya, most of the previous studies that have evaluated the impact of improved technologies on yields have relied on experimental data. For example, the Fertilizer Use Recommendation Project (FURP) studied 70 sites across the country in the early 1990s in conjunction with the Kenya Maize Database Project (MDBP). Kenya Agricultural Research Institute has also conducted many trials at its experimental stations. Both FURP and KARI used experimental approaches, but their results were significantly different. Yield levels recorded by FURP were 50% lower than those recorded by KARI. Hassan et al. (1998) thus combined experimental data generated by FURP with survey data to evaluate the impact of inorganic fertilizer use on maize yield. They observed that optimal use of fertilizer would lead to about 30% rise in yields. In the same vein, Duflo et al. (2003) used a controlled field experiment in western Kenya to test the

yield change attributable to top-dressing fertilizer. They noted a yield rise ranging between 28% and 134% for two cropping seasons.

De Groote et al. (2005), using an econometric approach, analyzed the maize green revolution in Kenya using farm-level surveys between 1992 and 2002. They found that the intensity of fertilizer use had a major effect on maize yield. However, the use of improved maize varieties did not have any effects on the yields, an indication that some local varieties could perform as well as the improved varieties in some areas. The yield-enhancing effects of fertilizer and improved maize varieties are confirmed by Owino (2010), who used experimental data in the Trans Nzoia District. Owino further noted that the yields varied with different improved varieties, fertilizer types and intensity, and management practices.

Marenya and Barrett (2009), in an interesting study of fertilizer interventions in Western Kenya, found that fertilizer application is beneficial to farmers with high soil organic matter (SOM). The implication is that plots with poor, degraded soils limit the marginal productivity of fertilizer. The finding suggests that fertilizer interventions are not very helpful for poorer farmers who largely cultivate soils deficient in SOM. Suri (2011), using a dataset similar to ours, also found that not all farmers benefit from fertilizer use, despite the presence of high average returns. These findings challenge conventional wisdom and call for further work, especially among the poor who require multiple inputs in response to a new technology. Understanding the distribution of yield as a result of the use of multiple technologies and varying farmer efficiency levels is important for policy design and targeting. This approach is especially important for understanding the results of new technologies on farms that are actually worked by farmers, which is a different situation from evaluating results in a highly monitored field experimental plot. Mobile phones have a greater impact on price dispersion across markets. The impact is bigger where traveling costs are higher, especially in rural areas connected by unpaved roads. A study by Jensen (2007) in Kerala, India, found that mobile phone coverage alone led to significant market efficiencies: the difference in prices across markets declined, as did waste; fisher's profits increased by 9% and consumer prices declined by 4%. Another study done by Japan International Cooperation Agency (JICA) in Uganda on the banana market found that mobile phone coverage rose information flows and encouraged farmers 'market participation

(especially for those living furthest from markets) (Yamano and Muto, 2009). Similarly, a study by Alker (2008) in Niger on the effect of mobile phone service penetration on grain markets found reduced market price dispersion across markets by 10%. The study also found that grain traders began trading in more markets once they had mobile phones, had more market contacts, and their profits increased by 29%.

Farmers in the Kinangop region of Kenya using M-Farm, a mobile phone marketing application for collective selling, are said to have received more than double the price for certain types of produce (such as snow peas and sugar snap peas) than what they got for them when they were selling them individually. The feedback from farmers using the service has revealed that access to current market information has given them a transparent bargaining platform to use when selling individually to brokers or middlemen (Woodard, 2012).

2.4 Review of Farm Gate Maize Price

The maize market in general is characterized by a variety of marketing arrangements. Since the liberalization of the marketing system, several private sector entrepreneurs have joined the various parts of the maize supply chain. These entrepreneurs include companies that are active in regional maize grain trading, informal cross-border traders, produce agents, small and medium millers, transporters, wholesalers, and retail stores. Virtually all the domestic transactions made by these players are spot market and cash-based. They sell the maize grain in l00kg bags without any grading and premium prices for quality produce. However, for milled maize, there are three major grades. The flour is sold in kilograms, and prices differ by grade (Jones, 2007).

A typical maize supply chain was noted to have the following shortcomings: This supply chain has too many participants, with many speculative traders and agents who make the movement of maize time-consuming. There is normally over oversupply of maize during the harvest season as farmers and traders have no stores. Participants' competition reduces as one goes up the chain. No clear flow of market information. Transactions are 'on spot' market and cash-based. The markets are thin and volatile in terms of prices, trading volumes, and liquidity. The marketing arrangement is not well developed, leading to inadequate market outlets, high transaction costs and minimal value addition (Anderson, 2002).

According to Minten (2010), maize farming in Africa has faced serious challenges that have led to the overall decline in the quantities of maize produced. However, Africa is a suitable region for maize farming given the suitability of the climatic conditions of the area, but the lack of knowledge on the right practices of maize farming has led to a decline in trends, especially in the quantities of maize produced. Rural livelihoods in many areas depend on the viability of maize production as a commercial crop. On the other hand, the food security of the growing urban population and many rural households who are buyers of maize depends on keeping maize prices at tolerable levels. For many years, policymakers have attempted to strike a balance between these two competing objectives: how to ensure adequate returns for domestic maize production while keeping costs as low as possible for consumers. Maize marketing and trade policy have been at the center stage of debates over this food price dilemma, including discussions over the appropriateness of 23 trade barriers and the role of government in ensuring adequate returns to maize production (MOA, 2009).

2.5 Review of Maize Marketing Studies

The implementation of the liberalization of maize marketing was a major component of the economic recovery program (ERP) in the 80s and 90s. The EEC and World Bank supported the Cereal Sector Reform Program (CSRP). The liberalization was further supported by USAID under the KMDP from 1989, although significant implementation started in 1993. Implementation of the liberalization process by the Government during the 1990s was gradual and on course. This was because of the donor condition of tying donor lending and support to liberalization (Nyangito, 1998; Argwings-Kodhek, 1999b; KMH, 2009). For the same reasons, the reforms are still intact, although the Government, through the NCPB, has tended to renege on a number of issues as reviewed below.

The removal of controls of maize movement was politically acceptable to the GOK and was fully and gradually implemented over three years. Until 1988 the limit was one 90 kg bag of maize. This was increased to ten 90 kg bags in 1989/90, then to forty-four in 1990/91, eighty-eight bags in 1991/92 and complete decontrol after 1993 (Gordon and Spooner, 1992; Nyoro 1992; Omamo, 1998; Argwings-Kodhek, 1992). There was mass media publicity by the GOK utilising funds from KMDP (GOK, 2009). A special campaign was targeted at District Administration

and police to ensure that they did not interfere with the movement of maize within and outside their districts. As a result, there were more market outlets, improved distribution and availability of maize in all parts of Kenya (Mutahi, 1996; Nyangito, 1997 and 1998; Nyangito and Ndirangu, 1997; Argwings-Kodhek, 1998). Argwings-Kodhek (1998) reported that 59% of Kenyan households reported better availability of maize in the post-liberalization era, 31% in the pre-liberalization era, and 10% saw no change in availability. On the convenience of selling maize, 88% of the households preferred the present system, 7 % the old system, and 5% saw no change. Overall, 61% of households prefer the present system, 34% the old system, and 5% saw no change.

A key impact on the maize market of deregulating maize movement was the reduction in the costs of transportation since economies of scale were realized with larger volumes (Omamo, 1998). In addition, the number of private sector participants and fair competition increased substantially. This also improved income redistribution in the country. However, the strict conditions of delivering to the NCPB discouraged farmers from selling maize to the Board. De-control of Prices of Maize. Figure 3 shows the movement of maize prices paid to farmers by the NCPB before and after the decontrol, 1976- 1996. Prices of maize and products at all levels in the marketing channel were decontrolled fully in 1995. There was a substantial price increase and fluctuation in the post-liberalization era (1994-98). There were wider disparities between the open market prices in deficit and surplus areas (Nyangito, 1997).

In 1995, prices offered outside the NCPB were relatively lower (KSh 400 to 550) than the floor price of KSh 600 per 90 kg bag set by NCPB (Nyangito, 1997). Consumer prices showed a similar trend, although they were higher than producer prices, except in 1996 when they were lower. As shown in Table 2, import parity prices increased rapidly from KSh 550 per 90 kg bag in 1992 to KSh 1,190 in 1993. These declined to KSh 1,141 and KSh 798 in 1994 and 1995, respectively, due to large global supplies. Import parity prices rose to KSh 1,376 in 1996. This price movement during these years benefited mainly urban consumers and farmers, and consumers in deficit areas. Conversely, producers in surplus areas and consumers in deficit areas suffered. Despite the higher price offered by NCPB, only 36% of marketed maize was sold through this outlet compared to 64% in the private sector. The strict NCPB conditions of 100%

clean maize, dusted with insecticide, in new bags and with a moisture content of 12% discouraged farmers from selling maize to the Board.

Despite the fact that "price" is an important factor in production, marketing, processing, and consumption, there are no proper mechanisms and forums for setting the price of maize. Various stakeholders try to optimize prices through political pressure and noise, threats, and advocacy without objective and factual justification for the prices demanded. Indeed, stabilization of producer maize prices remains a big riddle due to instability in production and uncertainty in market outlets. (Nyangito, 1997 and 1998; Argwings-Kodhek, 1999a; Nyoro, 1992). Nyangito (1997) has suggested the use of buffer stock, buffer funds, and compensation funds to deal with price fluctuation. Argwings-Kodhek (1998 and 1999a) indicated that the majority of maize producers prefer the liberalized marketing system to the controlled one. The system is easy, free, and payment is prompt. The conclusion is simplistic since preference depends on market conditions, i.e., seasonal and spatial prices, national and global maize supply and demand.

2.6 Theoretical Framework

The study adopted a random utility maximization theory. The farm household seeks to maximize utility subject to its limited resources and with a trade-off in its goal of minimizing risk. It does this by treating off-farm investment just like any other on-farm investment; it will only invest if the present value of the benefits of the investment exceeds the present value of the associated costs of the investment (Mishra and Morehart, 2001). Given that the farmer is usually capital-constrained, the farmer will choose the investment with the highest net present value (NPV). The NPV of the off-farm investment is as shown in equation 2.2.

$$NPV = \int_{i-0}^{T} e^{-rt} (R_t - C_t)dt \quad \text{.....} \quad (2.2)$$

Where T is time, r is the discount rate, $R_t$the expected net returns of the investment and C_t represents the expected costs of the investment. Economic research into risk attitudes is based on a set of axioms proposed by Von Neumann and Morgenstern (1947) and later developed by others. The axioms are used to demonstrate that an individual's risk attitude can be inferred if the preference ordering and distributional properties of the risky prospect are known.

The smallholder maize farmer is assumed to maximize their utility function subject to farm production and cash flow constraints. An implicit assumption is that the small-scale maize farmer household behavior is primarily the result of purposeful, rational decisions designed to provide the greatest possible level of satisfaction for household members, given the available resources. It is known that farmers' decision of supplying one market or another is categorized as a function of a set of incentives and capacity variables that allow the fulfillment of technological requirements. The farmer or producers behave like neoclassical firms that control the transformation of inputs into valuable outputs to maximize profits (Varian, 1992). The decision on whether or not to adopt a new technology is considered under the general framework of utility or profit maximization (Norris, 1987; Pryanishnikov and Katarina, 2003). Rural households may be producers and consumers of both marketed and non-marketed commodities, and they may or may not participate in a labour market. The household is assumed to maximize its utility function subject to a production function and time and income constraints.

It is assumed that economic agents, including smallholder subsistence farmers, use certain diversified cropping systems only when the perceived utility or net benefit from using such a method is significantly greater than it the case without it. Again, small-scale maize farmers are assumed to be rational and they want to derive the highest utility from the choices they make, either to participate in crop diversification independently or not. They make their choices with respect to random utility theory, which states that a decision maker is guided by unobservable, observable, and random characteristics when making decisions. Although utility is not directly observed, the actions of economic agents are observed through the choices they make. This study formulated participation in diversified food cropping system choice decision as a two-alternative choice (participation in diversified food cropping system = 1 and not participating (growing sugarcane crop) = 0).

Let a decision maker choose from a set of mutually exclusive alternatives, j = 1, 2…, J. The decision maker obtains a certain level of utility $U_{ij}$from each alternative. The discrete choice model is based on the principle that the decision-maker chooses the outcome that maximizes the utility. The producer makes a marginal benefit-marginal cost calculation based on the utility achieved by diversifying to a particular food crop or to another. His/her utility is not observed,

but some attributes of the alternatives as faced by the decision-maker are observed. Hence, the utility is decomposed into deterministic (V_{ij}) and random (ε_{ij}) part:

$$U_{ij} = V_{ij} + \varepsilon_{ij}; \forall_{ij} \in N \text{……………………………………………………………… (2.3)}$$

Since $\varepsilon_{ij}$is not observed, the decision-makers' choice cannot be predicted exactly. Instead, the probability of any particular outcome is derived. The utilities (or the difference between benefit and cost) cannot be observed directly, but the choice made by the producer reveals which one provides the greater utility (Greene 2003). A producer selects market channel j=1 if;

$$U_{ik} > U_{ij} \forall_j \neq k \text{……………………………………………………………………….. (2.4)}$$

Where U_{ik} denotes a random utility associated with a particular crop enterprise j=k, and V_{ij} is an index function denoting the producer's average utility associated with this alternative. The second term, ε_{ij}, denotes a random error which is specific to a producer's utility preference. Now, suppose that Y_i and Y_j represent a household's utility for two diversified food crop enterprises, which are denoted by U_i and U_j, respectively. In the linear random utility model, the diversified food crop enterprise choice is modeled as in equation 2.5.

$$U_{ij} = \beta_j X_{ij} + \varepsilon_{ij} \text{………………..……………………………………………………...… (2.5)}$$

Where U_{ijis} is a vector of participation in diversified food crop enterprise choices (j = 1 diversified food crop enterprises; and 0 not to diversified crop enterprise, i.e., to continue growing sugarcane crop) of i^{th} small-scale maize farmer, β_{jis} is a vector of participation in diversified food crop enterprise. ε_{ijis} the error term assumed to have a distribution with mean 0 and variance 1 and identically distributed (Greene, 2003). X_{ijis} the vector of explanatory variables that determines and or influences the perceived desirability of participation in the diversification of food crop enterprise. Therefore, for the case of participation in diversified food crop enterprise choice, if a small-scale maize farmer decides to use option j crop, it follows that the perceived utility or benefit from option j crop is greater than the utility from other options (say k) depicted as shown in equation 2.6.

$$U_{ij}(\beta_j^1 X_i + \varepsilon_j) > U_{ik}(\beta_k^1 X_i + \varepsilon_k), k \neq j \text{…………....…………………………..…………….. (2.6)}$$

The probability that a small-scale maize farmer will choose crop enterprise j among the set of diversified food crop enterprise choice instead of the k sugarcane crop could then be defined as shown in equation 2.7.

$P(Y = 1|X) = P(U_{ij} > U_{ik})$……..……...…….…… (2.7)

Therefore,

$P(\beta_j^1 X_i + \varepsilon_j - \beta_k^1 X_i + \varepsilon_k > 0|X$……..…….……..…….……. (2.8)

Hence $P(\beta_j^1 X_i - \beta_k^1 X_i + \varepsilon_j - \varepsilon_k > 0|X)$

$P(X^* X_i + \varepsilon^* > 0|X = F(\beta^* X_i)$…….,,. (2.9)

Where; P is a probability function, Uij, Uik, and Xiare as defined above, ε* = εj –εkis a random disturbance term,$\beta^* = (\beta_j^1 - \beta_k^1)$is a vector of unknown parameters that can be interpreted as a net influence of the vector of independent variables influencing the participation in diversified food crop enterprise choices, and$F(\beta^* X_i)$is a cumulative distribution function of the error terms (ε*) evaluated at $\beta^* X_i$. The exact distribution of F depends on the distribution of the random disturbance term, ε*. Depending on the assumed distribution that the random disturbance term follows, several qualitative choice models can be estimated (Greene, 2003).

2.7 Conceptual Framework

A Conceptual framework is typically derived from a theory (Leshem & Trafford, 2007). It identifies the concepts included in a complex phenomenon and shows their relationships. The relationships are often presented visually in a flow chart, web diagram, or other type of schematic representation (Glatthorn& Joyner, 2005).

The model shows that farmers have different social-economic factors which together with the different farm production characteristics (technical factors) interact with marketing and institutional factors hence influencing the level of household income. In this study, variables that affect household income have been highlighted since they are decision making units (DMUs) of the small-scale maize farmers.

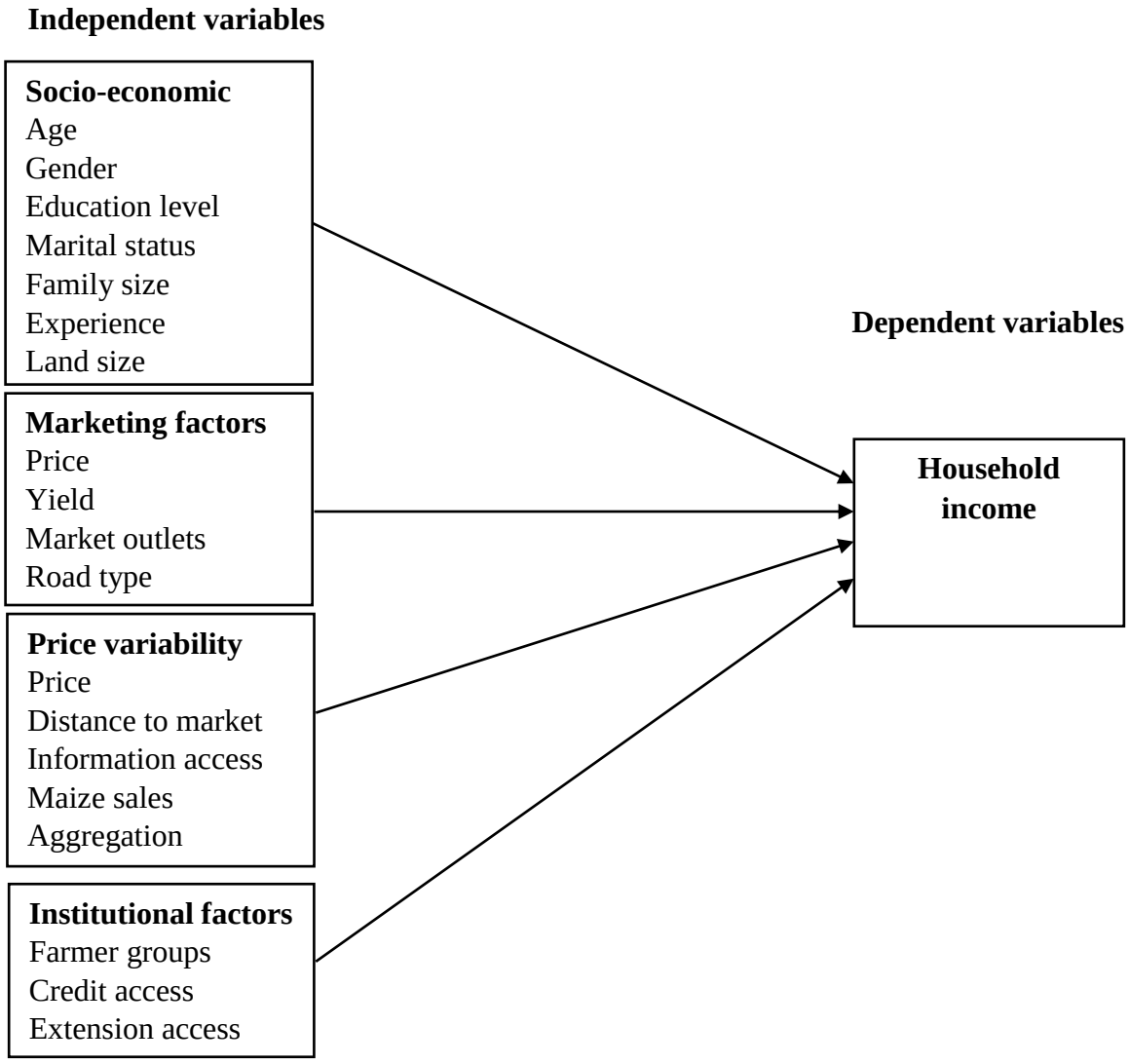

Figure 2.1Conceptual Framework

Source: Author's conceptualization, (2024)

2.9 Identification of Knowledge Gap

Maize production in the study area has been misconstrued to mean provision of food security and partly income for the households for a very long time, yet most of these small farms have been utilized fully for maize production. Dry maize grain prices have been plummeting to levels too low to provide meaningful returns to the small-scale farmers for their produce. Despite efforts by the County Government and farmers to form groups and marketing cooperatives to enhance their livelihood capacities, little has been achieved as far as good and stable prices are concerned. Various studies have pointed out areas of weakness and possible causes of these weaknesses to no avail; thus, this study endeavored to unravel the theories surrounding the problem of

variability in dry maize grain prices that more often leads to variability in household incomes in Keiyo North Sub-County, Elgeyo Marakwet County.

CHAPTER THREE
RESEARCH METHODOLOGY

3.0 Introduction

This chapter presents the study area, research design, target population, sample size determination, sampling procedure, data types, instruments of data collection, validity and reliability of the instruments, pre-test pilot study, data analysis techniques, theoretical models, model specifications, diagnostic tests, definition of variables, and ethical consideration.

3.1 The Study Area

The study was conducted in Keiyo North Sub-County, Elgeyo Marakwet County, Kenya, as shown in Figure 2.2. The Sub-County is situated at a latitude and longitude between 0.5248°N to 0.6437°N and 35.5057°E to 35.5924°E, respectively. The altitude ranges between 1500 and 2000 meters above sea level and is characterized by distinct ecological zones of highlands and valleys with an annual mean temperature of 18°C – 22°C in the highland and 25°C- 28°C in the valley. The area receives a mean annual rainfall of between 700 and 1700 mm from the months of March to October of the year. According to the Census of 2019, the sub-county's population was 107,109 with a population density of 198 square kilometers (KNBS, 2019).

The sub-county is subdivided into four wards, namely Kapchemutwa, Tambach, Kamariny, and Emsoo. The study area is 80 percent arable, with many areas having fertile black cotton soil. The Sub-County produces both food and cash crops that vary with the agro-ecological zones. The major food crops include maize, beans, wheat, bananas, green grams, groundnuts, sorghum, millet, and cowpeas. Horticultural and industrial crops include Irish potatoes, avocado, passion, mangoes, tea, coffee, and pyrethrum (CIDP 2018-2022). Livestock farming is also practiced in the study area. Cattle (both dairy and beef), goats (Small East African goats, Toggenburgs, and Alpine dairy goats), sheep (Dorper and local breeds), and poultry are the main livestock found in the Sub-County.

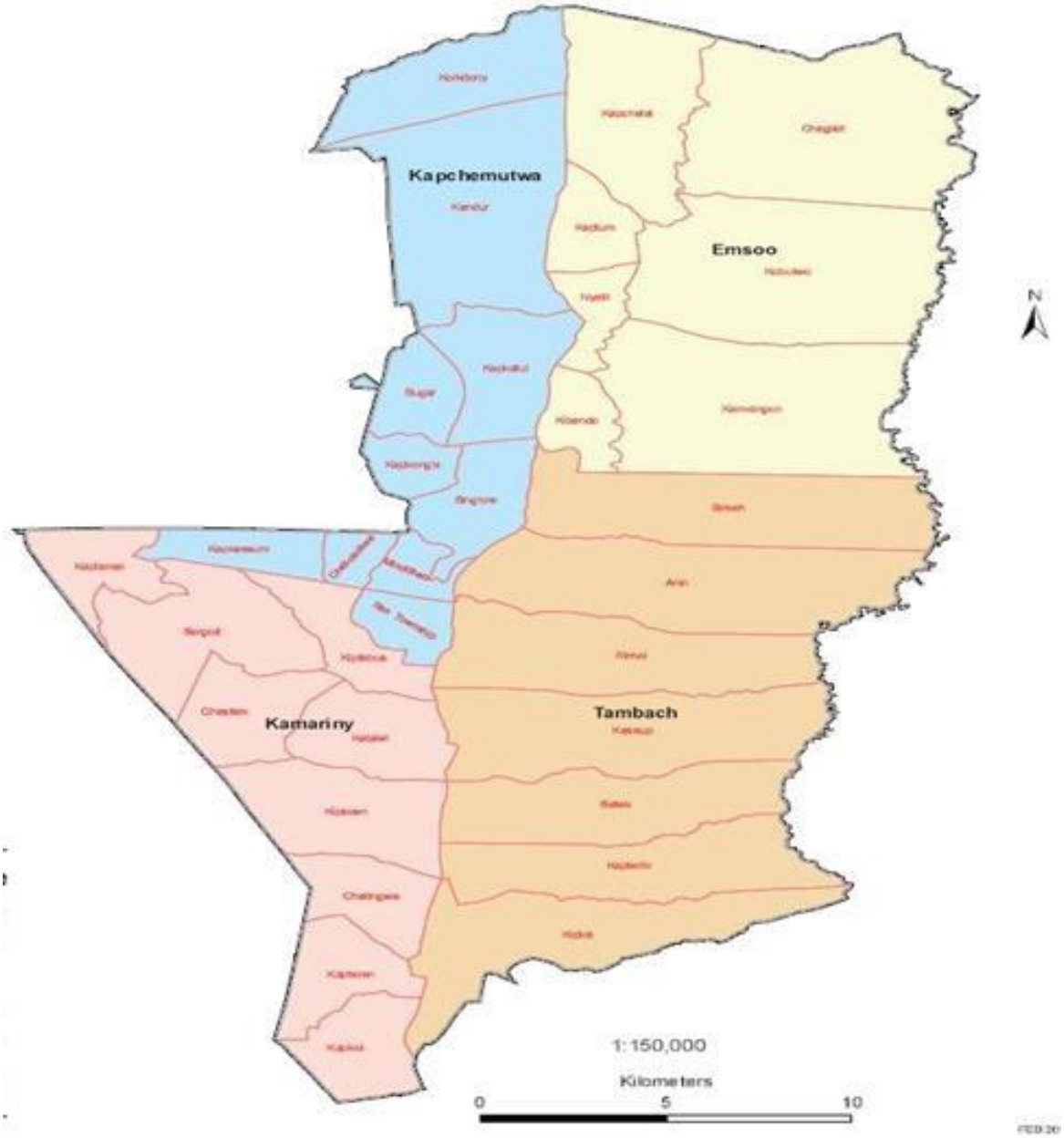

Figure 3.1Map of Keiyo North Sub-County

Sources: Elgeyo Marakwet (CIDP, 2018).

3.2 Research Design

The study adopted descriptive and cross-sectional survey designs. The major purpose of descriptive research design is to provide information on characteristics of a population or phenomenon (Mugenda & Mugenda, 2003). The descriptive research design was preferred because it is concerned with determining the frequency with which a factor determines an

outcome or the relationship between variables (Bryman& Bell, 2011). A cross-sectional survey was used for this study because it employs a single point of data collection for each participant, it is cheaper to undertake compared to a longitudinal survey, and the results from the sample are extrapolated to the larger population.

3.3 Target Population

A target population is a group of individuals taken from the general population sharing a common characteristic, such as age, sex, or health condition (Kombo and Tromp, 2006). According to MOA (2020), Keiyo North Sub-County has a total of 4,107 small-scale maize farmers within the four wards. The respondents for this study were the small-scale maize farmers, particularly those who plant maize and sell dry maize grains at the farm gate. Therefore, the distribution of the 4,107 small-scale maize farmers in the four wards of Kamariny, Emsoo, Tambach, and Kapchemutwo of the sub-county was as shown in Table 3.1.

Table 3.1: Population of small-scale maize farmers in Keiyo North Sub-County

S/NO	Ward	Target Population
1	Kapchemutwa	1074
2	Tambach	969
3	Kamariny	1144
4	Emsoo	920
Total		**4,107**

Source; MOA, Elgeyo Marakwet County, (2020).

3.4 Sample Size Determination

The sample size used in this study was determined by the Mugenda and Mugenda (2003) formula, as shown in Equation 3.1.

$$n = \frac{Z^2pq}{d^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.1)$$

Where: n = desired sample size (if the target population is over 10,000),

Z = the standard normal deviation at the required confidence level,

d = the level of statistical significance set,

p = the proportion in the target population estimated to have characteristics being measured,

q = 1 – p.

The proportion in the target population assumed to have the characteristics of interest, as recommended by Fisher et al is = 50%. However, for our case we considered 80% proportion of the target population. The z-statistic is 1.96 and the desired accuracy level is = 0.05.

Therefore, using the formula, we obtain a sample size of 384 respondents.

$$n = \frac{1.96^2(0.8)(0.2)}{(0.05)^2}$$

$$n \cong 246$$

Given that the target population is less than 10,000. Therefore, the actual sample size will be;

$$n_f = \frac{n}{1 + \frac{n}{N}} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (3.2)$$

Where: n_f = desired sample size (when population is less than 10,000), n = desired sample size (when population is more than 10,000), N = the estimate of population size.

$$n_f = \frac{246}{1 + \frac{246}{4107}}$$

$$n_f \cong 232$$

Therefore, from the above calculations, a total of 232 small-scale maize farmers formed the required sample size and were used for data analysis in this study.

3.5 Sampling Procedure

The study employed a multi-stage sampling technique that combined purposive, stratified, proportionate, and simple random sampling techniques. In the first stage, Keiyo North Sub-County was purposively selected as the study area due to its dominance in terms of maize production in Elgeyo Marakwet County. In the second stage, a stratified random sampling procedure was used to obtain the sample of small-scale maize farmers in the whole sub-county. The area under study has four administrative wards, which form the three strata for this study. In the third stage, a proportionate size sampling procedure was used to pick respondents for the study from each ward, as shown in Table 3.2. Thereafter, lists of smallholder maize farmer households from each ward were obtained from the sub-county Agricultural Office. The names

of the farmers in the lists was first serially numbered and then randomly ordered and picked using a simple random sampling technique.

Table 3.2: Proportionate Distribution of small-scale maize farmers

S/NO	Ward	Target Population	Proportion (%)	Proportionate size sample	Target Sample
1	Kapchemutwa	1074	26%	0.26	60
2	Tambach	969	24%	0.24	56
3	Kamariny	1144	28%	0.28	65
4	Emsoo	920	22%	0.22	51
Total		**4,107**			**232**

Source: Author's Computation (2024)

Random sampling was required to ensure that the sample is representative of a larger underlying population. To select small-scale farmers using this method, the study generated random numbers within the range 1 – 351 in Excel using the formula: =rand between (351). A farmer was then selected when the random number fell within their cumulative sample range, thus making the probability of his/her selection proportionate to the sample size of the ward. Continuous generation of random numbers by pressing the F9 key until the desired number of farmers were selected from each ward. If a random number fell within an already selected farmer, it was simply continued pressing F9 until a random number that fell for another farmer in a village within the sample range was found.

Table 3.3: Table of Probability of Small-Scale Farmers' Selection

Ward	Cumulative Sample	Target Sample
Kapchemutwa	60	60
Tambach	116	56
Kamariny	181	65
Emsoo	232	51
Total		**232**

Source: Author's Computation (2024)

3.6 Data Types and Sources

Primary and secondary data were used in this study. Primary data was collected directly from the small-scale maize farmer household heads through self-administered questionnaires by enumerators. Primary data that was collected included small-scale maize farmers' socio-economic characteristics, pricing factors, marketing, and institutional factors that contribute to the incomes earned by the households.

Secondary data was collected through a literature review. A review of books, journal articles, unpublished study documents, ministry of agriculture databases, the National Cereals and Produce Board (NCPB) databases, other official reports of relevant quality, and internet sources economic journals, statistical abstracts, conference reviews, books, magazines, national and county development and strategic plans, National Bureau of Statistics publications, desktop literature, and the internet sources.

3.7 Data Collection Instruments

Primary data was obtained using questionnaires. The questionnaire was made up of closed-ended questions. The closed-ended questions were preferred because of the listed options that were to measure the socio-economic, pricing, and institutional factors. According to Saunders et al. (2012), the closed or structured questions provide simple results and are generally easier to evaluate. Well-trained enumerators were employed to help administer the questionnaires to the farmers through interviews.

3.7.1 Validity of Research Instruments

Validity refers to the extent to which a research tool measures what it is expected to measure (Kimberlin and Winterstein, 2008). It is the degree to which the outcomes of a test are acceptable. To ensure that the results obtained from this study meet all the credentials of scientific research, the instruments were presented to experts from the Department of Agriculture Economics and Rural Development at the University of Eldoret. They were able to ascertain the validity by the clarity of wording and whether the respondents were able to interpret all questions similarly. Their comments were incorporated into the instrument.

3.7.2 Reliability of Research Instruments

Kothari (2008) refers to reliability as the degree to which scores obtained with an instrument are consistent. The instrument should return the same measurements when it is used at different times. Therefore, for this study, the reliability of the instrument was determined by pre-testing the instrument with a sample of 9 respondents in Metkei ward and in Keiyo South Sub-county. Data from the pilot study was analyzed using Cronbach's Alpha coefficient, mathematically expressed as shown in equation 3.3. Adjustments were then made where necessary on the questionnaire to increase its reliability.

$$a = \frac{N\bar{c}}{v+(n-1)\bar{c}} \quad \text{..... (3.3)}$$

Where $a$is the Cronbach's Alpha coefficient, $\bar{c}$is the average inter-item covariance among the items, is the average variance, and N is equal to the number of items/observations. After calculating the Cronbach's Alpha coefficient for this study, the reliability coefficient results are shown in Table 3.4 using the questionnaire. A coefficient of 0.724 was found, which showed that the data collection instruments were reliable.

Table 3.4: Interview Schedule Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items
0.724	0.737	9

Source: Author's Computation (2024)

3.8 Data Collection Procedures

The researcher sought a letter from the Directorate of Postgraduate Studies, University of Eldoret, to conduct the study. The enumerator-administered questionnaires were preferred over questionnaire administration to give respondents enough time to seek clarification and guidance in responding to questions. The researcher sought the help of research assistants, well conversant with the four wards, to help with the administration of questionnaires.

3.9 Data Analysis and Presentation

Before processing the responses, the completed questionnaires were edited for completeness and consistency. The data was then coded to enable the responses to be grouped into various categories and corresponding tables. Data was then analyzed with the help of STATA software.

Descriptive statistics, such as frequencies, percentages, mean score, and standard deviation, were computed for all the quantitative variables and information presented in the form of tables and graphs. Regression analysis was used to establish the existence of significant relationships among variables in the study area.

3.10 Specifications of Empirical Models

3.10.1 Estimates of Socio-Economic Factors Affecting Household Income

Objective (i) of the study was analyzed using a multiple linear regression model. This model presumes the existence of a linear relationship between the dependent variable, independent variables, and latent variable. It was modeled as shown in Equation 3.4 and as adopted from Brown (2009).

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.4)$$

Where Y is the household income,

X_1= Age,

X_2= Gender,

X_3= Education Level,

X_4= Marital status,

X_5= Family Size

X_6= Years of experience,

X_7= Land size

$\beta_0$to$\beta_7$are the regression coefficients and ε is the error term that is normally distributed with a mean of zero and constant variance of sigma squared, ~N (0, σ2).

3.10.2 Estimate of Marketing Factors Affecting Household Income

A multiple regression model was also applied for this case, as it entailed estimating the effect of market knowledge on household income (multiple independent variables versus a single dependent variable). The dependent variable was household income, while the independent variable was marketing factors with the following measurable: Maize Price, Maize Volumes, Market outlets, Road type. The regression model was:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.5)$$

Where Y is the household income,

X_1 = Maize price,

X_2 = Maize Volumes,

X_3 = Market Outlets,

X_4 = Road type.

β_0 to β_4 were the regression coefficients and $\varepsilon$is the error term that is normally distributed with a mean of zero and constant variance of sigma squared, *~N (0, σ^2).*

3.10.3 Estimate of Institutional Factors Affecting Household Income

A multiple regression model was also applied for this case, as it entailed estimating the effect of institutional factors on household income (multiple independent variables vs a single dependent variable). The dependent variable is household income, while the independent variable is institutional factors with the following measurables: Farmer Groups (Membership to cooperative society), Access to credit, and Access to Extension service. The regression model will thus be:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$……...……. (3.6)

Where Y is the household income,

X_1= Farmer Groups,

X_2= Access to credit,

X_3= Access to Extension service

$\beta_0$to$\beta_3$are the regression coefficients and ε is the error term that is normally distributed with a mean of zero and constant variance of sigma squared, *~N (0, σ^2).*

3.10.4 Estimate of Pricing Factors Affecting Household Income

For the fourth objective, a multiple regression model as specified in Equation 3.3 was also used to estimate the effect of pricing factors on household income. As such, household income forms the dependent variable as it is responsive to farm gate pricing factors. Therefore, the regression model assumed the form shown in Equation 3.6:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon$……...…… (3.7)

Where Y is the household income

X_1= Price,

X_2= Distance to the market,

X_3= Access to market information

X_4= Sales volume,

X_5= Aggregators

$\beta_0$to $\beta_5$are the regression coefficients and $\varepsilon$is the error term that is normally distributed with a mean of zero and constant variance of sigma squared, ~N (0, σ2).

3.11 Diagnostics Tests

Diagnostic tests were conducted from the regression results of the analyzed data. Diagnostic test results provided information on how these raw data are modeled. When a model is estimated, diagnostic tests on model residuals yield information about model adequacy (Mahmood and Saad, 2018). In this study, a multicollinearity test was performed to check for correctness of the estimates of the variables using the Variance Inflating Factor (VIF) as shown in Equation 3.8. It is the most widely used measure with independent variables. The formula is as shown below, as adopted from Marquardt (1970).

$$VIF(X_i) = \frac{1}{1 - R_i^2} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (3.8)$$

Where R_i^2 the coefficient of determination is obtained when X_i is regressed on all other predictors in the model. The Variance Inflating Factor of 1 indicates that there is no correlation between the independent variable and any others. VIFs between 1 and 5 suggest that there is a moderate correlation, but it is not severe enough to warrant corrective measures. VIFs greater than 5 represent critical levels of multicollinearity where the coefficients are poorly estimated, and the p-values are questionable.

3.12 Definition, Measurement of Variables, and Expected Signs

The operational framework helped in summarising the determinants of farm gate dry maize grain output of small holder farmers in Keiyo North sub-County. It showed how the variables are accountable to farm gate prices. The variables were presented in a tabular form as indicated in Table 3.5. Table 3.5 shows the variables that were used in this study and their measurements. The positive (+) sign means an increase in the variable causes an increase in household income

level, while a negative (-) sign means an increase in the variable causes a decrease in household income level.

Table 3.5: Description, Measurement and Expected Signs of Variables

Variable	Description	Units	Expected sign
Dependent variable			
Household income	Continuous	Kenya shillings	
Independent variables			
Age	Categorical	Years	+/-
Gender	Categorical	Male/Female	+/-
Education level	Categorical	Non-formal/Primary / Secondary/Tertiary/ University	+/-
Marital status	Categorical	Single/Married	+/-
Family size	Continuous	Numbers	+/-
Experience	Categorical	Years	+/-
Land size	Continuous	Acres	+/-
Maize price	Continuous	Kenya shillings	+/-
Distance to market	Continuous	Kilometres	+/-
Yield	Continuous	No. of 90kg Bags	+/-
Maize sales	Continuous	No. of 90kg Bags	+/-
Information access	Categorical	Yes/No	+/-
Aggregation	Categorical	Yes/No	+/-
Farmer groups	Categorical	Yes/No	+/-
Credit access	Categorical	Yes/No	+/-
Extension access	Categorical	Yes/No	+/-
Market outlet	Categorical	NCPB/Broker/Miller/other	+/-
Road type	Categorical	Earth, murram, Tarmac	+/-

Source: Author's Computation, (2024)

3.13 Ethical Considerations

A research permit was obtained from the National Commission for Science, Technology, and Innovation (NACOSTI) through an introductory letter from the Board of Post-Graduate Studies, University of Eldoret. The permit was then presented to the Sub-County Agricultural Officer in the Ministry of Agriculture, Livestock and Cooperative Management, and the Sub-County Commissioner responsible for data collection in the Sub-County for permission to collect data from the small-scale maize farmers. The small-scale maize farmers were fully informed about the procedures involved in the process, and they were assured of the confidentiality of the information they provided, including their personal information. They were to remain anonymous throughout the study, and even to the researcher himself, to guarantee the needed

privacy. The small-scale maize farmers were guaranteed that the provided information would not be made available to anyone who was not taking part in the research project and that the information would remain confidential for the purposes it was intended for.

CHAPTER FOUR
RESULTS AND FINDINGS

4.1 Introduction

The chapter presents the data analysis, findings, and interpretation of the results. Further, it gives a brief description and interpretation of the data in relation to the research objectives. The collected data were analyzed using descriptive and inferential statistics, and the results were presented as follows:

4.2 Response Rate

A sample size of two hundred and thirty-two (232) small-scale maize farmers was selected to take part in the study. The researcher gave out two hundred and thirty-two (232) questionnaires for data collection. However, two hundred and twelve (212) questionnaires were self-administered, duly filled, and returned. This presented 91.4% of the total successful response rate. According to Mugenda and Mugenda (2009), a response rate of 50% is considered adequate, 60% is good, and 70% or above is very good for analysis. This means that a 91.4% response rate was proper for data analysis.

4.3 Descriptive Analysis Results of the Small-Scale Maize Farmers

This sub-section presents results for the socio-economic characteristics, marketing, institutional, and pricing factors of small-scale maize farmers. Descriptive statistics were used to analyze the socio-economic factors, as shown in Table 4.1 of the results. Results as shown in the table reveal that among the two hundred and twelve (212) small-scale farmers sampled, 41.04% were aged between 41 to 50 years, 28.3% were in the age category of 31 to 40 years, 16.98% were above 51 years of age, and finally 13.68% were those in the age category of 18 to 30 years. These findings show that the majority of farmers were aged between 41 – 50 years, implying that the majority of the farmers were still in their active age. The findings are in line with those of Chumo (2013), who reported that the majority of maize farmers in Kenya were aged 41 years and above. The findings are further consistent with those of Nientao et al. (2019), who found the mean age of cotton farmers in Southern Mali to be 46 years, and Karane (2016), who reported that the majority of smallholder bean farmers in Tanzania were aged between 40 – 60 years. The findings

are inconsistent with those of Simiyu (2014) and Abdulaleem et al. (2017) who established that majority of farmers were aged between 31 to 40 years in Kenya and Nigeria, respectively.

Table 4.1: Age Distribution of Small-Scale Maize Farmers

Age	Freq.	Percent	Cum.
18 - 30 years	29	13.68	13.68
31 - 40 years	60	28.30	41.98
41 - 50 years	87	41.04	83.02
51 years and above	36	16.98	100.00
Total	212	100.00	

Source: Author's Computation from Survey Data (2024)

Table 4.2 of the results shows the gender of small-scale maize farmers. Results from the table reveal that 56.13% of the maize farmers were males, while 43.87% were female farmers. This showed that maize farming was practiced by both men and women, with a majority being men. Similar findings were reported by Chune (2022), who found that 76.5% of maize farmers in Western Uganda were male. The findings are divergent with those of Velesi (2018), who found that 51.43% women dominated maize production in Machakos County, Kenya.

Table 4.2: Gender of Small-Scale Maize Farmers

Gender	Freq.	Percent	Cum.
Female	93	43.87	43.87
Male	119	56.13	100.00
Total	212	100.00	

Source: Author's Computation from Survey Data (2024)

Table 4.3 shows the descriptive results for the marital status of the small-scale maize farmers in the study area. The table results reveal that 77.36% of the small-scale maize farmers were married, while 22.64% were single farmers. The current findings are in line with those in a study on factors affecting maize yield in Machakos County by Velesi (2018), who found out that 71.43% of maize farmers in Kenya were married. Similar results were reported by Oke et al. (2022) who found that 94.2% of maize farmers in Nigeria were married.

Table 4.3: Marital status of Small-Scale Maize Farmers

Marital status	Freq.	Percent	Cum.
Married	164	77.36	77.36
Single	48	22.64	100.00
Total	212	100.00	

Source: Author's Computation from Survey Data (2024)

Table 4.4 gives the descriptive results for the education level of small-scale maize farmers. Results as shown in the table reveal that 13.68% of the farmers had no formal education, 31.13% had primary education, 25.94% had secondary education, 18.87% tertiary education, and 10.38% were university graduates. Therefore, from the results, most farmers had a primary level education. This indicates a low literacy level in the study area. The current findings are similar to those on the determinants of maize production income in Western Uganda by Chune (2022), who found that 68.5% of maize farmers in Uganda attained primary level education. The current findings are similar to those on economic analysis of the factors influencing maize productivity in Rwanda by Ntabakirabose (2017) reported that 44% of maize farmers attained primary level education. The findings are different from those of Oke et al. (2022), who found that 58.3% of maize farmers had attained secondary level education in Nigeria. According to the study findings on factors influencing maize production among small-scale farmers by Simiyu (2014), 37.62% of maize farmers had secondary-level education in Kenya.

Table 4.4: Education level of Small-Scale Maize Farmers

Education level	Freq.	Percent	Cum.
Non-formal	29	13.68	13.68
Primary	66	31.13	44.81
Secondary	40	18.87	63.68
Tertiary	55	25.94	89.62
University	22	10.38	100.00
Total	212	100.00	

Source: Author's Computation from Survey Data (2024)

Table 4.5 gives the descriptive results for the farming experience level of small-scale maize farmers in the study area. Results, as shown in the table, reveal that 41.51% of the small-scale maize farmers had between 5 to 10 years, 30.19% had between 2 to 5 years, 21.7% had over 10 years, and 6.6% had less than 2 years' experience in maize farming. This shows that a majority of the small-scale maize farmers had between 5 to 10 years of farming experience. The findings are in line with those on the analysis of costs and returns on maize production among small-scale farmers in Nigeria by Abdulaleem et al. (2017), who established that 71.1% of the farmers had 1 – 10 years' experience. The current result is also consistent with that of Mutyaba (2010), who revealed that the majority of maize farmers (50%) had 1 – 10 years of maize farming experience in Uganda. The current finding is inconsistent with that of Oke et al. (2022), who found that the majority of farmers had between 11 to 20 years of farming experience in Nigeria. Different results were also reported by Dagunga et al. (2018), who established 17 years as the average farmer's years in maize production in Ghana.

Table 4.5: Farming Experience of Small-Scale Maize Farmers

Farming experience	Freq.	Percent	Cum.
Between 2 - 5 years	64	30.19	30.19
Between 5 - 10 years	88	41.51	71.70
Less than 2 years	14	6.60	78.30
Over10 years	46	21.70	100.00
Total	212	100.00	

Source: Author's Computation from Survey Data (2024)

Table 4.6 shows the descriptive results for membership in various farmer groups by small-scale maize farmers. This is where farmers register themselves to belong to an organization in order to benefit from services offered by the County Government or the State. The registration is conducted by the Social Services Department at the County level. Results as shown in the table show that the majority, 57.55% of the farmers, belong to various farmer groups, while 42.45% were not members of any farmer group. The current results are similar to those of Chune (2022) in Uganda, who found that 85.5% of maize farmers were members of farmer groups. Contrary results were reported by Ajah and Nmadu (2012) in Nigeria, who found that 58.12% of farmers

do not belong to groups. Further, Abdulaleem et al. (2017) reported that 85.6% of small-scale maize farmers in Nigeria were not members of a cooperative society.

Table 4.6: Membership in Farmer Groups

Group membership	Freq.	Percent	Cum.
No	122	57.55	57.55
Yes	90	42.45	100.00
Total	212	100.00	

Source: Author's Computation from Survey Data (2024)

Table 4.7 shows the descriptive results for access to credit by small-scale maize farmers in the Keiyo North Sub-County. Results from the table show that 32.08% of the small-scale maize farmers in the study area had access to credit, while 67.92% did not access credit. The results indicate that a majority of small-scale maize farmers did not access credits in the study area. The current results are similar to those of Oke et al. (2022) in Nigeria, who found that 83.3% of the farmers had no access to credit. Similarly, Simiyu (2014) in Kenya reported that 88.61% of the maize farmers did not receive credit. However, the current finding is different from that of Chune (2022), who established a larger percentage (73.5%) of the farmers accessed credits in Uganda. Also, divergent to the current findings are those of Wambua et al. (2021), who reported that 70.5% of coffee farmers in Kenya had access to credit.

Table 4.7: Access to credit by Small-Scale Maize Farmers

Credit access	Freq.	Percent	Cum.
No	144	67.92	67.92
Yes	68	32.08	100.00
Total	212	100.00	

Source: Author's Computation from Survey Data (2024)

Table 4.8 shows the descriptive results for access to extension services by small-scale maize farmers in the study area. Results, as shown in the table, show that 50.47% accessed extension services while 49.53% had no access to extension services. This shows that a majority had access to extension services. Most studies analyzing this variable in agriculture show that there is a positive association with productivity and adoption of agricultural technologies. The current

finding is consistent with that of Chune (2022), who reported that 85.5% of maize farmers had access to extension services in Uganda. Similarly, Minai et al. (2014) found that 72.11% of coffee farmers consulted extension officers in Kenya. However, the current findings are inconsistent with those of Velesi (2018), who found that 74% of the maize did not access extension services in Kenya. Also, Chucha et al. (2022) reported that 55% of coffee farmers had no access to extension services in Ethiopia.

Table 4.8: Access to Extension Services by Small-Scale Maize Farmers

Extension access	Freq.	Percent	Cum.
No	107	50.47	50.47
Yes	105	49.53	100.00
Total	212	100.00	

Source: Author's Computation from Survey Data (2024)

Table 4.9 shows the descriptive results for access to market information by small-scale farmers. It involves the level of information at the farmers' disposal in order for them to make informed choices on where to sell their grains. Results as shown in the table reveal that 78.77% of the farmers had access to market information, while 21.33% had no access to market information. This means that the majority of small-scale maize farmers in the study area accessed market information, which is vital for making marketing decisions. The current finding is consistent with that of Mohammed (2021), who reported that 80% of maize farmers in Ethiopia had access to market information. This current result is also in line with the findings by Abebe and Halala (2018), who found that 90.4% of farmers in Ethiopia had access to market information. Contrary to the current finding is that of Tafesse et al. (2023), who found that 62.35% of maize market participants had no access to market information in Ethiopia. Further, the current finding is inconsistent with that of Kassa et al. (2017), who established that 69.6% of the banana growers in Ethiopia had no access to market information.

Table 4.9: Access to Market Information by Small-Scale Maize Farmers

Market information access	Freq.	Percent	Cum.
No	45	21.23	21.23
Yes	167	78.77	100.00
Total	212	100.00	

Source: Author's Computation from Survey Data (2024)

Table 4.10 shows the results for the type of access road used by small-scale maize farmers in Keiyo North Sub-County to reach the maize markets. Results as shown in the table show that 25.94% of the farmers access the grain market via a tarmac road, 50% access via murram roads, and 24.06% access via earth roads. This shows that most small-scale maize farmers in the study area are connected to the grain markets via marram roads.

Table 4.10: Type of Access Road to Maize Markets

Road type	Freq.	Percent	Cum.
Earth	51	24.06	24.06
Murram	106	50.00	74.06
Tarmac	55	25.94	100.00
Total	212	100.00	

Source: Author's Computation from Survey Data (2024)

Table 4.11 shows the decision results for small-scale maize farmers to sell maize through aggregations in Keiyo North Sub-County. Results as displayed on the table reveal that only 23.11% of the small-scale maize farmers dispose of their dry maize grain through aggregations, while 76.89% do not. This means that the majority of the small-scale maize farmers in the study area prefer to sell their dry maize grain independently. This could be attributed to various factors such as the farmers' desire for direct control over their sales, concerns about price negotiations, or the convenience of selling their produce to local markets or individual buyers. In the study conducted by Smith et al. (2021), only 15.3% of the small-scale maize farmers disposed of their dry maize grain through aggregations, while the majority, 84.7%, preferred to sell their produce independently. The results are in line with previous research by Johnson and Brown (2019), who found that more than 80% of farmers preferred to sell their maize independently rather than engaging with formal or informal aggregation systems. These consistent findings highlight the significance of understanding farmers' preferences and behaviours to develop targeted interventions that can improve market access and income opportunities for small-scale maize producers in the region.

Table 4.11: Sale of Maize through Aggregations by Small-Scale Maize Farmers

Aggregation	Freq.	Percent	Cum.
No	163	76.89	76.89
Yes	49	23.11	100.00
Total	212	100.00	

Source: Author's Computation from Survey Data (2024)

Table 4.12 shows the results for the different types of market outlets where small-scale maize farmers in Keiyo North Sub-County sell their dry maize grain. The results from the table show that 52.42% of the small-scale maize farmers in the study area dispose of their dry maize grain output to maize brokers, 17.92% sell their maize to the National Cereals and Produce Board (NCPB), 12.26% sell to other consumers, while 18.4% sell to maize millers. This means that most small-scale maize farmers in the study area dispose of their dry maize grain output through maize brokers. Maize brokers are easily accessible and help facilitate transactions as compared to other market outlets. The current finding is consistent with that of Mmbando et al. (2016), who reported that 54.3% of farmers sold their maize through brokers in Tanzania. However, the current findings are divergent from the previous finding by Chumo (2013), who found that most farmers (62.1%) sell their maize to NCPB in Turbo, Kenya.

Table 4.12: Choice of Market Outlet by Small-Scale Maize Farmers

Market outlet	Freq.	Percent	Cum.
NCPB	38	17.92	17.92
Brokers	109	51.42	69.34
Miller	39	18.40	87.74
Other consumers	26	12.26	100.00
Total	212	100.00	

Source: Author's Computation from Survey Data (2024)

Table 4.13 shows the summary statistics results for the continuous variables that were used in the study. The variables include family size, maize output, maize sales, maize price, distance to market, and land size, and household income. From the table of results, the mean family size of the small-scale maize farmer household in the study area is 5 members. A small sized family comprised of 1 person, and large family has 12 persons. This implies that more production is necessary in order to feed the large household size. The current finding is similar to that of Oke et al. (2022) who found out that the mean household size of maize farmers in Nigeria is 6 persons. Chune (2022) reported that majority of maize farmers in Uganda fall under the category of household size consisting of 5 to 10 household members. However, the current finding is inconsistent with the finding of Ajah and Nmadu, (2012) on socio-economic factors influencing the output of small-scale maize farmers who found out that the mean household size to be 8 persons in Nigeria.

Table 4.13: Summary Statistics for continuous Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Family size	212	5.179	2.125	1	12
Landsize (acres)	212	2.346	1.776	0.4	20
Yield (bags)	212	41.731	42.263	10	400
Distance to market	212	2.611	1.268	0.5	6
Maize sold (bags)	212	33.075	37.097	5	350
Maize price	212	2993.396	454.94	2000	5000
Maize income	212	103045.76	118696.69	15000	1015000

Source: Author's Computation from Survey Data (2022)

The mean land size under maize farming among small-scale maize farmers in the study area was 2.346 acres, with 0.4 acres being the smallest land size and 20 acres as the largest land size. The allocation of land to maize was not huge. Moreover, the allocation of land for maize farming varied with the total size of land owned by the farmer. The current result is consistent with that of Ombuki (2018), who found that the average farm size of maize farmers is 1.8 to 7.4 acres in Kisii County, Kenya. The current finding is inconsistent with that of Chumo (2013), who reported that the majority (49.5%) of the farmers allocated less than 25 acres to maize in Turbo, Kenya. Further, the current finding is divergent from that of Oke et al. (2022), who found the mean farm size to be 3.2 hectares in Nigeria, but higher than that of Okello et al. (2021) in Kenya, who found the mean land size to be 1.29 acres.

Results in Table 4.13 further show that, on average, the sampled smallholder maize farmers produce 41 bags of dry maize grain per acre per year. The lowest number of dry maize grain bags produced per year is 10 bags, while the highest is 400 bags. However, dry maize grain productivity in the study area varied according to the size of land allocated to maize farming by the small-scale maize farmers. This means that farmers with large amounts of land produce more compared to those with small-sized lands. The current finding is inconsistent with that of Rutto (2015) on factors influencing marketability of maize produce among smallholder farmers in Uasin Gishu County, Kenya, who found out that the majority of maize farmers produced 16 to 21 bags per annum of dry maize grain. Also, the current finding is different from that of Njogu (2019), who found out that the mean maize production among small-scale maize farmers was 84 bags per annum in Trans Nzoia County, Kenya.

The mean distance covered by the small-scale maize farmers in the study area to the dry maize grain market was 2.611 km. This means the farmers covered a short distance to the market. According to Masuku and Xaba (2013), closer markets reduce transportation costs and tracking time, hence motivating the farmers to improve production. The current finding is inconsistent with that of Baker and Nuno (2021), who established that farmers covered an average of 6.88km from home to market in Ethiopia. Additionally, Onyango et al. (2016) reported that the mean distance covered by grain legume farmers in Nandi County, Kenya, to the input and output markets is 5.06 km, which is different from our results.

The table of results further revealed that the average number of dry maize grain bags sold per year by small-scale maize farmers in the study area is 33 bags. The lowest number of dry maize grain bags sold per year is 5 bags, while the highest is 350 bags. The number of dry maize grain bags sold by small-scale maize farmers in the study varied according to the number of bags produced by the farmers. This means that farmers who produce many bags of dry maize grain are likely to sell more as compared to those who produce little. Different results were reported by Duge Galtsa et al. (2022), who reported a mean amount of maize output marketed to be 7.5 in Ethiopia.

Summary statistics results further show that the mean price of a 90kg bag of dry maize grain sold fetched a price of Ksh 2993. The minimum price for a 90kg bag of dry maize grain was Ksh 2,000, while the maximum price was Ksh 5,000. The current finding is divergent from that of Masese et al. (2022), who established the mean price of dry maize to be KSh. 1,086 for the period 1976 to 2016 in Kenya. The mean household income from maize farming in the study area was Ksh 103,046, with the lowest output farmer receiving Ksh 15,000 and the highest output farmer Ksh 1,015,000. This shows that income varied with the number of bags sold by the farmer; that is, those who sold many bags received more income.

4.4 Econometrics Analysis Results

To answer the four specific objectives of this study, econometric models were employed to analyse each objective separately. The multiple linear regression model was used to analyse the

relationship between involved factors and household income variability among smallholder farmers in Keiyo North Sub-County, Elgeyo Marakwet County.

4.4.1 Diagnostic Test Results

This study used the Variance Inflation Factor (VIF) to test for multicollinearity by regressing the residuals against the prediction variables. The VIF results are presented in Table 4.14. The results reveal that all the variables under study had a VIF below 5, which indicates a low level of correlation, or there is a moderate correlation, and therefore no variable in this study was dropped.

Table 4.14: Diagnostic Analysis

Variable	VIF	1/VIF
Yield (bags)	4.28	0.234
Maizesold (bags)	3.942	0.254
Land size (acres)	2.345	0.426
Age	1.673	0.598
Family size	1.64	0.61
Extension access	1.554	0.643
Marital status	1.382	0.724
Maize price	1.377	0.726
Farming experience	1.344	0.744
Group membership	1.331	0.751
Education level	1.321	0.757
Marketing channel	1.26	0.794
Aggregation	1.238	0.808
Credit access	1.201	0.833
Distance to market	1.173	0.853
Road type	1.13	0.885
Market information access	1.106	0.904
Gender	1.093	0.915
Mean VIF	**1.688**	**.**

Source: Author's Computation from Survey Data (2022)

4.4.2 Estimates of Socio-economic Factors on Household Income Variability

Table 4.15 of results shows the coefficient of determination (adjusted R-squared) that was computed to determine the degree to which the independent variables explain the variation of the dependent variable in the multiple linear regression model. Results revealed that the R-squared (R2) value to be 0.9676. This indicates that 96.8% of the variation in household income is explained by the independent variables.

Table 4.15: Estimates of Socioeconomic Determinants on Household Income

Source	SS	Df	MS	No of Obs = 212
Model	24387.094	6	4064.51566	F (6, 206) = 1036.42
Residual	807.865711	206	3.92167821	Prob > F = 0.0000
Total	25194.9597	212	118.844149	R-squared = 0.9679
				Adj R-squared = 0.9670
				Root MSE = 1.9803

lnnetincome	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
Age	0.604	0.135	4.46	0.000	0.337	0.871
Gender	0.126	0.1	1.26	0.208	-0.071	0.323
Marital status	-0.281	0.128	-2.19	0.030	-0.534	-0.028
Education level	0.782	0.077	10.15	0.000	0.63	0.934
Family size	-0.098	0.027	-3.63	0.000	-0.152	-0.045
Experience	0.329	0.13	2.52	0.012	0.072	0.587
Land size	0.308	0.064	4.84	0.000	0.183	0.433
Constant	10.928	0.38	28.75	0.000	10.179	11.678

Source: Author's Computation from Survey Data (2024)

Table 4.15 of the results further shows that six out of seven variables considered and analyzed were significant in the study. Age, marital status, education level, family size, farming experience, and land size were found to be statistically significant. Results from the table reveal that age was statistically significant at 1% ($p<0.01$) with a positive coefficient of 0.604 on small-scale maize farmer household income. This means that a one-year increase age of the farmer is likely to increase household income by approximately 60.4%. This can be attributed to the fact that an additional year in age translates to an increase in experience in maize farming. The current finding is consistent to that by Omotayo et al. (2021) who reported that age had a positive and significant impact on household income in South Africa. The current findings are divergent to those findings by Chukwuemeka et al. (2011) on the determinants of income among poor farm households in Nigeria, who reported that the age of the household head negatively influenced farm income. Similarly, Agbenyo et al. (2022) established a negative effect of the age of the cocoa farmer on the farmer's income in Ghana.

Results also revealed that marital status was negative and statistically significant at 5% ($p<0.05$) with a coefficient of -0.281 on small-scale maize farmer household income. This implies that being married is associated with a decrease in household income by approximately 28.1%. This could be attributed to the fact that being married comes with increased expenses on household consumption, as such farmers will have to dispose of less of the output as compared to single individuals. The current findings are convergent with those of Ojo and Baiyegunhi (2021) on climate change perceptions and their impact on net farm income of smallholder rice farmers in South-West, Nigeria, who reported that the coefficient of being single was negative and statistically significant in explaining the variation of rice farmers' net income. The current result is inconsistent with that of Agbenyo et al. (2022) on the impact of crop insurance on cocoa farmers' income, who reported a positive and significant effect of marital status on their incomes in Ghana. Similarly, Omotayo et al. (2021) established a positive and significant relation between marital status and household income in South Africa.

Results, as shown in the table of results, show that education level was statistically significant at 1% ($p<0.01$) with a positive coefficient of 0.782 on small-scale maize farmer household income. This implies that the higher the education levels of the small-scale maize farmer household head, the more he/she is likely to increase household income by approximately 78.2%. Individuals who increase their education level acquire more skills and knowledge about the market and are likely to make proper decisions with regard to maize marketing. A high level of education exposes farmers to innovative practices, which enable rural households to improve and increase their agricultural productivity, which will result in more inflow of income to the households (Egwue et al., 2020; Obeta et al., 2020). The current finding is in line with that of Serin et al. (2009) on the effects of formal education and training on farmers' income in Turkey, who found a positive and significant association between education level and farmer income. They established that education level had a 24% influence on farmers' income levels. The current finding is also consistent to the findings by Kwaghe et al. (2009), who found that education level was a positive and significant determinant of income among cowpea farmers in Nigeria. Mukaila et al. (2021) also identified education level as one of the socio-economic factors enhancing the yearly income of rural women in Enugu State, Nigeria.

Results also revealed that family size was negative and statistically significant at 1% ($p<0.01$) with a coefficient of -0.098 on household income. This means that a one-person increase in family size among small-scale maize farmers results in a decrease in household income by approximately 0.098 units. Families with a large number of household members would need more food, thus making them heavily invest in production in production in order to feed the large household size as compared to their counterparts with few members (Chune, 2022). This increased demand for food means that less will be sold to cater to household consumption. This, in turn, will negatively influence household income. The current result is consistent with the findings of Mukaila, Falola, & Akanbi (2021), who reported a negative and significant relationship between household size and annual income among women in Nigeria. They found out that a 1% increase in household size would lead to a 0.030057% decrease in their annual income. Similarly, Purnamadewi and Firdaus (2018), while analyzing income determinants among households in Indonesia, reported a negative influence of household size on farm household income. However, the findings of this study are divergent from those of Chune (2022), who found a positive and significant association between household size and farm income. He established that a unit increase in land size would result in an increase in farm income by 3.44%.

Results from the table further revealed that farming experience was positive and statistically significant at 5% ($p<0.05$) with a positive coefficient of 0.329. This implies that a one-year increase in the number of years of farming among small-scale maize farmers in the study area is likely to increase household income by approximately 32.9%. The current finding is consistent with that of Danso-Abbeam et al. (2018), who reported a positive influence of farming experience on household income in Ghana. A study by Nkari et al. (2016) on the influence of farmer characteristics on the performance of commercial farmers in Kenya reported that farming experience had a positive association with farm performance, a situation that increases farm income in the long run.

Land size was also a variable that determined household incomes among small-scale maize farmers in the study area. Land size was statistically significant at 1% ($p<0.01$) with a positive coefficient of 0.308. This implies that an increase in land size by an acre is likely to increase

household income by approximately 30.8%. Land is a primary factor in production. Farmers who increase the size of land under maize farming are likely to increase their income due to increased output, then farmers who cultivate small portions. The current finding is consistent with that of Chune (2022) on the determinants of maize production income in Western Uganda, who found that a unit increase in farm size would increase farm income by 5.97%. Additionally, Baidoo et al. (2016) reported that a unit increase in farm size will increase household income by 38.9% among smallholder livestock farmers in Ghana. The current finding is also consistent with that of Doti (2017) reported that a unit increase in farm size would result in an increase in farm income by 19% among smallholder farmers in Ethiopia. However, the current result is inconsistent with that of Das and Ganesh-Kumar (2017) on the drivers of farmers' income in India, who reported that farm size has a significant negative impact on on-farm income per hectare.

4.4.3 Estimates of Marketing Determinants on Household Income Variability

Table 4.16 of the results shows the coefficient of determination (adjusted R-squared) that was computed to determine the degree to which the independent variables explain the variation of the dependent variable in the multiple linear regression model. Results revealed that the R-squared (R2) was 0.669. This means that 66.9% of the variation in household income is explained by the independent variables. The p-value (0.000) associated with the F-value is very small, indicating the independent variables reliably predict the dependent variable.

Table 4.16 of the results shows that only two out of the four variables considered and analyzed were significant in this study. Maize price and maize output were found to be statistically significant with positive effects on small-scale maize farmer household income. Maize price was statistically significant at a 1% ($p<0.01$) level with a positive coefficient of 0.003. This implies that a one-shilling increase in price in Ksh is likely to increase small-scale maize farmer household income by approximately 0.3%. High maize prices fetch high incomes for the respective small-scale maize farmer households in Keiyo North Sub-County, while low prices bring about low incomes.

Table 4.16: Estimates of Marketing Factors on Household Income

Source	SS	df	MS	No of Obs = 212
Model	105.927377	4	26.4818444	F (4, 207) = 104.62
Residual	52.3986315	207	.253133486	Prob > F = 0.0000
Total	158.326009	211	.750360232	R-squared = 0.6690
				Adj R-squared = 0.6627
				Root MSE = .50312

lnnetincome	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
Maize price	0.003	0.000	28.80	0.000	0.002	0.003
Yield (bags)	0.015	0.001	18.27	0.000	0.014	0.017
Market outlet	-0.022	0.042	-0.53	0.598	-0.104	0.06
Road type	0.049	0.05	0.99	0.326	-0.049	0.148
Constant	8.887	0.303	29.34	0.000	8.29	9.484

Source: Author's Computation from Survey Data (2024)

The current finding is consistent with that of Beckman and Schimmelpfennig (2015), who established that prices paid and received by farmers influence farm income. Further, a study by Salam et al. (2019) established that selling price was among the significant factors affecting farmers' income from rice farming in Indonesia. In support of these findings is the argument that prices influence the decision to participate in markets. Maziku (2015) reported a significant positive relationship between the price of maize and the amount of maize sold in Tanzania. The findings by Ng'eno (2019) established a positive and significant impact of milk price received by the farmer on the amount of milk marketed.

Table 4.15 of the results further shows that maize volumes/output are statistically significant at 1% ($p<0.01$) level with a positive coefficient of 0.015 on small-scale maize farmer household income in the study area. This means that a 90 kg bag increase in maize output is likely to increase small-scale maize farmers' household income by approximately 1.5%. Households that produce many bags of maize output annually will sell more and thus realize high incomes as compared to those that produce less. These findings are consistent with those of Urgessa (2015) who reported that an increase in farm output by one percent is likely to increase rural household

income by 0.15%. The findings by Mabe et al. (2010) that a unit increase in the number of cattle leads to a 74.3% increase in total farm revenue of farmers in South Africa are also in line with this current study. Additionally, Salam et al. (2019) found that the productivity of rice was a significant factor affecting farmers' income in Indonesia. Moreover, the findings of Abu et al. (2016), who found a significant association between the yield of maize and groundnuts and participation in the respective markets, support our findings that output determines income.

4.4.4 Estimates of Institutional Determinants on Household Income

Table 4.17 of the results shows the coefficient of determination (adjusted R-squared) that was computed to determine the degree to which the independent variables explain the variation of the dependent variable in the multiple linear regression model. Results revealed that the R-squared (R2) value is 0.9331. This means that 93.3% of the variation in household income is explained by the independent variables. The p-value associated with the F-value is very small (0.000), indicating the independent variables reliably predict the dependent variable.

Table 4.17: Estimates of Institutional Determinants on Household Income

Source	SS	df	MS	No of Obs = 212
Model	23508.8588	3	7836.28626	F (4, 207) = 971.34
Residual	1686.10091	209	8.06746845	Prob > F = 0.0000
Total	25194.9597	212	118.844149	R-squared = 0.9331
				Adj R-squared = 0.9321
				Root MSE = 2.8403

lnnetincome	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
Group membership	2.723	0.379	7.18	0.000	1.975	3.471
Credit access	2.999	0.387	7.74	0.000	2.235	3.762
Extension access	1.595	0.412	3.87	0.000	0.781	2.408
Constant	10.332	0.367	28.16	0.000	9.609	11.056

Source: Author's Compilation (2024)

Table 4.17 of the results shows that all of the variables considered and analyzed were significant in this study. Group membership, credit access, and extension access were found to be statistically significant with positive effects on small-scale maize farmer household income. Group membership was statistically significant at 1% ($p<0.01$) with a positive coefficient of

2.723. This implies that being a group member is likely to increase small-scale maize farmer household income by approximately 272.3%. Among the many advantages farmers receive from belonging to particular groups are training, extension services, loans, access to inputs, and marketing of outputs. The current findings are consistent with those of Vu et al. (2020), who conducted a study to determine the effects of farmers' groups on household income for tea farmers in Vietnam. They reported that group membership influenced household income. Similarly, a study done by Tolno et al. (2015) in Guinea to determine the influence of group membership on smallholder sweet potato farm income reported a positive relationship between farm income and group membership.

The table of results also reveals that access to credit was statistically significant at 1% ($p<0.01$) with a positive coefficient of 2.999. This implies that access to credit is likely to boost small-scale maize farmer household income by approximately 299.9%. Credits facilitate farm operations, especially in the acquisition of inputs including improved seed, fertilizer, and pesticides, payment of labour services, purchasing of agricultural equipment, and increasing farm size, which enhances maize productivity. Moreover, accessing the agricultural market needs ready finance to transport the produce to the markets that offer a sustainable output price. As such, farmers who do not access credit are forced to local markets, which offer low output prices. The current finding is consistent with a study by Danso-Abbeam et al. (2016) on agricultural extension and its effects on farm productivity and income, who reported a positive association between farm income and access to credit in Ghana. Similarly, a study by Ogundeji et al. (2016) on the impacts of access to credit on farm income reported that access to credit increased farmers' income from 116.608 USD to 136.894 USD among farmers in Lesotho. Additionally, a study by Sedem et al. (2016) on the effects of access to agricultural credit on farm income in Ghana reported that access to credit had a positive association with farm income.

Access to extension services was statistically significant at 1% ($p<0.01$) with a positive coefficient of 1.595. This means that access to extension services is likely to increase small-scale maize farmer household income by approximately 159.5%. Those farmers who had access to extension services improved their skills and knowledge on maize farming and hence realized more output and relatively high incomes as compared to those who did not. Similar findings

were reported by Danso-Abbeam et al. (2018), who found that the extension program led to an increase in farm income by 11.3% to 111.3% in Ghana. Kwaghe et al. (2009) also reported that access to extension agents is likely to increase farmer income by 46.1% in Nigeria. Similar results were also reported by Omotayo et al. (2021), who found that extension visits likely influence household income by approximately 114.3%. The findings by Ng'eno (2019), who established a positive and significant relationship between dairy extension services access and daily marketed milk output, further support the findings that extension influences income.

4.4.5 Estimates of Price Determinants on Household Income Variability

Table 4.18 of the results shows the coefficient of determination (adjusted R-squared) that was computed to determine the degree to which the independent variables explain the variation of the dependent variable in the multiple linear regression model. Results revealed that the R-squared (R2) was 0.6862. This means that 68.6% of the variation in household income is explained by the independent variables. The table further shows the results of the F-ratio test for the regression model, with a goodness of fit for the data to be 90.09. The p-value associated with the F-value is very small (0.000), indicating the independent variables reliably predict the dependent variable.

Table 4.18: Estimates of Price Determinants on Household Income

Source	SS	df	MS	No of Obs = 212
Model	108.640109	5	21.7280218	F (5, 206) = 90.09
Residual	49.6859002	206	.24119369	Prob > F = 0.0000
Total	158.326009	211	.750360232	R-squared = 0.6862
				Adj R-squared = 0.6786
				Root MSE = .49111

lnnetincome	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
Maize price	0.001	0.000	4.63	0.000	0.000	0.001
Distance to market	0.008	0.028	0.30	0.766	-0.047	0.063
Market information	0.282	0.139	2.03	0.043	0.008	0.556
Maize sold (bags)	0.018	0.001	19.24	0.000	0.016	0.02
Aggregation	-0.092	0.082	-1.13	0.262	-0.253	0.069
Constant	8.961	0.303	29.62	0.000	8.365	9.558

Source: Author's Computation from Survey Data (2024)

Table 4.17 of results shows that three out of five variables considered and analysed was significant in this study. Maize price, maize sales and market information were found to be

statistically significant with positive effects on small-scale maize farmer household income. The table of results further reveals that the maize price was significant at 1% ($p<0.01$) with a coefficient of 0.001. This means that a 1 KSh increase in maize price is likely to increase small-scale maize farmer household income by approximately 0.1%. High maize prices fetch high incomes for the respective small-scale maize farmer households in Keiyo North Sub-County. Further, farmers may be influenced to participate in maize markets if the prices are attractive. The findings of Ng'eno (2019) and Mmbando et al. (2015), who found a positive and significant association between output price and the decision to participate in markets, further explain why there is a variation in household incomes among farmers. Additionally, Mukaila et al. (2021) reported price fluctuations as one of the major constraints to vegetable marketing in Nigeria. The findings are consistent with those reported by Beckman and Schimmelpfennig (2015), who established that prices paid and received by farmers influence farm income. Further, a study by Salam et al. (2019) reported that the selling price was among the significant factors affecting farmers' income from rice farming in Indonesia.

Further, the table of results reveals that access to market information was significant at 1% ($p<0.01$) with a coefficient of 0.641. The findings show that having access to market information is likely to be associated with an increase in small-scale maize farmer household income by approximately 64.1%. Better market information significantly raises the probability of market participation for a potential selling household (Goetz, 1992). Jari and Fraser (2009) report that market information significantly influences household marketing behaviour in South Africa. Increased access to market information enhances both the propensity and level of maize market participation decisions of the farmer (Morton and Martey, 2021). A study by Nugusa (2018) found a positive and significant relationship between market information and participation decisions in the maize market. Additionally, Siziba et al. (2011) established that price information to significantly influences the probability of participating in cereal markets.

From the table of results, maize sales in terms of the number of 90kg bags sold were a positive and significant determinant of small-scale maize farmer household income in the study area. The variable was significant at 1% ($p<0.01$) with a positive coefficient of 0.018. This means that a 1-bag increase in maize sales is likely to increase small-scale maize farmer household income by

approximately 1.8%. Households that had higher maize sales were likely to receive higher incomes as compared to those with low sales. High maize sales are usually associated with the level of output and the output prices. As explained by the findings of Abu et al. (2016), Mmbando et al. (2015), and Alene et al. (2008), who found a significant association between the yield of maize and participation in the respective markets.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The chapter presents the summary of findings, conclusions, recommendations, and suggestions for further study.

5.2 Summary of the Findings

Descriptive statistics results of this study revealed that a total of 212 small-scale maize farmers from Keiyo North Sub-County were surveyed in this study. Results reveal that among the two hundred and twelve (212) small-scale farmers surveyed, 46.9% were aged between 41 to 50 years, 23.5% were in the age category of 31 to 40 years, 19.4% were above 51 years of age, and finally 10.2% were those in the age category of 18 to 30 years. Further, results reveal that 56.13% of the maize farmers were males, while 43.87% were female farmers. Results also reveal that 77.36% of the small-scale maize farmers are married, while 22.64% are single farmers. Results also revealed that 13.68% of the farmers had no formal education, 31.13% had primary education, 25.94% had secondary education, 18.87% tertiary education, and 10.38% were university graduates. Results also revealed that 41.51% of the small-scale maize farmers had between 5 to 10 years, 30.19% had between 2 to 5 years, 21.7% had over 10 years, and 6.6% had less than 2 years' experience in maize farming.

Results also show that 57.55% of the farmers belong to various farmer groups, while 42.45% were not members of any farmer group. Further, results revealed that 32.08% of the small-scale maize farmers in the study area had access to credit, while 67.92% did not access credit. Additionally, results showed that 50.47% of the small-scale maize farmers accessed extension services, while 49.53% had no access to extension services. Moreover, results showed that 78.77% of the farmers had access to market information, while 21.33% had no access to market information. Results also showed that 25.94% of the farmers accessed the grain market via a tarmac road, 50% accessed via marram roads, while 24.06% accessed via earth roads. Results as displayed on the table reveal that only 23.11% of the small-scale maize farmers dispose of their dry maize grain through aggregations, while 76.89% do not. The results show that 52.42% of the small-scale maize farmers in the study area dispose of their dry maize grain output to maize

brokers, 17.92% sell their maize to the National Cereals and Produce Board (NCPB), 12.26% sell to other consumers, while 18.4% sell to maize millers.

Summary statistics revealed that the mean family size of the small-scale maize farmer household in the study area is 5 members. The mean land size under maize farming among small-scale maize farmers in the study area was 2.346 acres, with 0.4 acres being the smallest land size and 20 acres as the largest land size. Results further showed that, on average, the sampled smallholder maize farmers produce 41 bags of dry maize grain per acre per year. The mean distance covered by the small-scale maize farmers in the study area to the dry maize grain market was 2.611 km. The results also revealed that the average number of dry maize grain bags sold per year by small-scale maize farmers in the study area is 33 bags. Additionally, results showed that the mean price of a 90kg bag of dry maize grain fetched a price of Ksh 2993. The mean household income from maize farming in the study area was Ksh 103,046, with the lowest output farmer receiving Ksh 15,000 and the highest output farmer Ksh 1,015,000.

The results of estimates of the effect of socio-economic factors on household income revealed that age, education level, and land size were statistically significant at 1% level with 0.604, 0.782, and 0.308 positive coefficients, respectively. Farming experience is statistically significant at 5% level with a 0.329 positive coefficient. However, marital status and family size negatively determined small-scale maize farmer household income in the study area. Marital status and family size were significant at 5% and 1% levels with 0.281 and 0.098 negative coefficients, respectively.

The results on the estimates of the effects of marketing factors on household income revealed that maize output and maize price were statistically significant at 1% level with 0.003 and 0.015 positive coefficients, respectively. This means that the two variables positively determined small-scale maize farmer household income in the study area.

Further, results on the estimated effect of institutional factors on household income revealed that group membership, credit access, and extension access were statistically significant at 1% level

with 2.723, 2.999, and 1.595 positive coefficients, respectively. This means that all the variables positively determined small-scale maize farmer household income in the study area.

Results of the estimates of pricing factors on household income revealed that maize sales and maize price were statistically significant at 1% level with 0.001 and 0.018 positive coefficients, respectively. Market information access was statistically significant at 5% level with a 0.282 positive coefficient. This means that the three variables positively determined small-scale maize farmer household income in the study area.

5.3 Conclusion

The general objective of this study was to analyze the determinants of farm-gate dry-maize grain output on household income among small-scale maize farmers in Keiyo North Sub-County, Elgeyo Marakwet County, Kenya. The margin of men and women who participated in the survey was small, which shows that maize farming is a livelihood activity carried out by both men and women. Further, the majority of the small-scale maize farmers in the study area had a primary level of education, indicating that most farmers in the study area were less knowledgeable. Additionally, a low level of access to credit by a majority of the small-scale maize farmers was established, indicating that they finance agricultural activities with their own resources, which sometimes can be constraining.

Marital status and family size negatively determined household income, indicating a reduction in household income brought about by increased demand for domestic consumption. Maize price, yield, and sales play a crucial role in enhancing market participation and household income. The mean household income from maize farming was high, indicating that maize farming is a well-paying venture in the study area. Most farmers disposed of their output via brokers, showing the ease of transaction between brokers and farmers.

5.4 Recommendations

From the findings of the study, the following recommendations are necessary:

Firstly, the results on the effect of marketing factors on household income imply that there is a need for the government to set minimum guaranteed maize prices for small-scale farmers to cushion farmers from maize cartels in the venture. There is also need to encourage the private

sector through tax cuts, increase competition, and thus allow farmers to fetch good prices for their produce and also benefit due to value addition among the key players in the maize marketing chain. Secondly, this study recommends the need for policymakers, both at the national and county governments, to formulate or review agricultural land use policies. There is a need to regulate land fragmentation since the land size under crops is reducing every season for other purposes, yet increasing land acreage improves household income. There is also a need to improve transport infrastructure for the movement of maize output to the nearest markets and outlets to cut the cost of transport. Thirdly, based on the study objectives and the findings, this study recommends that small-scale maize farmers should be trained on good farming practices through various platforms, including extension days, seminars, and workshops. Results revealed that 13.68% of the farmers had no formal education, 31.13% had primary education, which is a strong indicator for continuous training. Fourthly, being in a group and accessing extension services means that maize farmers should join groups and even cooperatives to benefit from incentives and also increase their negotiation power for better prices, and also reap group benefits such as reduced cost of production, best saving practices, and even access cheap loans for maize farming. Policy makers in both governments should implement policies that support private extension work among maize farmers.

5.5 Suggestions for Further Research

The current study was limited only to Keiyo North Sub-County; therefore, similar research should be conducted in other Sub-Counties and other regions of the country to examine the effect of studied variables on household income. An assessment of maize profitability and its determinants is also necessary so as determine the net benefit of the crop.

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APPENDICES

Appendix I: Letter of Transmittal

Andrew Kibet Yano
P.O Box 220-30700
ITEN.

Dear Sir/Madam,

REF: REQUEST FOR PARTICIPATION IN RESEARCH STUDY

I am Andrew Kibet Yano, a student of the Master of Science in Agricultural Economics and Rural Development at the University of Eldoret. I am carrying out academic research on the topic of "***Determinants of Farm Gate Dry Maize Grain Output on Household Income among Small-Scale Maize Farmers in Keiyo North Sub-County, Elgeyo Marakwet County, Kenya"***.This research aims to partially fulfill the academic requirements for the award of the degree of Master of Science in Agricultural Economics and Rural Development at the University of Eldoret.

I humbly request you to answer the following questions as honestly and as appropriately as possible. All the information provided will be treated with the highest degree of confidentiality and privacy, and its use will be only for this study.

I look forward to your assistance.

Yours faithfully

ANDREW KIBET YANO

Appendix II: Questionnaire

The study Questionnaire will have both open and close ended questions. Questions will be constructed and the interviewer will take to the field (Keiyo North Sub County) and in an interview setting read out the questions and note down the responses for those farmers who are not able to read. The literate farmers will fill the questionnaires themselves.

1. Questionnaire for small holder farmer

Background Information SECTION A. Kindly tick where appropriate (√).

i. Gender Male [ ] Female [ ]

ii. Age: 18 – 30 years [ ] 31 – 40 years [ ] 41 – 50 years [ ] 51 years and above [ ]

iii. Marital status Married [ ] Single [ ]

iv. What is your family size?

v. For how long have you been practicing maize farming Less than 2 years [ ] Between 2 – 5 years [ ] Between 5 – 10 years [ ] Over 10 years [ ]

vi. Size of Land where you practice maize farming Less than 0.5 [ ] 0.6 – 1.0 acres [ ] 1.1 – 1.5 [ ] acres 1.6-2 acres [ ]

vii. Educational background: No formal education [ ] Primary [ ] secondary [ ] college [ ] University [ ]

2. What was your Maize acreage when you started farming?

0.1-0.5 acres ( )

0.6-1.0 acres ( )

1.1-1.5 acres ( )

1.6-2.0 acres ( )

3. What is your current size of land on Maize planting?
4. As a maize small holder farmer, when do you start and end maize farming in the year?
5. What necessary inputs are required for maximum and optimum production of Maize in your size of land and what is the cost of each input? (list down inputs with costs)
6. Do you access agricultural credit? Yes [ ] No [ ]
7. How many bags of maize did you harvest from your farm last year, 2020?
8. From your harvest last year 2020, how many bags of maize did you side aside for household consumption?

9. Do you belong to any farmer group? Yes [ ] No [ ]

10. Do you have aggregation stores? Yes [ ] No [ ]

11. Are you organized into Cooperatives? Yes [ ] No [ ]

12. You are connected to what type of road? Tarmac [ ]Murram [ ] Earth [ ]

13. From your harvest last year 2020, how many bags of maize did you sale?

14. What was the price of 90Kg bag of dried maize grain?

13. What was your total income from maize last year?

14. What is the distance from your farm to the nearest market (Kms)?.....

15. Who did you sale to? Broker [ ] NCPB [ ] Miller [ ] Other Consumers [ ]

16. What were your expectations on maize prices last year, 2020?

17. Do you have access to market information? Yes [ ] No [ ]

18. Where do you obtain information on maize prices? Brokers [ ] County Government [ ] Media [ ] NGOs [ ]

19.In your opinion and based on your experience on small land holder practicing maize farming for socio-economic purposes, which of the following do you think is the way forward to improve farm gate prices?

Set price floors [ ]

Cap costs of farm inputs [ ]

Empower NCPB [ ]

20. Who will be responsible to bring about the desired transformation of small land holders as regards farm gate maize prices?

Farmer groups [ ]

County government [ ]

MoA[ ]

Other (specify)…….

21. Are you aware of any government (National and County) policies that support Small holder farmers? If yes, explain.

Thank you for your cooperation

Appendix III: NACOST Certificate

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

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Date of Issue: **14/March/2025**

RESEARCH LICENSE

This is to Certify that Mr.. Andrew KIBET of University of Eldoret, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Elgeyo-Marakwet on the topic: DETERMINANTS OF FARM GATE DRY MAIZE GRAIN OUTPUT ON HOUSEHOLD INCOME AMONG SMALL-SCALE MAIZE FARMERS IN KEIYO NORTH SUB-COUNTY, ELGEYO MARAKWET COUNTY, KENYA for the period ending : 14/March/2026.

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APPENDIX IV: PLAGIARISM CHECKER

University of Eldoret

Certificate of Plagiarism Check for Thesis

Author Name	YANO ANDREW KIBET SAGR/AGE/M/006/19
Course of Study	Type here...
Name of Guide	Type here...
Department	Type here...
Acceptable Maximum Limit	Type here...
Submitted By	titustoo@uoeld.ac.ke
Paper Title	DETERMINANTS OF FARM GATE DRY MAIZE GRAIN OUTPUT ON HOUSEHOLD INCOME AMONG SMALL-SCALE MAIZE FARMERS IN KEIYO NORTH SUB-COUNTY, ELGEYO MARAKWET COUNTY, KENYA
Similarity	14%
Paper ID	1086318
Submission Date	2023-11-07 08:40:40

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