ANALYSIS OF TERMINAL AND SOURCE DRY MAIZE GRAIN MARKET INTEGRATION IN KIPKELION EAST AND WEST SUB-COUNTIES, KERICHO COUNTY, KENYA

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DECLARATION AND APPROVAL

Declaration

I hereby declare that this thesis is my original work and has not been presented for the conferment of a degree or award of a diploma in this or any other university:

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DEDICATION

I dedicate this work to my beloved wife Ann Sang and Children Brian, Emmaculate and Stacey for their endless support, encouragement, tolerance and for creating a conducive environment for my study. Thank you all for your support.

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ABSTRACT

Price in a market is a key factor in controlling decisions in production, consumption, and marketing over time. A clear picture of markets is critical to finding out the causes of price variations in spatially separated markets. Prices of various products in non-integrated markets are distorted and leads to inefficient allocation of resources. However, studies on dry maize grain market integration have not been undertaken fully, especially the terminal and the source markets. Therefore, this study analyzed market integration of dry maize grain in Kipkelion East and Kipkelion West Sub-Counties in Kericho County. The objectives of the study were to determine the extent of dry maize grain market integration in the terminal and source markets, the relationship of prices between the terminal and source markets, and price adjustment time between terminal and source markets of dry maize grain to move halfway back to its threshold. The study was guided by price difference theory, and descriptive and cross-sectional research designs were adopted. The content and face validity of the instruments used were determined by two experts in the department of Agricultural Bio-systems and Economics in the university. The targeted population were 35,500 dry maize grain traders. Data was collected from a sample of 156 maize traders through stratified random sampling procedures. An interview schedule was used to collect primary data, while secondary data and information were collected through literature review. Co-integration, Granger causality, Regression and Correlation and Threshold Autoregressive models were used for data analysis on market integration. Johansen tests results for co-integration returned the trace statistics less than the critical value at 5% level of significance (14.5083<15.41) which depicted non-existence of co-integration in terminal and source markets. The Regression model accounted for approximately 46.6% of the total variation of the market price as predicted by the source market price. Pearson's product-moment correlation results showed a strong positive correlation of 0.83 and the p-value less than 5%, which means that there was a strong positive correlation between terminal and source markets' prices. Standard Threshold Autoregressive model results indicated a mixed patterns price adjustment transmission, level of transaction costs and adjustment half-lives between the market pairs. On average, prices needed 1.14 months (5 weeks) under lowered costs periods to correct half of the deviations from equilibrium price in response to market shocks as indicated by half-lives of price adjustment, while under the high tariffs period exactly one month was needed to effect similar correction. Therefore, to achieve market integration, the government and private sector need to enact policies that improve marketing infrastructures such as communication facilities and feeder roads. In return, transaction costs will significantly reduce and leads to an improvement in price transmission. Market information needs to reach the producers promptly; this can be achieved through the use of ICT to assist dry maize grains traders establish which markets offer good prices. If this is put in place, the traders will not be in a position to use increased production to decrease earning that the producers should receive, and hence promoting market integration.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dickey-Fuller
ECM	Error Correction Model
GDP	Gross Domestic Product
GoK	Government of Kenya
GPS	Global Positioning System
GVAR	Global Vector Auto Regression
KG	Kilograms
KSH	Kenya shillings
LOP	Law of One Price
MIS	Market Information System
MoA	Ministry of Agriculture
MoALF	Ministry of Agriculture, Livestock and Fisheries
NAFTA	North America Free Trade Agreement
NACOSTI	National Commission of Science, Technology and Innovations
NCPB	National Cereals and Produced Board
OLS	Ordinary Least Squares
PBM	Parity Bounds Method
SSA	Sub-Sahara Africa
TAR	Threshold Autoregressive Model
TVECM	Threshold Vector Error Correction Model
VECM	Vector Error Correction Model

DEFINITION OF TERMS

The following terms were operationalised as follows:-

Dry maize grain: This is kernel that has dried out and become difficult to chew without cooking them, tender first in boiling water.

As per this study, it refers to threshed/shelled dry maize in the market.

Half-life: This is the required time for a quantity to reduce to half its initial value.

As per the study, it refers to time taken for a given price change of dry maize grain in the market to return back to half its original value given in months/weeks.

Market: A place where selling and buying of goods and services is being carried out.

In this study, it is a place where buyers and sellers exchange their dry maize grains for money.

Market efficiency: This is the magnitude to which market price reflects all available, relevant maize market information.

As per this study, it is Extent to which prices of products in the market indicates the availability of all the necessary information like demand and supply.

Market integration: How easily two or more markets can trade with each other.

In this study it is the flow of excess demand from one market to another, or the physical flow of commodities, information mixed with the transmission of price shocks from one market to another.

Marketing margin: Variation between what a business entity pays for the product and what it charges for the product.

As per this study, this is the variation between what buyers pay for a good or a service and the prices received by sellers for the similar good or a service.

Price transmission: Effect of prices in one market on prices in another market.

As per this study, it is the effect of terminal market prices on source market prices and vice versa.

Threshold: This is the magnitude or intensity that must be exceeded for a certain reaction, phenomenon, result or condition to occur or be manifested .

It refers to a band of adjustment that represents transaction costs between terminal markets and source markets as per the study

Traders: Individuals who engage in buying and selling of financial assets for in any financial market, either for himself or on behalf of another person or institution.

This refers to those entities who are involved with the physical exchange of dry maize grain with money as per this study.

Terminal market: The central site that serves as an assembly and trading place for commodities. In this study, this is a final market place within the study area where it is regarded as an urban marketing place.

Source market: This is the point or place from which something originates.

In this study, it refers to the production point of dry maize grain where most of the initial marketing takes place.

CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter presents the background of the study, problem statement, objectives, hypotheses, justification, and the significance of the study, the scope of the study, limitations of the study and assumptions of the study.

1.2 Background of the Study

The origin of Maize (*Zea mays*) is the Andean region of Central America, and it is one of the significant cereal crops for both human and animal consumption (Food Agricultural Organization Statistic, 2000). Maize is the third preferred traded cereal worldwide after wheat and rice; its production is estimated to be 828 million tonnes (Ministry of Agriculture (MoA), 2011). In Africa and Latin America maize is a staple food Maize due to its low prices and worldwide distribution. Currently, the majority of livestock farmers use maize as feed for animals. Maize is also very accommodative in terms of ecological requirements. It does well in various soils, altitude, and fertility conditions; this is why it is well adapted to most parts worldwide and the reason of having many varieties in the market for production (MoA, 2008).

In the world market, maize still attracts a few exporting countries, but there are numerous importers across the world. The United States is the key player; in the market, since it is the world's major producer, consumer, and exporter. However, countries like Brazil, China, and Argentina have emerged to be active in the international market Globally maize sector has been dominated by a large number of private firms who control

operations such as storage, transportation in the supply chain, with an elongated worldwide appearance (MoA, 2012). World maize prices rose seasonally in the first months of 2019, after a significant drop in 2018 with the commercialization of the main and second season harvests (Food Agricultural Organization (FAO), 2019). Maize demand in the developing world will double between now and 2050, by 2025, it will have become the crop with the greatest production globally and in the developing world (Rosegrant *et.al*., 2008)

Agriculture plays an essential function in Kenya's economy and provides earnings to a large number of populations. In a nutshell, agriculture contributes twenty-six per cent to the Gross Domestic Product (GDP) of Kenya's economy, according to the MoA, 2010. Food security heavily depends on agricultural production, whereas subsectors such as horticulture and industries are major foreign exchange earners to the economy of Kenya.

Kenya's economy heavily relies on agriculture (MoA, 2012). Therefore, maize production is a practice that is done in most parts of the country. Kenya's population heavily rely on maize farming as a source of income. However, maize is commonly grown with potatoes, beans, and bananas. The maize crop is produced in a wide range of ecological conditions in Kenya, but generally, it does well in warm temperatures above 15^0 C and high rainfall of between 1000 mm -2400 mm per annum. However, maize crop can perform well with rainfall less than 1000 mm and requires well-drained fertile loamy soil (MoA, 2012).

Maize in Kenya is a key staple commodity; nationally it is a key crop in agriculture, contributes to feed industry and food security, it also generate income and provide food to the household unit (Gitau and Meyer, 2018). In Kenya maize has persisted to perform a key function in the welfare of the household members. In the previous decades, its contribution to the gross crop income rose from 30 per cent to 47 per cent and on the other hand, its contribution to the entire income fell from 11 per cent to 9 per cent (Kirimi *et al*., 2011; Njagi, Wanyama, and Mbaka, 2015).

In Kenya 85% of land is categorized as arid and semi-arid areas, leaving 15% of the total land area arable (MoA, 2013). Despite this agriculture still forms an integral part in Kenya's economy. In addition, agriculture in Kenya is highly vulnerable to weather challenges since it depends heavily on rain. Agricultural sector contribute 65% of total export which is equivalent to 194 billion Kenya shillings to the economy of Kenya (MoA, 2012).

The major producers in agriculture in Kenya are small scale farmers. These are those farmers practicing maize production in less than one hectare of land, the bulk of these produce are meant for home consumption while the surpluses are sold for income generation. Statistically small scale farmers contribute 75% of the total maize yields to the country and the large scale farmers contribute the remaining 25%. Challenges such as unpredictable rainfall, seasonal rivers and wells affect maize production (MoA. 2011). Kenyan's population heavily depends on maize as source of food in both urban and rural areas. Consumption of maize per person is approximately 98 kilograms per year, which is equivalent to 30 to 34 million bags roughly (Africog, 2009).

Agriculture contributes seventy-five per cent of raw materials to industries, twenty-seven percent indirect GDP from manufacturing, distribution, and service sectors, and about eighty per cent food supply to the population (MoA, 2010). Apart from food provision, agriculture provides eighty per cent employment to Kenya's populations (MoA, 2008). Based on these statistics, agriculture is placed sixth as a pillar player in driving the Kenya's economy growth country's per year by ten per cent for two decades if existence of an innovative, commercial and mechanized agriculture is in place (Government of Kenya (GoK), 2008).

Maize marketing chain has many players referred to as marketing agents. These players are wholesalers, retailers, posho millers, large-scale millers, assemblers and dis-assemblers. A few groups of players use donkeys and bicycles to supply maize at source to assembling and retailing points (MoA, 2012). Maize marketing in Kenya has been largely affected by two key challenges. These challenges are the classic food price dilemma and food price instability. Classic food price dilemma-how to keep farm prices of maize adequately low to ensure poor consumers are in a position to access food at the same time keeping prices high enough to provide production intensification incentives for farmers. Food price instability on the other hand has been identified as a significant impediment to smallholder productivity growth and food security (Ariga, J & Jayne, T.S, 2010).

On the other hand agricultural marketing has been side-lined for several years and production given a lot of emphasis since majority of the population believe that production is more significant than marketing. However, economists and planners have

re-assed this belief with an objective of making sure agricultural marketing is accorded more attention in terms of economic development. Marketing system in less developed and developing countries is still lagging behind in terms of efficiency and in order to promote agricultural production and economic growth a lot of emphasis and enormous recognition of efficient marketing system needs to be considered (Mafimesebi, 2002).

International markets in the year 2008 were marked by high food prices as a result of global market instability and high energy prices. In international price formation the two factors are key (Raphael and Ferdi, 2019). Understanding price transmission and market integration is key drafting of various policies. The policies are geared on having adequate knowledge on the interaction between markets and prices in space and time (Von Cramon -Taubadel, 2017). Successful price stabilization policies can only be achieved if markets are integrated and functioning well. Marketing costs, border effects and distance between markets has been found to have a significant effect on price transmission and market integration (Raphael and Ferdi, 2019).

In Kenya maize sector is key and therefore, marketing is important hence requiring the parties involved to be in a position of understanding price setting mechanisms. Maize value chain in Kenya is comprised of market players, input suppliers, processors, post processors and farmers. Competition exists between these different players (Raphael and Ferdi 2018). Dry maize grains are sold to NCPB and directly to individual traders/consumers. Marketing of dry maize is faced with challenges such as; competition in the market, climate hazards, diseases, poor infrastructures and poor marketing strategies (Ministry of Agriculture, Livestock and Fisheries (MoALF), 2014).

In Kenya, retail price transmission of maize is asymmetrical, hence sticky prices along the maize value chain. The prices of food indicate a higher response to increasing prices than decreasing prices (Ngare *et. al.,* 2013). The authors' results also indicated that, market pairs that are far from one another have a greater speed of price response unlike the market pairs closer to each other. The maize industry is marked by high transportation costs as a result of poor roads network connecting markets and production areas and similarly those connecting deficits and surplus markets. According to Kenya roads board 59 per cent of unpaved roads are poor (Kenya Roads Board, 2015). The transport costs accounts for 64 per cent of the marketing costs, as a result of poor roads network in Kenya (World Bank, 2009).

Maize Produce and Marketing board for several years in Kenya has been in charge of marketing and thereafter National Cereals and Produce Board (NCPB) took over as the umbrella of all produce marketing boards. However, prior to liberalization that took place in 1993 NCPB was the only setter of maize price in Kenya. The setting of maize price is still under the jurisdiction of NCPB since its mandate is to purchase strategic grain reserves from farmers on behalf of the government which are normally. National Cereals and Produce Board has a capacity of more than 4 million of 90 kilograms bags (MoA, 2012).

Maize price of NCPB is transmitted to other markets; such price is faced by challenges of imports from neighbouring countries. On the other hand individual farmers can sell maize directly to consumers. Price setting in such scenarios depends on farmers reasons of trading out, for example if the reason is for urgent cause like paying school fees, the farmer has to take up consumers offer whether low or high, since that could be the only

channel that can give cash immediately. The farmer may not go for traders who pay by cheque, because liquid cash is needed immediately. A farmer can also sell the maize to middlemen, who buy in small quantities and assemble for sale in bulk to NCPB or other agents like millers after sorting and grading. Middlemen are known to be intelligent when it comes to marketing and tend to pay low prices to farmers in order to make more commission (MoA, 2011). However, majority of maize farmers in Kipkelion East and West Sub-counties are small-scale farmers and they highly rely on the commodity as main source of income. (MoA, 2012).

The important aspect of market research is market integration since it provides the basic information for comprehending how particular markets work. The significance of the information obtained depends in its application to drafting of policies and decisions, on the extent of promoting market development. In addition, the understanding of movement equilibrium paths of market forces (supply and demand) for a specific commodity or group of produce highly depends on market integration. The level of proximity of the accuracy and speed of diffusion of market price information or spread of information/ price transmission efficiency and price movement are prerequisites for attaining efficient spatial and temporal resource allocation (Jayara, 1992). However, if markets are efficient and interlinked price co-movement in such markets can be achieved. Little has been determined in Kericho County dry maize grain markets. In addition, the factors causing variations in the market prices of dry maize grains are not fully understood.

Market integration is regarded as a major market research tool that gives clear picture of how a given market functions. Understanding market integration enhances policy making

and decision making in resources allocation in production. Market integration also provides sufficient knowledge on the behaviour of supply and demand in a market for a given product. In maize production and marketing, just like any other enterprise, utilizes resources across space and time in order to yield better returns. Therefore, through market integration efficiencies in resource allocation can be achieved; thus better returns realization (Venny, 2013). Marketing of dry maize grain in Kericho County is one of the ventures that contribute to income generation to majority of the population. Dry maize grains are sold to consumers within the county and bordering counties like Kisumu, Kisii, Nandi, Uasin Gishu, Bomet and Nakuru. Traders also sell their dry maize grains to Kericho, Fort Ternan, Kipkelion and Kedowa NCPB depots (MoALF, 2016).

The asymmetric price transmission between markets that are vertically linked together is caused by uncompetitive behavior among traders in a concentrated market (Kovalenko *et al.*, 2016; Epifanova *et al.*, 2015 ;). Generally, the objective of the intermediary trader is to maintain the profit and therefore, will not decrease/increase the price as per the actual price signal. Therefore, the intermediary trader will respond faster to the price rise compared to decline in price of a product in the market. This phenomenon causes imperfect price transmission and competition restraint on the marketing channel between consumer and producers. As a result the producers' and consumers' markets become nonintegrated. Non-competitive market results in lack of price transmission between different markets for agricultural product in the marketing chain. On the other hand imperfect competition opens an avenue for the middlemen to take an advantage of the market power (Meyer and Cramon-Taubadel, 2004).

There are two types of market integration, spatial and vertical market integration (Meyer, 2004). Spatial market integration refers to transmission of price signals between markets in varied locations and vertical market integration means transmission of price signals from one marketing channel to another (Minot, 2010). Price transmission results when a change in one price of a commodity causes another price of a commodity to change. Price volatility on the other hand describes how fast/widely prices can change (Minot, 2010). Agricultural markets are characterized by price fluctuations, when this become huge and unexpected can yield negative results on food security of the whole population. Therefore, the extent of market integration helps to determine the strength and effectiveness of price mechanism in resource allocation and incase prices of commodities are volatile the farmers will not be in a position to practice specialization as per long-run comparative advantage and better returns from trade will not be achieved (Baulch, 1997a). If two spatially located markets of a given commodity are related in terms of supply and demand, the price between them, will also be integrated (Emokaro, 2014; Leonard, 2011).

The key determinants of food availability and accessibility are markets, therefore, the degree to which markets keep prices stable, makes food available and accessible rely on whether or not markets are integrated. If the markets are integrated, market forces are assumed to be functioning well i.e. price changes in one market are consistently related to price change in other markets. High prices in low supply markets provides an incentive to traders to bring their products from the surplus markets to low supply markets; this indicates the existence of integrated markets (Kabbiri *et.al* 2016).

In Kipkelion East and West Sub-Counties dry maize grains production is of great significance and it contributes 68% of the total county production (MoALF, 2017). This implies that maize marketing in these sub-counties play a vital role in income generation to a larger population. However, if markets are efficient and interlinked, trade will be beneficial to both producers and consumers.

1.3 Statement of the Problem

Integrated markets in literature are those markets with negligible differences in price of a given commodity and which allows effectiveness of commodity transfer and inter-market transmission of price shock; thus such markets can trade efficiently (Kibiego. Odhiambo. & Kosura, 2006). However, this is not the case being observed in the terminal and source markets for the study areas of Kipkelion East and Kipkelion West Sub-Counties in Kericho County. Previous studies carried out by Kibiego *et al.,* (2006) in Nairobi, Nakuru, Eldoret and Kitale focused on market integration of dry beans. However, studies on dry maize grain market integration have not been undertaken, especially for the terminal and the source markets in the current study area. The major markets for the dry maize grain in Kericho County are Chepseon, Londiani in Kipkelion East Sub-County and Fort Ternan, Kamasian and Barsiele in Kipkelion West Sub-County. Dry maize grain prices in these markets fluctuate over time and sometimes the prices in the source markets are similar to terminal markets prices and vice versa, yet the markets are far from each other. There has been transmission of price shocks from one market in the study area to another leading to market inefficiencies. Similarly no effectiveness of dry maize grains transfers between the source and terminal markets. The

average dry maize grain prices (in Kshs) per 90kg bag from 2014 to 2016 for the source and terminal markets are as shown in Table 1.1.

Table 1.1

Comparisons of dry maize grains market prices trends

Markets	Average price per 90kg bag of Dry maize grain (Kshs)		
	Years		
	2014	2015	2016
Chepseon	2500	2000	2550
Kamasian	2500	2000	2500
Londiani	2550	2000	2500
Barsiele	2600	1950	2550
Fort Ternan	2500	1950	2550

Source: Agribusiness Annual Reports (MoALF, 2014, 2015 and 2016)

From Table 1.1, the source markets (Kamasian, Londiani and Barsiele) and the terminal markets (Fort Ternan and Chepseon) are not integrated. Price of a commodity between markets which are sparsely located should have a margin difference which caters for transaction costs. However, for the two dry maize grains markets, their prices are similar, that means no marginal difference. Because of this problem that existed in the two markets under the study, the current study attempted to fill the existing knowledge gap by analysing the dry maize grain market integration in Kipkelion East and West Sub-Counties of Kericho County, Kenya.

1.4 General Objective

The general objective of the study was to analyze dry maize grain market integration in Kipkelion East and West Sub-Counties in Kericho County, Kenya.

1.5 Specific Objectives

The study was guided by the following objectives:

(i) To determine the extent of dry maize grain market integration in the terminal and source markets in Kipkelion East and West Sub-Counties, Kericho County, Kenya.

(ii) To determine the relationship between the terminal and source market prices of dry maize grain in Kipkelion East and West Sub-Counties, Kericho County, Kenya.

(iii) To analyze the time it takes for the price transmission between the terminal and source markets of dry maize grain, in Kipkelion East and West Sub-Counties, Kericho County, Kenya.

1.6 Hypotheses of the Study

The study was guided by the following hypotheses:

H_{01}: There is no statistical significant integration between the terminal and the source markets of dry maize grain in Kipkelion East and West Sub-Counties, Kericho County, Kenya.

H_{02}: There is no significant relationship between the terminal and the source market prices of dry maize grain in Kipkelion East and West Sub-Counties, Kericho County, Kenya.

H_{03}: There is no significant price transmission between the terminal and the source dry maize grain markets in Kipkelion East and West Sub-Counties, Kericho County, Kenya.

1.7 Justification of the Study

In Kipkelion East and West Sub-Counties, Kericho County, maize is the major staple food and income generating enterprise to majority of farmers. These sub-counties provide 68% of dry maize grain to the County (MoALF, 2017). Moreover, maize trading is largely carried out in the two sub counties. Therefore, understanding price relationship and shock transmission across the markets is essential in order to protect farmers from price risk.

There is evidence attached to the significance of market integration. However, in Kenya no study has been carried out to reveal the extent of dry maize grain inter-markets integration. Hence, price information does not reach farmers, traders, and consumers. Therefore, the findings of this study on dry maize grain market integration will benefit traders, producers, consumers, processors and policy makers nationally; by enabling

them organize their resources efficiently, increase specialization and economies of scale in production, minimized costs incurred in marketing, access new varieties of products and obtain dry maize grain in the market at lower prices. It will also enable traders and processors to ascertain whether the business they are engaged in will be yielding profit or loss. Policy makers in Kenya will be in a position to draw policy guidelines which assist the government to regulate the dry maize grains markets.

1.8 Significance of the Study

The findings of the study are expected to benefit policy makers, farmers/producers, consumers, traders, agents of marketing, processors and researchers by enriching them with information on dry maize grain marketing in Kenya. The study findings are also expected to increase the actions of farms that lead to increased net farm income for dry maize grains and enhance better movement of dry maize grain from source markets to terminal markets or vice versa depending on shortages and surplus. In general, an understanding of market integration aims at equipping farmers and traders with information that would end up boosting their dry maize grains income, as well as enabling allocation of available resources based on their comparative advantage to be attained.

1.9 Scope of the Study

The study majorly dwelt on marketing of dry maize grain within Chepseon, Londiani, Barsiele, Kamasian, and Fort Ternan markets in Kipkelion East and West Sub-Counties, Kericho County. The study analyzed the influence of transaction costs, market information access, infrastructures, and price transmission on market integration. This was due to the fact that the cited areas were the main producers of maize in Kipkelion

East and West Sub-Counties respectively. Therefore, the factors that were analysed were believed to be the key in influencing dry maize grain market integration.

1.10 Limitations of the Study

The study was not free from limitations. Firstly, analysis was based on assumption that the outcomes would be generalized with caution to the entire county and country, since market integration is affected by different factors across groups of dry maize grain traders and markets. Nevertheless, the study can be inferred to be a source of data that may be used to make judgement about other markets and form a foundation for future studies. Secondly, the study was conducted using a sample of dry maize grain traders; therefore, its finding may not be accurate and true for generalization for all the actors in the county. Lastly, the accuracy of responses from questions administered to most of the respondents may not have been accurate since most of them did not have records. Therefore, they relied on their past memories.

1.11 Assumptions of the Study

The participants were assumed to have responded to interview questions in an honest and candid manner. The information obtained from the interview exercise was a true representation of the entire dry maize grain traders in the county who did not participated in the exercise and can be generalized to the rest of the dry maize grain traders across the country.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The chapter presents the literature review on the relevant studies, market integration concept, marketing cost concept, price differential analysis, conceptual framework, theoretical frameworks of co-integration model and acknowledges the contributions made by various scholars through publications. It also identifies the gaps that exist in literature and gives a way forward. However, after a critical review was carried out, a summary of literature and emerging issues was made on the study.

2.2 Market Integration Analysis

Market integration exists when issues of prices in different markets are following similar pattern and trade is possible in such markets (able to trade between themselves). In literature price data have been used to analyze how markets are integrated (the change in commodity market price should bring an effect on price of similar commodity in a different market) (Barrett, 2001).

Farmers' participation in the market largely depends on whether they are able to access adequate infrastructure and appropriate incentives. Those who are not in a position to get access to these two key ingredients would not participate in the market (Barret & Swallow, 2006). This finding concurred with those of Kharallah *et.al*., (2000) that, having the right market prices is not sufficient to promote the welfare of farmers to participate in the markets and market integration. Traders need to be in a position to access public goods and have required economic incentives.

According to Ghosh (2000) spatial market integration exists when price products in markets co-moves. Price patterns and market information are being passed from one market to the other and the price effects need to be reflected in other markets. Markets that lack integration gives inaccurate pricing patterns, which end up interfering with producer's decisions in production and thus product movement, will be entangled with a lot of inefficiencies.

According to Korir (2003), market integration analysis in spatially separated markets can be measured by use of bivariate correlation coefficient; in which a positive correlation coefficient shows the pair of markets is integrated and a negative correlation coefficient reveals absence of market integration in the paired markets.

Susanto & Rosson (2007); Abey, (2008) an integrated market benefits both consumers and producers. Producers are able to organize their resources efficiently, improves the level of product specialization and economies of scale. Consumers are able to get access to new technologies such as new varieties of products in the market at lower prices. The market that lacks integration may give pricing information that might affect decision making in production hence creating inefficiencies in markets.

According to Barrett (2001) an efficient market may not appear as integrated especially if the transactions costs involved in two paired markets is higher compared to the difference in their prices in such markets; thus making the trading in such markets unprofitable. Therefore, an efficient market indicates absence of unexploited opportunities for trade. Markets will not be integrated in case a price change of a given commodity will not reflect a price change of a similar commodity in a different market.

However, market integration minus efficiency can still prevail for example if transactions costs are too high.

In East Africa region Kenya is considered to be a net consumer of maize, importing its shortages from Tanzania and Uganda. Studies have been done regionally to test price transmission and market integration in the maize markets. The results have shown that price transmission and market integration are influenced by distance between markets, border effects and marketing costs. Further results indicated that Dar es Salaam, Nairobi, Mombasa and Kampala markets are integrated (World Bank, 2009 and Ihel et al.; 2011).

2.3 Marketing Cost Analysis

All the costs involved in the trading process are regarded as marketing costs. Marketing costs comprise of handling charges, marketing charges and transfer cost in any transaction performed. According to Pomeroy and Trinidad (1995), transactions costs should be recovered in an efficient marketing system. However, costs changes based on the services offered. An analysis of marketing costs aims at estimating expenditure involved in any given activity in the market and be able to compare costs incurred by different traders in marketing a given product.

2.4 Price Differential Analysis

According to Mauyo (2004), price differential analysis refers to a process of working out the actual price changes between the initial and end markets which indicates price efficiency. The inclusions of transaction costs in analyzing market integration bring in the use of parity bound model (Baulch, 1997). However, in a competitive market structure, price variations should not be more than the transfer cost. If all

suppliers/producers take similar products to a terminal market, in a perfectly competitive market the price which each producer (seller) receives is the terminal market price minus the cost of transferring the product to a terminal market.

According to Bressler and King, (1978) site price is the price of a product at a specific area and this will be useful when determining whether the inter-market price differentials reflect transfer costs. A site price is derived from the market price of a given product minus the cost of transfer from a specific area and the cost of transfer is determined by the distance.

2.5. Literature on Relevant Empirical Studies

Co-integration model was applied in assessing relationships between maize, millet, and sorghum prices in Ghana markets. Average wholesale monthly prices were used in the assessment and the results were maize markets are integrated and linked to millet and sorghum markets (Alderman, 1992).

Jaleta and Gebremedhin (2009) used co-integration model to analyze integration of teff and wheat markets in Ethiopia. The outcome was that both markets were well integrated. The study didn't indicate whether wheat prices caused teff prices and vice versa.

Market integration after liberalization in Uganda maize markets, displayed sense of improvement (Rashid, 2004). This was arrived at after subjecting the maize markets in Uganda into Co-integration analysis and Causality test.

Van Campenhout (2007) used Threshold Autoregressive (TAR) in analyzing prices of maize in Tanzanian markets. This previous study used weekly price data for a given

period of time and the outcome was markets that were close to each other portrayed a small threshold unlike those which were far from each other. On half-life flexibility; it was identified that it took four to twelve weeks for half adjustment to be achieved. This study relied on secondary data only; while the current study included primary data in the analysis of market integration.

In Mozambique Tostao and Brorsen, (2005) used retail maize prices per month to determined market integration and in the determination the costs of transferring maize were factored in. These scholars employed Parity Bound Model (PBM) due to its capacity to differentiate three regimes i.e. competitive trade, disequilibrium, and non-trading markets. The feedback was that some of the markets in Mozambique were significantly integrated and the transfer cost in some of the markets was very high to justify maize trade in some of the market pairs. The study used secondary data only, but the current research study combined both secondary and primary data in the analysis of market integration.

According to Rashid (2011), prices of staple food are related in the long-run and price shock to a given market would be passed to other markets, spatially and temporally if markets are integrated. The study, however, did not determine the amount of time the price transmission would take. TAR model was used in the current study to analyze this feature.

Venny (2013) carried out an analysis of dry beans market integration in Kitale, Eldoret, Nakuru and Nairobi markets using average monthly price data from 1994 to 2011.Co-integration analysis results indicated that markets were integrated. The Causality test was also done to test to determine the direction of relationship after coin-integration test.

TAR was also employed to test for price adjustment in the dry beans markets. The study concentrated on secondary data for analysis but the current study made use of primary and secondary data.

According to Sopo (2008), maize markets in Malawi are linearly co-integrated. This was confirmed by use of linear co-integration and bivariate correlation coefficient test. The study results were based on linear co-integration which can't give conclusive results on market integration. Therefore, this study used threshold autoregressive error correction model which allowed analysis of price transmission since transaction cost involved was factored in the analysis.

Abdulai (2000) applied TAR model in analysing Ghana maize markets. The outcome was Ghana maize markets were integrated. In his analysis he used secondary data only. The current study included primary data for more objective results to be achieved.

Motamed, Foster & Tyner (2008) analysed prices of maize markets of Mexico and United States by use of linear Error Correction and Linear Cointegration models and the results were maize market prices were dissimilar in long run hence the markets lacked integration.

Kuan & Yuan (2009) applied the threshold vector error correction model (TVECM) to test asymmetric comparison between farm and retail rice market prices Taiwan markets. The author found out that, feedback between retail and farm rice market prices existed and in situations where marketing margin were low compared to threshold value the market system operated freely. The government intervened on occasion where marketing

margin was high compared the threshold value; thus the causality between the retail and farm rice prices ceased to prevail.

According to Mohammad & Wim (2010) rice markets in Bangladesh in short run was found to have weak co-integration. The analysis was done by use of cointegration and TVECM. Wholesale prices per week were used in the analysis. Co-integration test confirm whether spatial markets prices have long run integration. However, terminal market price change may not be reflected immediately in the source market hence in short run the two markets may not be co-integrated (Rapsomanik, Adenegan, Kemisola and Anifat. 2006).

Goychuk & Meyers (2014) applied co-integration model to analyze price dynamics between, European Union (E.U), Russia, United States (U.S), Ukraine and Canada in evaluating market integration of wheat markets. The results showed that E.U and U.S wheat prices were integrated but lacked co-integration with Canada wheat prices. On the same note, wheat prices of Ukraine were co-integrated with French prices only. Bakucs, Brümmer, Cramon-Taubadel & Ferto (2012) used the same model to analyze price transmission in order to determine market integration of wheat markets between Germany and Hungary

The studies reviewed have confirmed that traders in the markets are in a position to make prompt decisions when market information and road network are accessible. To determine market cointegration and price spread of agricultural produce, most of the scholars have used various approaches. In regard to the above approaches reviewed, the findings portray the existence of market integration in majority of the markets.

Studies on dry maize grain markets in Kenya have concentrated mostly on cross border and urban trade; and used co-integration and TAR models. However, no studies on terminal and source market integration in a rural setup markets have been carried out. Therefore, the co-integration, correlation and TAR models were used in this study to analyze integration between the source and terminal dry maize grain markets and the results of the study have contributed to the knowledge on Kenya's dry maize grain markets.

2.6. Theoretical Framework

Spatial and temporal transmission of price coupled with its speed will determine the ability of the marketing system to perform its function efficiently hence promoting market efficiency. The current study dwelt on analysis of relationship of dry maize grain prices in spatial differentiated markets; thus spatial market integration became the base of the study.

According to Ogutu *et al.,* (1997), competition and trade between markets would be promoted by market integration and the producers end up increasing their production and attain better income and improved living standards. Markets will work efficiently if they are fully integrated. However, in reality, an efficient market may fail to operate due to the presence of some factors that prevent its efficiency. For example; high transaction costs impedes the flow price information of various products in the markets. These costs of transaction are categorized into fixed and variable. Fixed transaction costs include costs involved in constructing road network and installing communication facilities, while variable transaction costs comprise of transportation costs. Variable transaction

costs depends on the quantity of products being handled, the higher the quantity the lower the costs incurred in trading process and vice versa (Williamson, 1985).

This study therefore, was able to build its analysis on the theory of price difference. The theory states that; 'In any two markets trading together, price variation equals the transfer costs.' This can be explained as price of a given product e.g. dry maize grain in time t is $P_{1,t}$ and $P_{2,t}$ for market 1 and 2 respectively. If the variation in market prices in the two markets equals transaction costs, then the two markets would be integrated as shown in equation 2.1 (Rapsomanikis *et.al.* 2006).

$P_1 = P_2 + K$..... (2.1)

Therefore, market 1 and 2 can trade only if $| P_1 - P_2 > K |$ ratifying the theory that ensures the prices of similar products being traded in any two separated markets are equal. However, if this is true, then the Law of One Price (LOP) can apply which states that, 'given market prices of a product in two markets which are spatially differentiated as $P_{j,t}$ and $P_{i,t}$ at all levels in time, the price difference should be the cost of transferring the product from market j to market i (Rapsomanikis *et.al.*, 2006). However, if the prices in the two markets are found to be having no relationship, then both price transmission and market integration will be lacking, resulting in market segmentation (Ravallion, 1986). This is illustrated in equation 2.2.

$P_{i,t} = P_{j,t} + C$..... (2.2)

Where C is the marginal costs of transferring a product from market i to market j. Therefore, if the theory would be depicted in the two markets, thus markets are said to be integrated. However, in extreme cases where price transmission and market integration in the two markets are lacking due to segmentation, it would results in a strong form

LOP. This in reality rarely occurs since the market price of a product would always vary by a value at most equal to cost of transferring. This can be illustrated in equation 2.3 as shown below.

$P_{i,t} - P_{j,t} \leq C$ ..... (2.3)

The above represent an equilibrium condition, which indicates that the prices being witnessed in markets may differ from what is being observed in equation 2 but spatially arbitrage will always cause variation in the two prices to shift towards the cost of transferring a product.

2.7. Conceptual Framework

Figure 2.1 presents the relationships between the dependent and independent variables. There are several factors that are perceived to influence market integration in the figure. These factors include transaction cost, infrastructure, market information access, price transmission, environmental factors and government policies. Transaction costs such as loading and offloading costs, transportation, marketing costs, and storage costs would determine the selling price of a product in the market, when pricing of a product is being done these cost need to be factored in to ensure efficiency in the market. Lowering transaction costs, it promotes an increased in market participation due to enhanced marketing margin. However, producers would be motivated to produce more surpluses for marketing under favourable conditions and surplus goods would flow to deficit markets effectively removing possibility of market segmentation. Access to quality feeder roads would improve the delivery of commodities to the market and ensures the supply is adequate to satisfy the demand. Storage facilities would ensure the products in the market are available all times whether is on season or not. Lack of communication and physical structures lowers the price information and hence leads to inefficient

market. Poor infrastructures raise the transportation costs and therefore affecting price transmission (Rapsomaniki *et. al.,* 2006). Access to market information such as supply and demand levels by traders and consumers would determine the trade of a product in a market. Existence of price variations, lack or availability of price information of a product in different markets would influence the demand and supply of a product, thus resulting in either efficient or inefficient market. For example, nature of infrastructure facilities and market information access would affect the price received by dry maize grain traders by influencing costs involved in transferring products hence promoting market participation. Price transmission and time on the other hand, was found to give a degree of market integration. It was found that, if source and terminal markets are integrated, then the price of dry maize grains per 90Kg bag in terminal market would exhibit some transmission. This is due to dry maize grain flowing from source market which was regarded as surplus market to terminal market which was regarded as deficit market, hence increasing terminal market supply. Therefore, terminal market prices would reduce due to the increased supply from the source market and vice versa. It was found that time required for price transmission to be felt portrayed a mixed pattern due to inadequacy of market information in the two markets under the study.

An integrated market occurs in a scenario where transaction costs, infrastructure, market information, price transmission are factored in product being traded. This study concentrated on analyzing the impacts of the enlisted factors on dry maize grain market integration in order to achieve the set objectives. Factors such as government policies, environmental factors and seasonal factors are intervening variables to the attainment of

dry maize grain market integration in the area of study. However, these three variables were not analysed in this study.

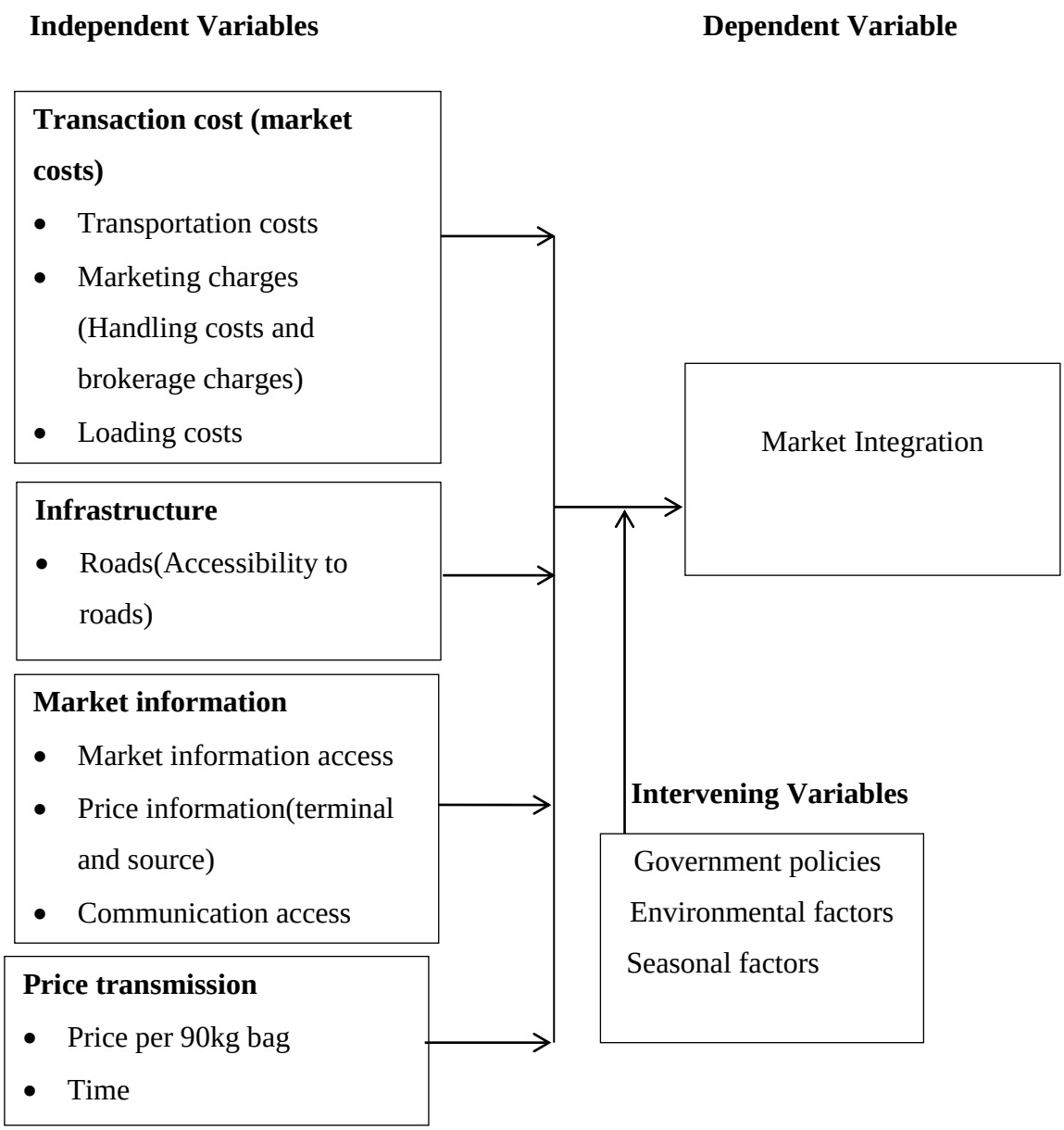

Figure 2.1: Conceptual Framework of the Analysis of Market Integration

Source: Author's own conceptualization, 2018

2.8. Identification of Knowledge Gap

Regardless of liberalization of dry maize grain market in Kenya, no market integration studies that have been undertaken on dry maize grain markets in a rural set-up. Previous

studies that focused on market integration of dry beans were carried out in Nairobi, Nakuru, Eldoret and Kitale. However, studies on market integration on dry maize grain have not been undertaken, especially terminal and source markets. Therefore, to address the existing knowledge gap and add more knowledge to literature, this study used the Co-integration, Granger causality, Regression and Correlation analysis, Pearson's product-moment correlation and Threshold Autoregressive (TAR) models to analyze dry maize grain markets integration in Kipkelion East and West Sub-Counties source and terminal markets in Kericho County. Dry maize grain prices in these markets have been fluctuating over time and sometimes the prices in the source markets have been similar to terminal markets prices and vice versa and yet the markets are far from each other. Lack of information about terminal and source markets has led to increased prices fluctuation in dry maize grain markets that affect resource allocation by farmers as well as the entire traders in dry maize grain sector. The possibility of determining integration of marketing system of dry maize grain would be achieved by analyzing the price transmission and extent of market integration in terminal and source markets. In addition, the speed at which traders move their dry maize grain from high supply to low supply markets was influence by price transmission. On the other hand, market integration ensures that an equilibrium state in terms of trade is achieved between terminal and source markets.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

This chapter presents the research design, location of the study, target population, sample size, sampling procedures, data collection instruments, the validity of the instruments, reliability of the instruments, data collection procedures, data analysis and presentation, and ethical considerations.

3.2. Research Design

The study used descriptive and cross - sectional research designs. Numerical data from an interview schedule was used in the design to analyze relationship of market integration, price and cost variables.

3.3. Study Area

The study was undertaken at Kipkelion East and West Sub-Counties in Kericho County (Appendix 5 and 6). Kericho County is classified into three agricultural zones; high, medium, and low productive zones. Kipkelion East and West Sub Counties fall under high productive agricultural zones and are in the Northern part of the County. The two Sub-counties constitute 52.2 % of the total land area of the County (MoALF, 2017). The two Sub Counties depend heavily on rain for the production of maize. Both Sub-Counties receive on average 1200mm of rainfall per year, which is well distributed. The soils are fertile loamy which favours maize production and other enterprises like coffee farming. Kipkelion West Sub-County, a medium productive agricultural zone covers the Northern-Western part which borders Kisumu County and Tindiret Forest in Nandi County. However, climatic conditions for this zone favour maize production. Kipkelion

East Sub County borders Nakuru County. The two sub-counties are the key dry maize grain producers in Kericho County which favoured to be chosen as the study area. Maize production across the county according to the county's MoALF report, 2017 is as shown in Table 3.1.

Table 3.1

Maize yields in Kericho County

S. No.	Sub-County	Maize production (in tonnes)	Hectares under production
1	Ainamoi	6,700	2,127
2	Belgut	3,024	960
3	Bureti	16,913	5,436
4	Kipkelion East	32,288	10,250
5	Kipkelion West	37,548	11,920
6	Soin/Sigowet	6,835	2,170
	Total	**103,308**	**32,863**

Source: Crops Annual Report, (MoALF, 2017)

Dry grain maize markets in the study area play a significant role in supplying dry maize grain across the county as shown in Table 3.1. The terminal markets are Fort Ternan (GPS Coordinates: 0.2017^0 S, 35.3474^0 E) and Chepseon (GPS Coordinates: 0.2554^0 S, 35.4786^0 E) whereas the source markets are Kamasian (GPS Coordinates: 0.14860 S, 35.4249^0 E), Barsiele (GPS Coordinates: 0.1497^0S, 35.4965^0 E) and Londiani (GPS Coordinates: 0.1635^0 S, 35.5931^0 E). Chepseon and Londiani markets are in Kipkelion East Sub County while Kamasian, Fort Ternan and Barsiele markets are in Kipkelion West Sub County.

3.4. Target Population

Target population is the totality of objects and persons of interest to the study (Grinnell and Williams, 1990). For this study, the primary unit of analysis was the traders of dry maize grain in terminal and source markets of Kipkelion East and West Sub-counties. The target population comprised of 35,500 dry maize grain traders in terminal and source markets in Kipkelion East and West sub counties of Kericho County respectively. These targeted individuals were involved in marketing of dry maize grains. The target population was according to records available in Kipkelion East and West Agriculture offices. This was displayed in Table 3.2.

Table 3.2

Distribution of target population

S. No.	Sub-County	Markets	Target population
1	Kipkelion East	Chepseon	9900
		Londiani	6390
2	Kipkelion West	Kamasian	5210
		Fort Ternan	9400
		Barsiele	4600
	Total		**35500**

Source: Annual Report, (MoALF, 2017).

The targeted population also focused on groups of farmers and NCPB who were involved in marketing of dry maize grains.

3.5. Sample Size and Sampling Procedures

3.5.1. Sample size

Sample size determination for this study was adopted from Nassiuma (2000), as shown in equation equation 3.1 to determine the '***n***' value, which is the sample size;

$$n = \frac{NC^2}{C^2+(N-1)e^2} \quad \text{...} \quad (3.1)$$

n = 35,500 x 0.25^2 ÷ 0.25^2 + (35,500 – 1) 0.02^2 = 155.57

Where,

n = Samples size;

N = Population size - N =35,500 (Agriculture office, 2017);

C = Coefficient of Variation which is 25%; and

e = Margin of error which is 2%.

Therefore, based on the above calculations, the sample size of traders was 156 which was then used for data analysis in this study.

3.5.2. Sampling procedures

Stratified random sampling was employed in the study to obtain the number of dry maize grain traders required for the study. The strata were the various dry maize grain markets. A total of 156 dry maize grain traders were sampled. These were distributed across the five markets as shown in Table 3.3.

Table 3.3

Sample size per market

S.no.	Market	Target population N	%	Sample Size N
1.	Chepseon	9900	28	44
2.	Londiani	6390	18	28
3.	Fort Ternan	9400	26	41
4.	Kamasian	5210	15	23
5.	Barsiele	4600	13	20
	Total	**35500**	**100**	**156**

Source: Authors' own computation, 2019

The percentages for each market was obtained by dividing the target population in each market by the total population of dry maize grain traders (i.e.35,500) and multiplying by

100 per cent. The calculated sample size of 156 was then distributed proportionately by dividing each market percentage by 100 per cent and multiplying the results by 156.

3.6 Data Collection Instruments

This study used both primary and secondary data sources. Primary data was collected directly from the dry maize grain traders using interview schedule. Interview schedule is a method of collecting data in which the respondents are asked questions by the researcher to find out what they do, think or feel. These study questions were of two types: closed ended questions that required dry maize grain traders to select the answer from a number of pre-determined alternatives and open ended questions where the dry maize grain traders gave their personal responses or opinions using their own words. The interview schedule questions were written in English and administered to dry maize grain traders who gave their responses on the socio-economic characteristics (such as age, gender, and education level), buying and selling price and marketing costs of dry maize grain from the traders, average retail price data per month for a four-year period from January 2014 - December 2017, infrastructure and market information. The interview schedule was organized in all the five markets. The researcher administered the interviews.

Secondary data was collected through literature review. A review of various reports such as from the Ministry of Agriculture, Livestock and Fisheries annual reports, published theses and economic journals, economic surveys, statistical abstracts, conference reviews, books, magazines, national and county development and strategic plans, National Bureau of Statistics publications, desktop literature, and the internet sources. Document analysis form was used to collect these secondary information/data.

In the MoALF the Sub Counties Crop, Agri-business officers and the County Crops and Agri-business officers provided the data. The researcher filled the document analysis form using the collected data from the reports.

3.6.1 Validity of the instruments

Validity of the instruments were determined by giving to two experts in the Department of Agricultural Bio systems and Economics at the University of Kabianga to determine both content and face validity. The experts possess wide experience in teaching, research and supervision of post-graduate students. Their comments were incorporated into the instruments.

3.6.2 Reliability of the instruments

The interview schedule questions were pilot tested with 30 dry maize grain traders in a neighbouring Sub-county with similar characteristics to the study sample to determine its reliability. The interviewed dry maize grain traders did not participate in the current study. Cronbach Alpha Coefficient was used to calculate the reliability. A reliability coefficient of 0.8 was obtained which was within the acceptable range. The reliability of Documentary Analysis Form was determined by pilot testing it in the neighbouring sub-county. The reliability coefficient was not calculated because of the nature of the instrument.

3.7 Data Collection Procedures

The researcher obtained a letter of introduction from the Board of Graduate Studies, University of Kabianga and sought a research permit from National Commission of Science, Technology and Innovations (NACOSTI). The researcher proceeded to book an

appointment with the Sub-County Agricultural Officer, to explain the objective of carrying out the research. The researcher proceeded to book appointments with the traders with the help of agricultural officers. The researcher administered the interviews to each dry maize grain trader.

3.8. Data Analysis and Presentation

STATA version 14.0 was used to analyse coded dry maize grain trader's survey data in order to generate descriptive statistics. STATA was also used to analyse the time series price data of dry maize grain collected from ministry of agriculture reports using document analysis form. Tables were used to present the results.

3.8.1 Co-integration analysis

Co-integration analysis was used to test how prices in terminal and source markets are related. When a long-run linear relation exists among different price series, the price series are said to be co-integrated. Goodwin and Schroeder (1991); Sexton and Carmar (1991), revealed that, an equilibrium relationship between terminal and source markets would exist, if the two markets are integrated. According to Goodwin and Schroeder (1991) equation 3.2 show a long run equilibrium relationship for analyzing market cointegration.

$Y_t = \alpha + \beta X_t$……..... (3.2)

Where Y_t and X_t = identical prices of a product in source and terminal markets respectively. β and α are parameters that was estimated. If α = 0, then the source and terminal market prices are identical (equal). This was based on LOP. However, market integration as per objective two of this study was analyzed using typical regression model as shown in equation 3.3.

$Y_t = \alpha + \beta X_t + u_t$……..…… (3.3)

Where, Y_t is the price series for terminal market in t time, X_t is the price series for source market in t time, α is the intercept term, β is the slope parameter and u_t is the error term. If β =1, source and terminal markets are said to be perfectly integrated. If this holds, then changes in terminal market price would be fully reflected in the source markets and vice versa. The extent of market integration may be determined by analyzing how far the deviation of $\boldsymbol{\alpha_1}$ is from unity, when $\beta \neq 1$ (i.e. $\beta < 1$ or $\beta > 1$).

3.8.2 Test for stationarity

Engle and Granger (1987), indicated that a two- step model would be used, since price, time series are usually non-stationary and because standard statistical models do not allow explicit determination of **α** and **β**. Step 1 would be to determine the "order of integration" of each price series by checking for stationarity. If the joint distribution of $\mathbf{Y_t}$ and $\mathbf{Y_{t+1}}$ is independent of time (**t**), hence time series (say $\mathbf{Y_t}$) would be stationary. This would be guaranteed by ensuring that the time series is integrated of order zero I (0). Since most price series have trends in them if only because of inflation, they are usually I (1) and thus they need differencing once to obtain I (0) process.

The order of integration was determine by use of Augmented Dickey-Fuller test (ADF). This was obtained by regressing $\boldsymbol{\Delta Y_t}$ on $\boldsymbol{Y_{t-1}}$ and several lags of $\boldsymbol{\Delta Y_t}$ (which was enough to avoid auto correlated disturbances). The model was presented as in equation 3.4.

$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \Sigma \alpha_{k+t} \Delta Y_{t+k} + \varepsilon_t$……..…… (3.4)

Where ΔY_t is the first difference of prices in market Y, Y_{t-1} is lagged price of dry maize grain in market Y, α_0 and α_1 are the parameters to be estimated and ε_t is the error term. The hypothesis H_o: $Y_t \sim I$ (1) Vs H_1: $Y_t \sim I$ (0) was tested by use of t-statistic on the

estimated coefficient of $Y_{t-1.}Y_t$, cannot be stationary if the null (H_o) cannot be rejected. It can be integrated of order one or even more. The test was repeated with ΔY_t in place of $Y_{t,}$ thus regressing $\Delta\Delta Y_t$ on a constant ΔY_{t-1} and several lags of $\Delta\Delta Y_t$ to find out the order of integration. The hypothesis *Ho:* $\Delta Y_t \sim I$ *(1) Vs; H1:* $\Delta Y_t \sim I$ (0) was tested by use of the ADF test.

Gujarati (2004) indicated that, the process would be repeated until the order of integration is established. Step 2 involved co-integration test based on the idea that if two time series (Y_t and X_t) are each ~ I (1), then their residual (say U_t) would be co-integrated of order zero (stationary). Where $U_t = Y_t - \alpha - \beta X_t$. The residual ($U_t$) would then be tested for stationarity. Large and negative statistics that would reject the null hypothesis of I (1) in favour of stationarity were obtained by applying ADF test to residuals. However, the two time series are said to be co-integrated only if the first and second step showed that each time series was integrated of order one and to a stationary residual respectively, this would imply that long run equilibrium relationship existed in the two sets of prices. TECM was used to make a clear difference between long-run and short-run integration. This made it possible for derivation of the speed of price movement from one market to another. Market integration would also be affected by speed of price adjustment. The Error Correction Model (ECM) used was as shown in equation 3.5.

$\Delta Y_t = \alpha_0 + \alpha_1 \Delta X_t + \alpha_2 U_{t-1} + \varepsilon_t$ ..... *(3.5)*

Where $\boldsymbol{\Delta}$ is the first difference operator, $\boldsymbol{\varepsilon_t}$ is the random error term and $U_{t-1} = (Y_{t-1} - \alpha - \beta X_{t-1})$. The absolute values of $\boldsymbol{\alpha_2}$ decide how quickly equilibrium will be restored (speed of adjustment) while ΔY_t depends on ΔX_t and equilibrium error term as stated by ECM.

3.8.3 Granger causality test

Gujarati (2004) argued that in order to determine the direction of relationship after doing co-integration tests; granger causality test would be required. The analysis of the nature of price transmission in both terminal and source markets was done with Granger causality test. The market price series P_{it} of dry maize grain was said to have effect on another dry maize grain market price series P_{jt} if current and lagged values of P_{it} improved prediction of $P_{jt.}$ However, according to Rashid (2004) causality determines the predictability of prices (price transmission) in markets; Johansen's co-integration test was used to confirm. Therefore, a pair-wise causal relationship was specified as shown in equation 3.6.

$$\begin{bmatrix}\Delta P_{it}\\ \Delta P_{jt}\end{bmatrix} = \begin{bmatrix}\alpha_i\\ \alpha_j\end{bmatrix} + \sum_{i-1}^{k-1}\begin{bmatrix}\varphi_{l,11} & \varphi_{l,12}\\ \varphi_{l,21} & \varphi_{l,22}\end{bmatrix}\begin{bmatrix}\Delta P_{it-l}\\ \Delta P_{jt-l}\end{bmatrix} + \begin{bmatrix}\beta_i\\ \beta_j\end{bmatrix}\begin{bmatrix}\delta_i & \delta_j\end{bmatrix}\begin{bmatrix}P_{it-}\\ P_{jt-}\end{bmatrix} + \begin{bmatrix}\varepsilon_{it}\\ \varepsilon_{jt}\end{bmatrix} \quad \text{..... (3.6)}$$

The granger causality in markets can be found to be bidirectional, independent and unidirectional. The shocks in market P_{it} would cause prices in market P_{jt} without reverse effect as indicated by unidirectional causality. The null hypothesis in this case will be coefficient δ_{it} which is statistically varying from zero ($\delta_{it}\neq 0$) against δ_{jt} which is not statistically varying from zero ($\delta_{it}=0$) the opposite will be shocks in market P_{jt} cause prices in market P_{it} without reverse effect.

On the other hand, if the shocks are transmitted back and forth it will indicate bidirectional causality. In this case the null hypothesis will be all coefficients i.e. $\delta_{i,}\delta_{j,}\beta_{i,}$ $\beta_{j,}\ \alpha_{i,}\ \alpha_{j}\neq 0$ statistically varying from zero. Null hypothesis in this scenario would be all coefficients $\delta_{i,}\ \delta_{j,}\beta_{i,}\ \beta_{j,}\ \alpha_{i,}\ \alpha_{j} = 0$ and are not statistically varying from zero.

3.8.4 Correlation and regression analysis

The aim of carrying out regression analysis was to be more reflective of the population than the mean (dependent value, or *Y*) alone, which would otherwise be the best estimate of the predicted value from a set of the given values. The study was concerned with whether the relationship pattern between two values of variables could be described as a straight line, which is the simplest and most commonly used form. The relationship between the source and the terminal market prices of dry maize grain was tested in the study. Equation 3.7 was used.

$$Y = \alpha + \beta X + \varepsilon \quad (3.7)$$

Where Y is the terminal market price for dry maize grain, X is the Source market price for dry maize grain, α is a constant. β is the regression coefficient, and ε is the error term. From policy researcher perspective, regression coefficient, β is typically more important than the intercept, since the policy makers are usually interested with the effect of one variable on another. The greater the regression coefficient, the more influence the independent variable has on the dependent variable, and the more change in Y associated with a change in X.

3.8.4.1 Pearson's product-moment correlation.

Pearson's *r* is a widely used correlation coefficient that measures the tightness of fit of X, Y-coordinates around the regression line of a scatter plot. Computed values of Pearson's *r* can range from -1 to +1. The larger the absolute value of *r*, the tighter the fit of *X*, *Y*-coordinates around the regression line. When the regression line slopes upward, we have a positive correlation. Pearson's *r* will be positive up to a value of +1, whereas when the regression line slopes downward, we have a negative correlation. Pearson's *r*

will be negative down to a value of -1 and finally, when the regression line is flat, we have no correlation and Pearson's $r = 0$

3.8.5 Threshold autoregressive (TAR) error correction model

According to Meyer (2002), the threshold Autoregressive Error Correction Model analyze price adjustment which can be tested and includes a band of non-adjustment and gives the ability of capturing potential symmetric price adjustment based on the assumption of constant cost of transaction in the period of analysis. In the long-run, equilibrium spatial price transmission for spatially integrated market (spatial arbitrage regime) under a competitive environment can be shown by equations 3.8 – 3.10.

$P_{it} - P_{jt} < C$ *if* $q = 0$ *(regime 1)*……..... (3.8)

$P_{it} - P_{jt} < C$ *if* $q > 0$ *(regime 2)*……..... (3.9)

$P_{it} - P_{jt} < C$ *if* $q < 0$ *(regime 3)*……..... (3.10)

Note:

P_{it} is the price in market i at time t, P_{jt} is the price in market j at time t, and q is the quantity of dry maize grain traded between the markets in two way direction; if $q > 0$ amount of dry maize grain traded from market i to j. If $q < 0$, the amount of dry maize grain traded from market j to i and C is the marginal transfer cost, assumed to be symmetric irrespective of direction the trade would take.

Equation 3.8 (regime 1) occurs when there is no trade between markets; thus the absolute value of the price transmission (spread) should be less than transfer cost. Equation 3.9 (regime 2) indicates that if trade flows from i to j, then the price in market j should be equal to the price in market i plus transfer cost. Equation 3.10 (regime 3) indicates that if trade flows from market j to i, then the price in market i should be equal to the price in

market *j* plus the transfer cost. In this study, the regimes were subjected to Threshold Autoregressive (TAR) Error Correction Time Series Statistical Model test since it allows for deviations from the efficiency conditions to occur both in short and long run. Equations 3.11 - 3.13 show the test presentation (Meyers, 2008).

$$\Delta d_t = \varphi + \beta_o d_t\text{-}_1 + \sum_{k-1}^{k} \beta_k \Delta d_{t-k} + \varepsilon_t \; if \; |d_t| \leq c_t \; (regime\ 1) \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.11)$$

$$\Delta(d_t - c_t) = \alpha\,(d_t\text{-}_1 - c_t\text{-}_1) + \sum_{k-1}^{k} \alpha_k \Delta(d_{t-k} - c_{t-k}) + \varepsilon_t \;\; if \; |d_t| > c_t \; (regime\ 2) \ldots\ldots (3.12)$$

$$\Delta(d_t - c_t) = \alpha(d_{t-1} + c_{t-1}) + \sum_{k-1}^{k} \alpha_k \Delta(d_{t-k} - c_{t-k}) + \varepsilon_t \; if \; |d_t| < c_t \; (regime\ 3) \ldots\ldots (3.13)$$

Where;

$d_t = P_{it} - P_{jt}$ is the price spread between markets at time *t*, Δ is the first difference operator; $\Delta d_t = d_t - d_{t-1}$, C_t is the long run cost of transfer at *t* time and ε_t is the error term. Non-linearity at the threshold allows the price transmission to show different behaviour inside and outside a 'parity bound' defined by long-run transfer costs. Thus to determine the effectiveness of spatial price transmission, the size of the parity bound in regime 1 and the behaviour of price transmission when they are outside the bounds in regime 2 was of great importance. This would explain deviations of price transmission from the parity bound and indicate how long it takes them to return to the bound. Therefore, the model was relevant for this study. The model estimated the time it took price transmission (spread) between market *i* and market *j* to move half way back to its threshold (half-life) by looking at regime 1 and 2. The value of α gave the rate of price adjustment but did not indicate the value of adjustment. Therefore, half-life price

transmission back to the parity bound in regime 2 and 3 was determined through equation 3.14.

$h = \{In\ (0.5) \div In\ (1 + p)\}$ 3.14

According to Meyers, 2008 the time taken by trade to increase and cause the price spread half-way back to the parity bound assuming no other shocks is referred to as half-life. The price transmission would be highly effective if the half-life is shorter (Meyers, 2008).

3.9 Ethical Considerations

Assurance was given to the dry maize grain traders that all the data collected from them will not be shared with anyone who is not participating in the study. More so, it would be kept confidential for the purposes of this study only. The dry maize grain traders remained anonymous throughout the study to guarantee confidentiality. The study was carried out with the authorization from NACOSTI.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The chapter presents the results and discussions on the response rate, socio-demographic characteristics of the respondents, descriptive and inferential analysis of the three specific objectives of the study.

4.2 Response Rate

One hundred and fifty-six (156) dry maize grain traders from Kipkelion East and West sub-counties were selected for interviews. For this study, 100% response rate from respondents was achieved, a response rate of 70% and over is excellent, a rate of 60% is good and a response rate of 50% is adequate for analysis and reporting (Mugenda and Mugenda, 1999). Thus, the response rate for the current study was excellent for analysis and reporting.

4.3 Descriptive Analysis

4.3.1 Socio-demographic analysis

Tables 4.1 to 4.3 present a summary of results of the demographic characteristics of dry maize grain traders. Gender distribution results of the dry maize grain traders are shown in Table 4.1 shows. Results show that 46.2 percent were females while 53.8 percent of the dry maize grain traders were males. This indicated that dry maize grain trade was dominated by male traders. Rutto (2015), in his study found out that 47.6% of maize small holding farmers respondents in Soy sub-county, Uasin Gishu County were female, while 52.4% were male. His gender response findings were in convergence with the current study findings.

Table 4.1

Gender distribution of dry maize grain traders

Gender	Frequency	Percent (%)
Male	84	53.8
Female	72	46.2
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

Results on age distribution of the dry maize grain traders are presented in Table 4.2. From the results, most of the dry maize grain traders were aged more than 35 years. This group represented 76.9% of all the dry maize grain traders sampled. The dry maize grain traders between the ages of 30-35 years, 24-29 years and 18 -23 years were 13.5%, 8.3% and 1.3%, respectively. According to the findings by Rutto, (2015) on age distribution of the maize small holding farmers, 57.3% were between 26-35 years of age, while 23.2%, 11.0% and 8.5% were between the ages of 19-25 years, 36-45 years and above 46 years, respectively. Author's findings showed divergence from the current study. Majority of the youth (below 35 years of age) are assumed to be pursuing education and majority of them end up participating in dry maize grain business after their education or as the last alternative source of employment as revealed by the findings of the current study.

Table 4.2

Age Distribution of The Dry Maize Grain Traders

Age bracket	Frequency	Percent (%)
18-23 years	2	1.3
24-29 years	13	8.3
30-35 years	21	13.5
Over 35 years	120	76.9
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

The levels of education attained by the sampled dry maize grain traders were shown in Table 4.3 of results. The adoption of innovation as revealed by the results is greatly influence by education. Therefore, young educated traders are expected to be adopters of innovations. From the table of results, 46.2% of the dry maize grain traders had attained secondary school level of education, whereas 44.9%, 6.4% and 2.6% of traders had attained primary, college and University levels of education respectively. This implied that most of the dry maize grain traders are primary and secondary school leavers. This was found to be a unique finding. Education in itself is considered vital in trading business. This finding was found to agree with Makhura, Kirsten & Delgado (2001) findings. The authors found out that household heads with at least secondary level of education increased understanding of market dynamics in the entire household and hence improve decisions making on the quantity of output that can be sold. College and university leavers were lowly represented in dry maize grain trading. The current study finding may be due to the fact that most of the college and university leavers prefer white collar jobs. The findings by Rutto (2015), shows that many of the youth engage in maize farming at least after finishing their secondary school education. This finding agreed

with the current study finding. Therefore, the study revealed that majority of dry maize grain traders have an average level of education in the study area.

Table 4.3

Education Levels of the Dry Maize Grain

Education Level	Frequency	Percentage (%)
Primary	70	44.9
Secondary	72	46.2
College	10	6.4
University	4	2.6
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

4.3.2 Transaction cost (marketing costs)

Tables 4.4 to 4.16 presents summary results of transaction costs incurred by dry maize grain traders in the area of study. The sources of dry maize grains for the maize traders are presented in Table 4.4 of results. As shown in the table, majority of dry maize grain traders (91.7%) sourced their dry maize grain from farmers while 6.4%, 6% and 1.3% of dry maize grain traders sourced their dry maize grain from agents, wholesalers and others respectively. Farmers were found to be the main producers and source of dry maize grain for sale to the traders both in the source and terminal markets in the study as indicated by the results.

Table 4.4

Source of Dry Maize-Grain

Source	Frequency	Percent (%)
Farmer	143	91.7
Agent	10	6.4
Wholesalers	1	.6
Other	2	1.3
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

Tables 4.5 present results on factors that are considered by dry maize grain traders while purchasing dry maize grains in the area of study. Majority (64.7%) of the dry maize grain traders reported price as the most influencing factor that is considered by maize traders when making decision on where to purchase dry maize grains. However, 27.6%, and 7.1% of the dry maize grain traders considered distance and means of transport respectively to be the main factors that are considered by maize traders while purchasing dry maize grains. According to Adesola and Kabir (2014), spatial price linkages within maize markets allows efficient movement of products across markets as product of efficiency of price information flow. The study found that there is critical need to provide more price information to dry maize grain traders to enable them benefit from spatial price difference. This earlier study was found to be convergent with the current study, since in both studies, price was established to be the main determining factor. It was evident from the results that distance contributes to poor maize marketing by the dry maize grain traders across the markets in the study area. Dry grain maize traders consider travelling and transport distance while buying dry maize grain since distance is a function of price and thus, the further the distance from the source to terminal market, the greater the transaction cost, and eventually impacting on the final selling price. John, David, Timothy and Ellen (2009), revealed that a major constraint to the intensity of market participation among traders is distance from the farm to point of sale. Key, Sadoulet & de Janvry (2000) and Makhura (2001) also found out that distance to market has a negative impact on both proportion of marketable load size and the decision to participate in the market. These previous findings are convergent with the findings of the current study. John *et.al.*, (2009) found out that price and formal market information sources would greatly intensify market participation. The current study results are in

lined with the author's findings and that of Ahmed *et. al.*, (2016) results on access to terminal market by small scale producers, in which the case study on Punjab and Pakistan showed that lack of market information, long distances from farm to market and high transportation cost threatened accessibility to market for agricultural produces. The study results therefore, indicated that besides distance covered by the maize traders, there is need for the traders to be equipped with price knowledge across the dry maize grain markets for trade to exist.

Table 4.5

Factors Considered When Buying Dry Maize Grains

Factors	Frequency	Percent (%)
Distance	43	27.6
Price	101	64.7
Means of transport	11	7.1
Other	1	0.6
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

Results on Table 4.6 show whether or not the dry maize grain traders had incurred transport costs or not. Table of results reveals that 91% of the dry maize grain traders had incurred transport cost. The remaining 9.0% indicated that there was no transport cost incurred. The results shows that dry maize grain transportation to the intended market was critical and therefore, the traders need to consider the transport means that offers minimal cost for better returns to be realized in dry maize grain trading.

Table 4.6

Transport Cost

	Frequency	Percent (%)
Yes	142	91.0
No	14	9.0
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

A summary of the various types of costs incurred by dry maize grains traders from the source to the terminal market in the study area are shown in Table 4.7 of results. From the results, transport cost was the highest at an average cost of Ksh. 72.17 per 90 kg of dry maize grain. This was followed by Ksh. 64.39 being the cost per trip. Offloading cost had the lowest mean cost of Ksh. 16.38 per 90 kg of dry maize grain. The high variations in the average cost per 90 kg of dry maize grain can be attributed to the storage cost that has a standard deviation of 58.559. Cess charges had the lowest variation in terms of average cost per 90 kg of dry maize with a standard deviation of 10.11. Navadkar, Amale, Gulave & Nannaware (2012) findings was that, major component of marketing cost is packaging (82.63%) and transportation charges (10.74%). The authors findings on packaging charges was found to be divergent with current study but findings on transportation charges agrees with the current study results.

Table 4.7

Descriptive statistics for transaction costs of dry maize grains

Type of cost	N	Mean	Std. Deviation
Cost per trip (90kg)	156	64.39	47.798
Labour for loading 90kg bag	156	18.46	12.123
Storage cost	156	34.20	58.559
Offloading cost	156	16.38	10.342
Transport cost	156	72.17	51.945
Market Charges (handling Cost/brokerage charges)	156	28.40	35.786
Packaging cost	156	30.56	15.839
Cess Charges	156	27.05	10.110
Valid N (list wise)	156		

Source: Author's Computation from Survey Data, 2018

Table 4.8 presents results on problems faced by dry maize grain traders during transmission of dry maize grains from source to terminal markets. From the results, 61.5% of the dry maize grain traders stated that poor roads were the biggest problem during transmission of dry maize grains from source to terminal markets. This was followed by 28.2% of the dry maize grain traders who reported the high charges and levies. Nine per cent (9%) of the traders mentioned lack of transport means while 1.2% of the traders stated lack of security as the hindrance to transmission of dry maize grains**.** Poor roads has led to high cost of transport which has consequently led to reduced volume of trade as well as household income. Buy, Deichmann, & Wheeler (2006) evaluated the degree of trade among African countries in reference to road quality and distance by use of gravity model. Their findings revealed that 2% increase in trade between countries was due to 1% increase in road quality. Shahidur, Nicholas, Solomon and Befakadu (2010) argued that, if the costs of transportation are much higher between source and terminal markets, it would imply that excessive checkpoints, road quality, in the transport sector, or imperfect competition are an issue. The author's findings agreed

with the current findings of the study. Further, according to Teravaninthon & Raballand (2009), increased transport costs is due to poor roads (tire replacement costs, faster depreciation of vehicles, lost time due to lower speed, higher fuel consumption and higher maintenance costs) thus impacting negatively on transmission of agricultural products. These previous research findings results are in convergence with the current study results on transmission of dry maize grains from source to terminal market. Loveridge (1991) found that, decreased price variations between two spatially separated markets and an increased price correlation with time were as a result of a road improvement project in Southwestern Rwanda. This finding was also found to be in convergent with the findings of the current study.

Table 4.8

Problems Faced During Transmission

	Frequency	**Percent (%)**
Poor roads	96	61.5
lack of transport means	14	9.0
High charges and levies	44	28.2
Lack of security	2	1.2
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

Results on remedies suggested by the dry maize grains traders that could improve transmission of dry maize grains from source to terminal markets are presented in Table 4.9. Good roads, as suggested by 71.1% of the dry maize grain traders, should be established in order to enhance transmission of dry maize grains across the markets. Twenty five per cent (25%) of the dry maize grain traders cited waived road levies as a way of improving transmission of dry maize grains. Buy *et.al.*, (2006) and John *et.al* (2009) found out that road quality impacted hugely to transportation of agricultural

products to markets. According to the findings by Buy *et.al.,* (2006), a 2% increase in trade between countries was associated with a 1% increase in road quality. The author's findings are convergent with the current findings of the study.

Table 4.9

Remedies to Improve Transmission

Remedies	Frequency	Percent (%)
Good roads	111	71.1
Waived road levies	39	25.0
Improve security	3	1.9
Others	3	1.9
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

Table 4.10 presents results on how transport charges are determined by dry maize grain traders in the study area. From the results, most of the dry maize grain traders stated that the volume to be transported was the key determinant of the transport charges. This was represented by 55.2% and 42.9% of the dry maize grain traders who stated that per volume and per distance transport charges, respectively were the main determinants of transport charges for dry maize grains. The study findings were found to be convergent with the previous findings by John *et.al* (2009) who found out that transport costs were the key constraints, especially for the rural farmers, due to distance they cover from rural to peri-urban centres where final selling of agricultural products (maize) was being carried out. World Bank, (2009) did a study in Eastern Africa to examined the cost of agricultural marketing and estimated the cost of marketing a commodity over shorter distances. The results indicated that marketing cost was much higher over short-distance. The higher marketing cost over short-distance was believed to be related to poorly

developed roads and the use of smaller vehicles. This finding was also found to be in convergence with the current study findings.

Table 4.10

Determination of Transport for Dry Maize Grains

Determinant	Frequency	Percent (%)
Per volume	86	55.2
Per distance	67	42.9
Other	1	1.9
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

4.3.3 Market information

Table 4.11 to 4.16 presents a summary of how traders get market information on dry maize grains. Table 4.11 of results shows that 55.1% of the dry maize grain traders were middle men and they were the main market players. However, 37.1% of the dry maize grain traders mentioned farmers as the main market players. The other market players of dry maize grain traders were NCPB and agents which represented 5.1% and 2.6%, respectively in the study area. Middlemen as per the study have most of the information as far as dry maize grain marketing is concern, thus exploiting the other traders as far as dry maize grain marketing is concern. According to Shahidur, Nicholas, Solomon and Befakadu, (2010), market performs best in generating optimal returns when there is existence of competition. This means that buyers and sellers are many and none of them would be large enough to affect the market price. Sarah (2011), on her study on effectiveness of ICT on maize marketing in selected maize markets in Dadza districts in Lilongwe (Malawi) concluded that provision of market information as well as developed infrastructure ensured that price signals across the markets are well transmitted and

promoted competition. On his part, Rutto, (2015), found out that the main market player in the maize market was NCPB with a sole responsibility of setting maize market prices. This finding showed divergence with the current study finding.

Table 4.11

Main Market Players

	Frequency	**Percent (%)**
Farmers	58	37.2
Middlemen	86	55.1
NCPB	8	5.1
Agents (Millers)	4	2.6
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

Table 4.12 of results on access to market information by dry maize grain traders on the study area revealed that 93.6% of the dry maize grain traders accessed market information as compared to 6.4% of the traders who did not. This implied that, issues of oversupply and undersupply of dry maize grain in terminal and source markets need not to arise. In settling on a price and locating a seller or a buyer, if terminal markets prices are known to producers and few traders; Market information was found to be critical. This would increase their shares in the value chain and their bargaining power, thus lowering market manipulation by the few traders and promote market integration and efficiency (Shahidur *et. al.,* 2010). These findings by Shahidur *et. al.,* 2010 are in convergence with the current study findings. Therefore, the means of accessing these markets such as road network need to be improved for fair trading to be realized. John *et.al.,* (2009) carried out a study to find out whether maize farmers are able to access market information. He found out that both rural and peri-urban market farmers had

access to market information on prices and quantities of commodities. Therefore, his findings were in agreement with the current study findings. According to Wanjiru (2011), access to market information reduces transaction costs and improves bargaining power among small-scale farmers. Wanjiru's findings are in convergence with the current study findings. The current study results on access to market information are also in agreement with the findings by Martey, Alexander & Caleb (2012) on determinants of rural and co-operative market choice among small holder yam farmers in the Brong Ahafo region of Ghana. The findings indicated that access to market information play a key role in determining the choice of market among smallholder yam farmers.

Table 4.12

Access to Market Information

	Frequency	**Percent (%)**
Yes	146	93.6
No	10	6.4
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

Table 4.13 of results on access to market information by dry grain traders indicated that 76.9% of dry maize grain traders obtained market information on dry maize grains markets by visiting market places, while 15.4% of them got the information on dry maize grain from electronic media. The remaining 6%, 5% and 1% of the dry maize grain traders received market information from government officials, NCPB and from agricultural extension officers, respectively. John *et.al.*, (2009) revealed that most of the household who were involved in rural and peri-urban maize marketing obtained market information through formal and informal sources such as radio, television, newspapers,

friends, public or private organizations, social networks of neighbours and relatives. Their findings agree with the current study findings.

Table 4.13

Source of Information on Dry Maize Grain

	Frequency	**Percent (%)**
By visiting market place	120	76.9
From NCPB	8	5.1
From government officials	1	0.6
From electronic media	24	15.4
From Agricultural extension officers	2	1.3
Others	1	0.6
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

The results of how buying price of dry maize grains in a market is set are presented in Table 4.14. From the results, it can be seen that buyers (53.9%) are key in deciding the buying price of dry maize grains and it was also noted that negotiations (42.3%) plays a key role in setting price of dry maize grains in the market. Schnepf Randy (2006) reported that price determination in markets for corn, wheat and cotton whether at terminal markets, port or commodity future exchange is greatly influenced by demand and supply (market forces), which is convergent with the current study findings.

Table 4.14

Price Setters of Dry Maize Grains when Buying

	Frequency	Percent (%)
Sellers	6	3.8
Buyer (self)	84	53.9
Through negotiation	66	42.3
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

The results of how selling price of dry maize grains in a market is set are presented in Table 4.15. From the results it was found that negotiations (46.8%) and buyers (37.2%) are major selling price setters in dry maize grain markets. According to the study by Korir, (2003), majority of traders and famers set the price for beans through negotiation. This finding was found to be convergent to the current study.

Table 4.15

Price Setters of Dry Maize Grains when Selling

	Frequency	Percent (%)
Sellers	25	16.0
Buyer (self)	58	37.2
Through negotiation	73	46.8
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

Results of how dry maize grains market prices are set are presented in Table 4.16. From the results within the study area it was noted that demand (67.9%) is the main pillar in market price determination of dry maize grains. Similarly, 25.0% of the dry maize grain traders stated that market prices are determined on the basis of supply. Only 7.1% of the traders cited surplus production. Schnepf Randy (2006) reported that price determination in markets for corn, wheat and cotton whether at terminal markets, port or commodity

future exchange is greatly influenced by demand and supply (market forces). The author's previous research finding agrees with the findings of the current study since both studies indicated that demand and supply determine the market prices.

Table 4.16

How Market Prices are Set

	Frequency	Percent (%)
Based on supply	39	25.0
Based on demand	106	67.9
Surplus production	11	7.1
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

Table 4.17 presents results on duration at which market price of dry maize grains would have to take to change. From the results, 35.3% of the dry maize grain traders revealed that maize price takes one week to change. 29.5% of the dry maize grain traders stated that dry maize grain prices changes over a span of three months, while 25.6% of them reported that the price would take one month to change. This shows that substantial change in dry maize grain price takes between one week and three months even though some maize traders normally store the commodity for a longer time while waiting for a higher price.

Table 4.17

Time Taken For Price to Change

	Frequency	Percent (%)
One week	55	35.3
One month	40	25.6
Three months	46	29.5
Half year	10	6.4
One year	1	0.6
Other	4	2.6
Total	**156**	**100.0**

Source: Author's Computation from Survey Data, 2018

4.4 Diagnostic Tests

Diagnostic test results provide information on how these raw data may be modelled. Diagnostic tests on model residuals yield information about model adequacy, when a model is estimated (Kuan, 2008). For the purpose of this study, stationarity was checked by performing Dickey-Fuller test. One of the assumptions made about residuals/errors in OLS regression is that the errors have the same but unknown variance. This is referred to as homoscedasticity or constant variance. The problem of heteroscedasticity occurs when this assumption is violated. Therefore, for this study, heteroscedasticity test was performed to test whether the variance of the errors from the regression are dependent on the values of the independent variables.

4.4.1 Dickey-fuller test for stationarity

The Dickey-Fuller test is a way to determine whether the autoregressive process has a unit root. The approach used was quite straightforward. First, the first difference was calculated, that was, if the delta operator was used, defined by $\Delta y = y - y$ and set $\beta = \varphi - 1$, then the equation becomes the linear regression equation where $\beta \leq 0$ and so the test for φ was transformed into a test that the slope parameter $\beta = 0$. Thus, giving one-tailed test (since β cannot be positive) where,

H: $\beta = 0$ (equivalent to $\varphi = 1$)

H: $\beta < 0$ (equivalent to $\varphi < 1$)

Under the alternative hypothesis, *b* was the Ordinary Least Squares (OLS) estimate of β. The coefficient, β, followed a *tau* distribution, and so the test consists of determining whether the *tau* statistic τ (which was equivalent to the usual t statistic) was less than τ based on a table of critical tau statistics values shown in Table 4.18.

Table 4.18

Dickey-Fuller test for unit root

			Interpolated Dickey-Fuller	
	Test Statistic	**1%Critical Value**	**5% Critical Value**	**10%Critical Value**
Z(t)	-2.169	-4.178	-3.512	-3.187

MacKinnon approximate p-value for Z (t) = 0.5073

Source: Author's Computation from Survey Data, 2018

Since the calculated test value was less than the critical value in the table of critical values, then the result was significant; therefore, we accept the null hypothesis that there was a unit root and the time series was not stationary.

4.4.2 Heteroscedasticity test

Breusch-Pagan test helps to check the null hypothesis versus the alternative hypothesis. A null hypothesis was that, where the error variances are all equal (homoscedasticity), whereas the alternative hypothesis states that the error variances were a multiplicative function of one or more variables (heteroscedasticity). The results of the test were displayed in Table 4.19.

Table 4.19

Heteroscedasticity test

chi2(1) =	12.57
Prob> chi2 =	0.0004

Source: Author's Computation from Survey Data, 2018

The probability value of the chi-square statistic was less than 0.05 as shown in Table 4.19. At 5% level of significance, the null hypothesis of constant variance can be rejected. This confirms that the residuals have heteroscedasticity. If the dependent variable changes significantly from the beginning to the end of the series, then time-

series model can have heteroscedasticity. Additionally, since we are modelling time series data and measurement error changes over time, heteroscedasticity can be present because regression analysis includes measurement error in the error term.

Ho: Constant variance means that, when the individual error is plotted against predicted value, the variance of the error predicted value should be constant. Heteroscedasticity is said to occur when variance of the error term, or the residual variance, is not constant across the observations.

4.5. Econometric Analysis

4.5.1 Extent of dry maize grain market integration between the terminal and source markets

The study first objective was to determine if there was co- integration in the terminal and source markets or not. In order to achieve this, the Johansen test for co-integration was performed as presented in Table 4.20.

Table 4.20

Summary Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Terminal market	48	2,383.333	576.6128	1300	3,400
Source market	48	2,012.5	513.0738	1000	3,000

Source: Author's Computation from Survey Data, 2018

The mean price from the results for the terminal market was Ksh. 2,383.33, which was greater than the mean price of Ksh. 2,012.5 for the source market. The standard deviations for the terminal market and for the source market are 576.61 and 513.07, respectively as shown in table of results. Since the standard deviations for the two markets were large, it means that the prices were more spread out from their means.

The results of statistic tests based on a model with two lags and constant trend were displayed in Table 4.21.

Table 4.21

Johansen Test for Cointegration

Trend: constant Number of obs = 46

Sample: 3 - 48 Lags = 2

Maximum Rank	parms	LL	Eigenvalue	Trace statistic	5% critical value
0	6	-591.05881	.	14.5083*	15.41
1	9	-585.64249	0.20982	3.6757	3.76
2	10	-583.80466	0.07680		

Source: Author's Computation from Survey Data, 2018

The statistics tests results as per the model with two lags and a constant trend are shown in Table 4.21. The test statistics and their critical values of the null hypotheses of no cointegration (where rank is 0) and one or fewer co-integrating equations (where rank is 1) were also presented in the same Table. At 5% level of significance, we failed to reject the null hypothesis that, there was no co-integration equation, since the trace statistics was 14.5083, which was less than the critical value of 15.41. Thus, let to the acceptance of the null hypothesis that there was no co-integrating equation in the bivariate model. Therefore, this means that market integration is lacking between the terminal and the source markets of dry maize grains in the study area. Similar test was performed on the relationship between the world maize market price with the maize market price in Tanzania (Arusha), results showed that about 54% of the variations in world market prices were being transmitted to the Arusha maize market price, indicating (Minot,

2011). Ikudayisi and Salman (2014) did a study in Nigeria to examine market integration among geographically separated maize markets by use of monthly retail price data. Johansen co-integration and vector correction model (VECM) were used to analyse the data and the findings were maize producing and consuming states were integrated and the VECM restored deviation from equilibrium moderately. In the reviewed studies, maize markets revealed to be integrated, which is in divergence with the current study findings. Cudjoe, Breisinger & Diao (2010) in their study, they found strong domestic maize markets integration in Ghana, which is in divergence with the current study on source and terminal dry maize grain markets. In the study by Gitau and Meyer (2018) on spatial market integration between surplus and deficit maize markets in Kenya, found out that those markets which are close to each other were integrated and had reduced costs of transaction compared to markets further apart. However, the current study findings are in divergence with these previous finding.

In summary, lack of market integration between the source and terminal market was as a result of poor feeder road network which ended up increasing the transaction costs. Increased transaction costs increases the prices of dry maize grain in the market, hence market integration failure. Mayer (2008) indicated that availability of technological changes and increased number of motor vehicles in an economy would cause major drop in costs of transaction and leads to speedy price signal transmission between markets resulting in markets co integration. This agrees with the current study findings. In the study by Tostao and Brorsen (2005), using estimated costs between various major maize markets pairs in Mozambique, revealed that the average cost of marketing across all the markets pairs relied largely on good roads conditions and access to timely market information on supply and demand levels by dry maize grain traders will promote market

integration. These findings are convergence with the current study findings. The current study also agrees with the findings that strong transmission of price is often seen within national borders among domestic markets which is related to low transaction costs, free flow of information and less barriers to trade entry that have been linked to promote market integration in Ghana (Abdulai, 2000), Tanzania (Van Campenhout, 2007), and Malawi (Myers, 2013). Similarly, the current study findings also agrees with the findings of Negassa and Myers (2007), Tostao and Brorsen, (2005), that high costs of transaction interferes with market integration and creates unexploited arbitrage opportunities. Rashid (2004) and Lutz, Kuiper & Van Tilburg (2007) consequently, reported no evidence of unique integrated maize market in Benin and Uganda, which is in divergence with the current study findings. Minten, (2014) did an analysis of domestic market integration in Ethiopia and the findings revealed existence of market integration. This was occasioned by low transaction costs involved, a divergence from the current study results.

Jayne, Myers & Nyoro (2008) reported no maize market co-integration, but there was spatial arbitrage between Kenya and Uganda maize traders, which is a convergence with the current study findings. Guillaume and Jonathan, (2018), did a study on analysis of integration between Global maize markets and Sub-Saharan Africa domestic using Global Vector Auto regression (GVAR) model and the findings indicated that there was weak market integration. These results also were not in agreement with the current study findings.

4.6.2 Correlation of dry maize grain prices between terminal and source markets

Regression and correlation analysis was used to analyze the second objective of the study with the purpose of determining the relationship between the terminal and source markets prices. The analysis was performed in order to test for the association between the two markets. Table 4.22 shows the results.

Table 4.22

Regression Analysis between Terminal and Source Markets for Dry Maize Grain

Terminal Market	Coefficient	Std. Err.	t	P>t	[95% Conf.	Interval]
Source Market	.9820277	.0847116	11.59	0.000	.814681	1.149374
_cons	395.5004	141.3782	2.80	0.006	116.2094	674.7915

Legend

Number of observations = 156, F(1, 154) = 134.39, R-squared = 0.4660, Adj R-squared = 0.4625, Root MSE = 284.4

Source: Author's Computation from Survey Data, 2018

Table 4.22 of results shows that R-squared value of 0.466 means that approximately 46.6% of the variance of terminal market price is accounted for by the model. In this case, the predictor variable is the source market price. Regression coefficients represent the mean change in the terminal market price for one unit change in the source market price while holding other predictors in the model constant. This statistical control that regression provides is important because it isolates the role of one variable from all of the others in the model. The t-test for source market price equals 11.59, which is statistically significant at 95% confidence interval. This means that the regression coefficient for source market is significantly different from zero. The coefficient of source market is 0.982, which means that for every unit increase in source market price,

we expect a 98.2% increase in terminal market price. The constant value is 395.5, and this is the predicted value when the source market value is zero.

The linear relationship between source and terminal market was tested by performing Pearson's correlation. The assessment of the relationship between terminal and source market prices of dry maize grains among 156 traders in Kipkelion East and West Sub-Counties, Kericho County was tested by use of a Pearson's product-moment correlation. Table 4.23 shows the test results.

Table 4.23

Pearson's Correlation between Source and Terminal Markets

	Terminal Market	**Source Market**
Terminal Market	1.0000	0.83 0.0000
Source Market	0.83 0.0000	1.0000

$r^2 = 0.6826$ $r = 0.83$

Source: Author's Computation from Survey Data, 2018

From the results, the correlation coefficient, *r*, is 0.83 and 0.0000 is the p-value which is less than 0.05. This means that there was a strong positive relationship between the terminal and the source market dry maize grains prices. A statistical measure of how close the data are to the fitted regression line is called R-squared. It is also referred to as the coefficient of multiple determinations for a multiple regression or the coefficient of determination. The r^2 of 0.68 with the source market explains 68% of the variation in terminal market price. In other words, $r^{2,}$ or coefficient of determination, shows the percentage variation in terminal market price, which is explained by all the source market prices of dry maize grains. This implied that higher prices in source markets translate to higher prices as well in terminal markets, thus promoting dry maize grain

trading since traders will be willing to participate since the business results in better income generation.

Hatzenbuehler, Abbott & Abdoulaye (2017), found a weak response on the Nigerian maize market price to world maize market prices, but a strong co-movement of domestic maize prices and those of neighbouring West African countries. The study agrees with current study findings. Guillaume & Jonathan (2019) analysed price transmission across Global markets and Sub-Saharan Africa (SSA) domestic maize markets and the findings showed that most local price series correlate to regional neighbours maize markets. The study finding likewise agrees with the current study findings.

4.6.4 Price transmission time between terminal and source markets.

The third objective of this study was analysed using TAR model in order to determine the price transmission time between the terminal and the source dry maize grain markets to move half-way back to its threshold. Two forms of TAR, the standard TAR models (2) were estimated; with time trend lacking and with time trend in the threshold and adjustment parameter in the model (3). The analysis was symmetric, determining price responses in the net source markets due to shocks on the terminal markets. STATA software was used to estimate. The results of the standard TAR model are presented in Table 4.24.

Table 4.24

Standard TAR model - Thresholds and half-lives

Market Pair	Dist. (Km)	High Costs			Reduced Costs		
		τ^{cs}	ρ^{out}	$\hat{\lambda}^{s}$	τ^{cs}	ρ^{out}	$\hat{\lambda}^{c}$
Barsiele - Fort Tenan	30	0.13	-0.490** (-5.87)	1.01	0.22	-0.664** (-6.8)	0.62
Kamasian - Fort Tenan	25	0.30	-0.394** (-5.09)	1.39	0.46	-0.295** (-4.3)	1.98
Londiani - Fort Tenan	40	0.37	-0.500** (-5.71)	0.99	0.30	-0.488** (-5.45)	1.04
Barsiele – Chepseon	15	0.70	-0.378** (-4.88)	1.46	0.53	-0.384** (-5.09)	1.43
Kamasian – Chepseon	20	0.35	-0.778** (-7.73)	0.46	0.21	-0.548** (-6.06)	0.87
Londiani – Chepseon	15	0.26	-0.478** (-6.73)	0.56	0.41	-0.378** (-5.73)	0.92
Average	24.17	0.3517	0.503	0.978	0.355	0.4595	1.14

Source: Author's Computation from Survey Data, 2018

The results indicated a mixed pattern of price transmission and market integration across the two periods. The asterisks, *, and **, denote significance of the adjustment parameters at 5% and 1% levels respectively, with the t-values of the speeds of price adjustment given in the brackets. ρ^{out} is the estimated adjustment speed in the outer regimes. The half-lives of price adjustment are $\hat{\lambda}s$ and $\hat{\lambda}c$ as measured in months for the market pairs under high and reduced costs respectively.

The estimated thresholds (τ^{cs}) a proportional measure of the amount that inter-market price differentials must go beyond before provoking price adjustment are greater for the market pairs namely; Barsiele - Fort Tenan (0.22), Kamasian - Fort Tenan (0.46) and

Londiani - Chepseon (0.41) in the reduced tariffs compared to the high tariffs period. The reverse holds true for the estimate for the Londiani - Fort tenan (0.30), Barsiele - Chepseon (0.53) and Kamasian - Chepseon (0.21) market pairs. On average, the threshold between the pairs of sources and terminal dry maze grain markets would have to be at least 35.17%, above the inter-market price margin under the high tariffs period that is the average summation of $_{\tau}cs$ expressed in percentage, and about 35.5% above the price margin under the reduced costs period, that is the average summation of $_{\tau}cs$ expressed in percentage, to trigger price adjustment in the outer bands. Whereas both the positive and the negative inter-market price difference of up to an average of 35.17% from their equilibrium values failed to trigger arbitrage in the first period, price deviation of up to an average of 35.5% failed to trigger arbitrage following reductions in costs. Therefore, the proportional "trigger" transaction costs increased by 0.33 percentage points in response to cost reduction.

There was significant evidence of price adjustment, indicated by high speeds of convergence of price deviations to long run equilibrium in the two periods. All the inter-market speed of adjustment parameters ($_{\rho}out$) was also significantly different from zero. This implied that information on trade flows freely between the market pairs. Considering each pairs of markets, there was a fair improvement in the speed of price adjustment between the markets pairs, by 0.174 (17.4%) with respect to Barsiele - Fort Tenan after costs reduction. All other market pairs indicated a drop/constancy price adjustment across the periods. A declined in speed of price adjustment was highly noted between Kamasian - Chepseon markets by about 23%.

Overall, in the period of high costs where the mean value of the speed of adjustment is about 50.3%, dry maize grains prices adjusted faster to market shocks, compared to speed adjustment of 45.95% in the reduced tariffs period. This represented a 4.35% drop in the rate of speed of price transmission between the source and terminal markets as well as in the level of spatial dry maize grain markets integration over the two periods. This was witnessed despite the reduction in costs of transferring products by about 2.4% over the same period.

The unexploited arbitrage opportunities and disequilibrium continued a little longer in lowered tariffs periods compared to high tariffs periods as revealed by estimated half-lives of price adjustment. On average, prices needed 1.14 months (5 weeks) under lowered costs periods to correct half of the deviations from equilibrium price in response to market shocks as indicated by half-lives of price adjustment, while under the high tariffs period exactly one month was needed to effect similar correction. These current findings as per the estimated adjustment parameters and thresholds, they were found to be mixed. Barsiele - Fort Tenan on the other hand time (half-life) required reduced rapidly from about one month to 0.6 months (2.57 weeks), whereas Kamasian and Fort Tenan market pairs time required increased from 1.39 months (6 weeks), within the first period to 2 months in the second period. Standard TAR model results indicated a mixed patterns price adjustment transmission, level of transaction costs and adjustment half-lives between the market pairs.

The results obtained in table 4.24 above were found to be consistent with those of Campenhout (2007), who used simple model without inclusion of transaction costs. The findings were estimated half-lives and time trend ranged from 3.9 to more than 22

weeks. On performing non-linear adjustment effected by costs of transaction, half-lives reduced to four - eleven weeks and on including time trend, half-lives ranged from $1^{1}/_{2}$ -5 weeks. Therefore, based on his study he made a conclusion that, failure to incorporate time trend in studies would mostly yields half-life values that are quite higher. The author also indicated that, half-life findings between 1-5 weeks are much more reasonable as compared to the ones that fail to include cost of transferring products. The findings on time (half-life) required for the price adjustment in dry beans markets by Venny (2013) on the other hand were consistent with the current study findings. On his study, the TAR model indicated mixed patterns price adjustment transmission, costs of transaction and adjustment to half-lives between paired markets. Results of Yeboah, (2012), on his study on spatial price transmission in regional maize markets in Ghana indicated that, time path needed for price adjustment ranged from 7 to 26 months. This was found to diverge with the current study findings.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the findings, conclusion and recommendations based on the study objectives.

5.2 Summary

Price of a product in a market is a key factor in controlling decisions in production, consumption and marketing over time. Price fluctuations in the market affects income attained by the producers, limits the consumers' needs and generally influence decision making in resources allocation as far as production and consumption are concerned. To have a clear picture of markets, it is critical to find out the causes of price variations in spatially separated markets. Prices of various products in markets that are not integrated are misleading and lead to poor resource allocation amongst competing enterprises. Therefore, the main objective of this study was to analyze dry maize grain market integration in Kipkelion East and West Sub-Counties in Kericho County, Kenya. The objectives was to determine the extent of dry maize grain market integration in the terminal and source markets, thus ascertaining whether terminal and source markets prices correlate with each other, and finally analyzing amount of time taken for price transmission between terminal and source markets of dry maize grain to move half way back to its threshold (half-life).

The study was guided by price difference theory and descriptive and cross-sectional research designs were adopted. Data was collected from a sample of 156 maize traders from a population of 35,500 dry maize grain traders through a stratified random

sampling procedure. Interview schedule was employed to collect primary data, while secondary data was collected through literature review. Co-integration, Granger causality, Correlation and regression, Pearson product moment correlation and Threshold autoregressive models were used for data analysis on market integration.

5.3 Conclusions

This study analysed dry maize grain market integration in Kipkelion East and West sub-counties, Kericho County, Kenya. The first objective of the study tested for the integration between the terminal and source dry maize grain markets. Johansen tests for co-integration returned the trace statistics less than the critical value at 5% level of significance (14.5083<15.41) which depicted non-existence of co-integration equation. Hence it was established that there is no market integration in the terminal and source markets of dry maize grains. Thus the study accepted the null hypothesis that there was no integrating equation in the bivariate model. This means that there was no market integration in the terminal and source markets of dry maize grains of Kipkelion East and Kipkelion West sub-counties.

The second objective determined the relationship between the terminal market prices and source market prices. The results from the correlation and regression analysis showed statistically significant relationship between the terminal and source market prices. The model accounted for approximately 46.6% of the total variation in the terminal market prices as predicted by the source market price. A Pearson's product-moment correlation results showed a strong positive relationship between terminal and source dry maize grain markets' prices, with 68% of variation in terminal market prices being explained by all the source market prices. High prices in the source markets would lead to higher

prices as well in the terminal markets and vice versa. Thus the study rejected the null hypothesis that there was no significant relationship between terminal and source market prices in Kipkelion East and West Sub-Counties, Kericho County, and instead accepted the alternate hypothesis.

The third objective analyzed the amount of time it takes for the price transmission between the terminal and the source markets of dry maize grain to move half way back to its threshold. The unexploited arbitrage opportunities and disequilibrium continued a little longer in lowered tariffs periods compared to high tariffs periods as revealed by estimated half-lives of price adjustment. On average, prices needed 1.14 months (5 weeks) under lowered costs periods to correct half of the deviations from equilibrium price in response to market shocks as indicated by half-lives of price adjustment, while under the high tariffs period exactly one month was needed to effect similar correction. These current findings as per the estimated adjustment parameters and thresholds, they were found to be mixed. Barsiele - Fort Tenan on the other hand time (half-life) required reduced rapidly from about one month to 0.6 months (2.57 weeks), whereas Kamasian and Fort Tenan market pairs time required increased from 1.39 months (6 weeks), within the first period to 2 months in the second period. Standard TAR model results indicated a mixed patterns price adjustment transmission, level of transaction costs and adjustment half-lives between the market pairs.

5.4 Recommendations

The following recommendations were made based on the research findings.

Firstly, the study recommends for a policy that will improve the market integration of dry maize grains which will balance the production, marketing and consumption of dry

maize grains in the terminal and source markets, which will eventually bring benefits to the producers, consumers and traders of dry maize grains. The drafting of the policies should be geared towards improving feeder road network and the general transport system in order cut down on the transaction costs and enhanced market integration in the county at large.

Secondly, the study recommends that the relevant government agencies need to formulate policies that will promote competition between the source and the terminal dry maize markets in the county. There is also need to improve market information flow in the county; particularly the use of information and communication technology (ICT) in order to ensure timely and faster flow of information across the product markets. It was also identified that if the traders, producers and consumers are given timely market information it will reduce cases of price shocks and promote market integration.

Thirdly, the collected market information through the MoALF on agricultural produces in markets across the country should be provided to both farmers and traders promptly. This will enable them access markets that offers better prices for their dry maize grains; thus enabling them to harness higher returns on their dry maize grains. This will also ensure none of the market players (buyers and sellers) is disadvantage in dry maize grain trading.

5.5 Suggestions for Further Research

The current study, analyzed market co integration and price adjustment transmission between terminal and source markets of dry maize grains. Co-integration, Regression and correlation and TAR models were used in the analysis. TAR model assumed costs of transaction to be constant and price transmission was perceived to be symmetric for the

entire 2014 to 2017 periods. Therefore, if over time the market integration would be expected to increase, for instance as a result decreasing transaction costs; future studies need to consider extending TAR model to allow for variable threshold.

The study limited itself three source markets and two terminal markets which were presumed to be key for the study area, therefore future studies need to consider adding more dry maize grain markets in the analysis of market integration and price transmission.

The study also recommend that future research should also attempt to use the actual primary data for a specified time that will give actual transportation costs of dry maize grain in order to achieve more accurate findings and inferences.

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Appendix 1: Interview Schedule

Dear respondent,

The major objective of this interview is to collect primary data that will be used for analyzing market integration of dry maize grain in Kipkelion East and West Sub-Counties source and terminal markets of Kericho County, Kenya, being undertaken by Isaac Kipchirchir Sang of University of Kabianga in the school of Agriculture and Biotechnology, Department of Agricultural Bio systems and Economics. Therefore, you are asked to kindly assist in the attainment of the student'sobjectives. All the responses will be treated with high confidentiality and will be usedfor the purpose of the above mentioned study.

Yours faithfully,

Sang K. Isaac

Section A: Personal Details

1. Code of the trader…….....

2. Sub county…….....

3. Gender [1] Male ( ) [2] Female ( )

4. What is your age? …….....

5. What is your highest level of education? [1] Primary ( ) [2] Secondary ( ) [3] College ( ) [4] University ( ) [5] Others (specify).....

Section B: Transaction Cost (Market Costs)

1. What is the source of the dry maize grains you sell? [1] Farmer ( ) [2] Agent ( ) [3] Wholesalers ( ) [4] Others (specify).....

2. Where do most of the dry maize grains you buy come from? .....

3. What do you consider when deciding on where to buy dry maize grains?

[1] Distance ( ) [2] Price ( ) [3] Means of transport ( ) [4] Others (specify).....

4. Do you incur any transaction costs? [1] Yes [2] No

5. If yes which market costs do you incur from the source to terminal market?

6. How much does it cost?

Type Of Costs	**Total Cost (90kg Bag Of Dry Maize Grains)**
Volume of dry maize grain per trip (90 kg)	
Labour for loading	
Storage cost	
Labour for off-loading	
Transportation charges/costs	
Market charges(handling costs/brokerage charges)	
Packaging costs(packaging material costs)	
Cess charges (County charges)	
Others (specify)	

Section C: Infrastructure

1. Are you accessible to a road? [1] Yes [2] No

2. If yes what type of roads do you frequently use to transport your grains from:

(a) Farm gate/seller? [1] All weather ( ) [2] Dry weather ( )

(b) Source market to terminal market? [1] All weather ( ) [2] Dry weather ( )

3. In your own view is the road network well developed to enable easy transportation of maize? [1] Yes ( ) [2] No( )

4. What problem(s) do you face during transportation of maize? [1]Poor roads ( ) [2] Lack of transport means ( ) [3] High charges and levies ( ) [4] Lack of security ( ) [5] Others (Specify)

.....

5. In your opinion what should be done to improve the situation? [1] Good roads ( ) [2] Waived road levies ( ) [3] Improved security ( ) [4] Others (specify) .....

6. Why did you opt to involve in trade of maize? [1] High returns ( )[2] High demand ( ) [3] Promising supplies ( )[4] Locally available ( ) [5] Easy business to start ( )[6] Low capital needed ( )

7. How is the transport cost determined? [1] Per volume transported ( ) [2] Per distance ( ) [3] Others (specify).....

8. Do you obtain adequate dry maize grain supplies?[1] Yes ( ) [2] No ( )

9. Do you store your dry maize grains? [1] Yes ( ) [2] No ( )

10. If yes where do you store? [1] Hired store ( ) [2] Godown ( ) [3]Built stalls in the market ( )[4] In my own house ( ) [5] Own store in the market ( ) [6]Others (specify).....

11. Why do you store your grains? [1]To assemble larger quantities ( )[2]To disassemble into smaller quantities ( ) [3]To wait higher prices ( ) [4] Lack of transport ( ) [5] Others (Specify).....

12. On average how many bags of dry maize grain do you normally store? .....

13. How much dry maize grain in 90kg bags do you sell? .....

14. How much dry maize grain in 90kg bags do you buy? .....

15. What limits your capacity to store more grains?[1] Lack of stores ( ) [2] High storage cost ( ) [3]Fear of pest infestation ( ) [4] Erratic price changes ( ) [5] Availability of constant supplier ( ) [6] Others specify).....

Section D: Market Information

1. Who are the main players in the dry maize grain markets? [1] Farmers ( ) [2] Middlemen ( ) [3] NCPB ( ) [4] Agents (Millers) ( ) [4] Others (specify).....
2. Do you access market information? [1] Yes ( ) [2] No ( )
3. How do you get marketing information on dry maize grain?

   [1] By visiting market place ( ) [2] From NCPB ( ) [3] From government officials ( ) [4] From printed media ( ) [5] From electronic media ( ) [6] From agricultural extension officers ( ) [7] Others (specify).....
4. Do you have a mobile phone? [1] Yes ( ) [2] No ( )
5. If yes do you use for business activities? [1] Yes ( ) [2] No ( )
3. Do you think that the flow of market information is okay? [1] Yes [2] No
4. If yes is it reliable? [1] Yes ( ) [2] No ( )
5. If no, why? [1] Lack of reliable sources ( ) [2] Lack of trust between traders? [3] Many middlemen ( ) [4] Others (specify).....
6. What are the barriers to entry in the dry maize grain trade or market?

   .....

Section E: Price Transmission

1. How much do you pay per 90kg bag of dry maize grains? .....
2. How much do you receive from 90kg bag of dry maize? .....
3. Who sets prices when you are buying dry maize grain?

[1]Sellers ( )[2]Buyer (self) ( ) [4]Through negotiation ( )

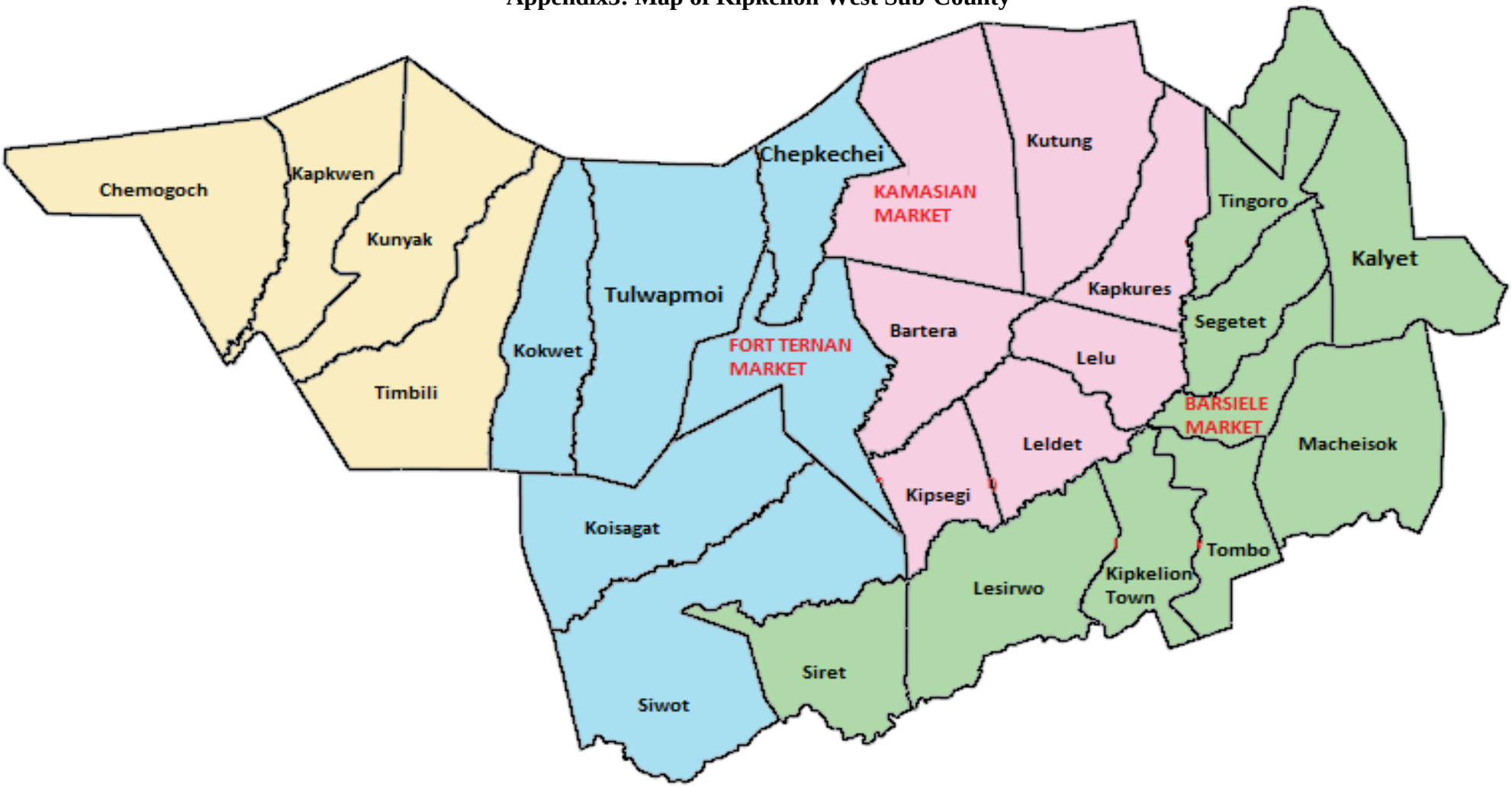
4. Who sets prices when you are selling dry maize grain?

   [1]Sellers ( ) [2] Buyer (self) ( ) [4] Through negotiation ( )
5. How are market prices set? [1] Based on supply ( ) [2] Based demand [3] Surplus production
6. How long does dry maize grain take to change (move)? in terms of time. [1] One Week ( ) [2] One month ( ) [3] Three months ( ) [4] Half year ( ) [5] One year ( ) [6] Others (specify).....

Appendix 2: Average Monthly Retail Price Data Form

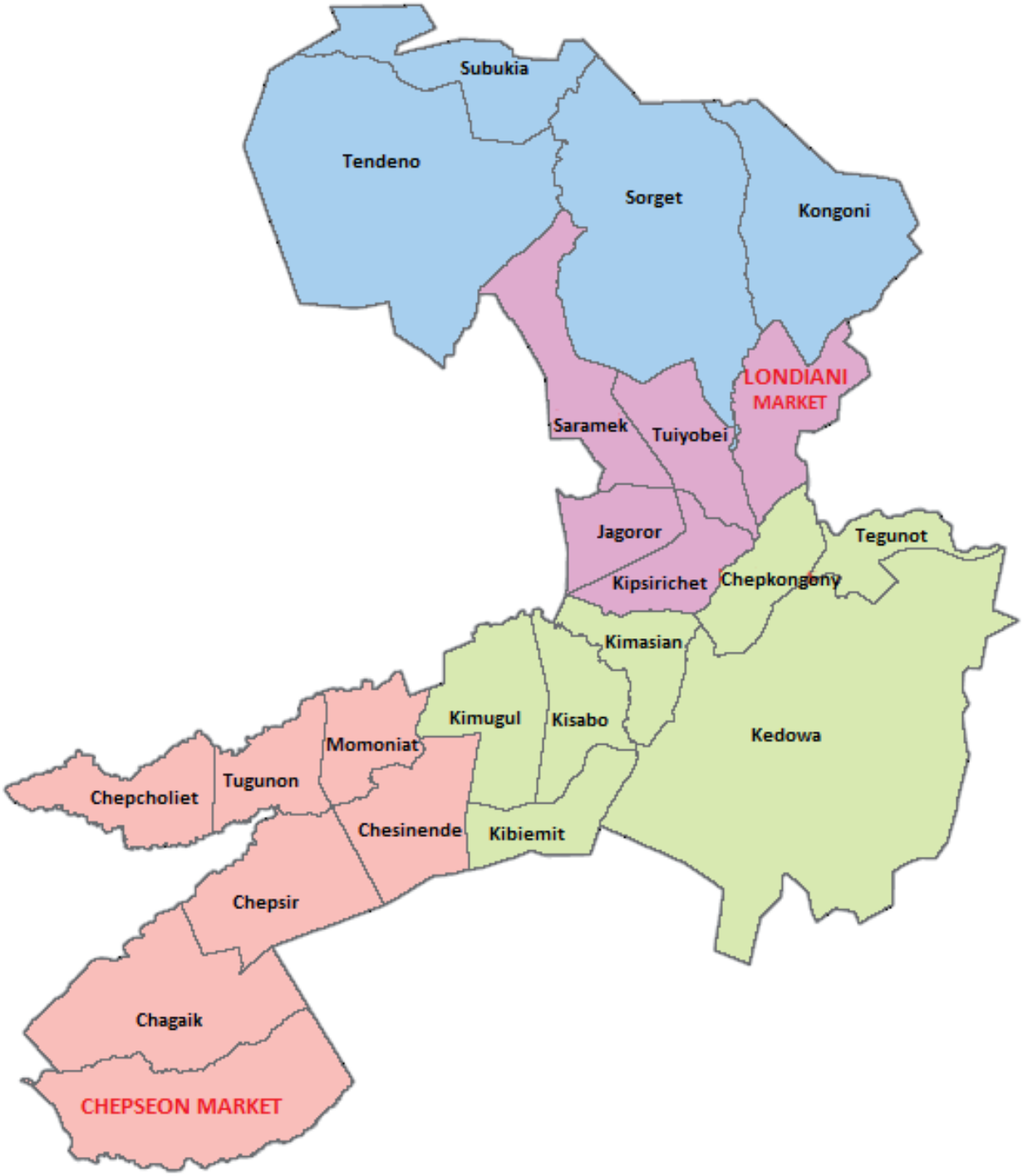
YEAR: 2014												
Months	J	F	M	A	M	J	J	A	S	O	N	D
Quantity (90kg)												
Av.Price (Kshs)												
Year: 2015												
Months	J	F	M	A	M	J	J	A	S	O	N	D
Quantity (90kg)												
Av. Price (Kshs)												
Year: 2016												
Months	J	F	M	A	M	J	J	A	S	O	N	D
Quantity (90kg)												
Av. Price (Kshs)												
Year: 2017												
Months	J	F	M	A	M	J	J	A	S	O	N	D
Quantity (90kg)												
Av. Price (Kshs)												

Appendix3: Map of Kipkelion West Sub-County



Source: Independent Electoral Boundaries Commission of Kenya, 2013

Appendix 4: Map of Kipkelion East Sub-County



Source: Independent Electoral Boundaries Commission of Kenya, 2013

Appendix 5: Research Permit

THIS IS TO CERTIFY THAT:
MR. ISAAC KIPCHIRCHIR SANG
of UNIVERSITY OF KABIANGA, 70-20217
CHESINENDE,has been permitted to
conduct research in *Kericho County*

on the topic: *ANALYSIS OF DRY MAIZE GRAIN MARKET INTEGRATION IN KIPKELION EAST AND WEST SUB-COUNTIES, KERICHO COUNTY*

for the period ending:
17th August,2019

Permit No : NACOSTI/P/18/75651/24207
Date Of Issue : 18th August,2018
Fee Recieved :Ksh 1000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

Appendix 6: Publication

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Analysis of Dry Maize Grain Market Integration in Kipkelion East and West Sub Counties, Kericho County, Kenya

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Abstract: This study analyzed market integration of dry maize grain in Kipkelion East and Kipkelion West Sub-Counties in Kericho County, Kenya. The objective of the study was to determine the correlation of prices between the terminal and source markets of dry maize grain. Purposive and stratified random sampling procedures were used to collect data from a sample of 156 maize traders. The survey data analysed using regression and Pearson's product-moment correlation models. Results shows that 53.8% of the dry maize grain traders were males and 46.2% were females with 46.2% dry maize grain traders having attained secondary school level of education. Regression and correlation results shows that a unit increase in the dry maize grain source market prices would result in a 98.2% increase in the terminal maize market prices. Pearson's Product-Moment correlation results showed that there was positive relationship between the terminal and the source market prices with 68% of variation in terminal market prices being explained by all the source market prices. High prices in the source markets would lead to higher prices as well in the terminal markets. In order to achieve market integration, improve market information flow and promote competitiveness between the source and terminal markets in the county and in the country, this study recommends the enactment of relevant policies by the government agencies, both in the county and in the national government. There is also need to improve market information flow in the county; particularly the use of information and communication technology in order to ensure timely and faster flow of information across the dry maize grains markets. If traders, producers and consumers are given timely market information, it will reduce cases of price shocks and promote market integration.

Keywords: Dry Maize Grain, Market Integration, Source Market, Terminal Market, Pearson's Product-Moment Correlation

1. Introduction

Maize (*Zea mays*) is one of the significant cereal crops for both human and animal consumption [1]. Maize is the third preferred traded cereal worldwide after wheat and rice; its production is estimated to be 828 million tonnes [2]. In Africa and Latin America maize is a staple food due to its low prices and worldwide distribution. Currently, the majority of livestock farmers use maize as feed for animals. Maize is also very accommodative in terms of ecological requirements. It does well in various soils, altitude, and fertility conditions; this is why it is well adapted to most parts worldwide and the reason of having many varieties in the market for production [3].

In the world market, maize still attracts a few exporting countries, but there are numerous importers across the world. The United States is the key player in the maize market, since it is the world's major producer, consumer, and exporter. However, countries like Brazil, China, and Argentina have emerged to be active in the international market. Globally maize sector has been dominated by a large number of private firms who control operations such as storage, transportation in the supply chain, with an elongated worldwide appearance [4]. World maize prices rose seasonally in the first months of 2019, after a

significant drop in 2018 with the commercialization of the main and second season harvests [5]. Maize demands in the developing world will be double between now and 2050. By 2025, it will have become the crop with the greatest production globally and in the developing world [6]. However, agricultural marketing has been side-lined for several years. Production is given a lot of emphasis since the majority of the population believe that production is more significant than marketing. Economists and planners have re-assed this belief with an objective of making sure agricultural marketing is accorded more attention in terms of economic development [7].

Marketing system in less developed and developing countries is still lagging behind in terms of efficiency. In order to promote agricultural production and economic growth, a lot of emphasis and enormous recognition of efficient marketing system needs to be considered [7]. In Kenya the maize sector is an important sector. Therefore, maize marketing is an important area, hence requiring the parties involved to be in a position of understanding price setting mechanisms. Maize value chain in Kenya is comprised of market players, input suppliers, processors, post processors and farmers. Competition exists between these different players [8]. Dry maize grains are sold to National Cereals and Produce Board (NCPB) and directly to individual traders/consumers. Marketing of dry maize grain is faced with challenges such as competition in the market, climate hazards, diseases, poor infrastructures and poor marketing strategies [9].

Market integration is regarded as a major market research tool that gives clear picture of how a given market functions. Understanding market integration enhances policy making and decision making in resource allocation in production. Market integration also provides sufficient knowledge on the behaviour of supply and demand in a market for a given product. In maize production and marketing, just like for any other enterprise, utilizes resources across space and time in order to yield better returns. Therefore, through market integration efficiencies in resource allocation can be achieved; thus better returns realization [10].

The important aspect of market research is market integration since it provides the basic information for comprehending how particular markets work. The significance of the information obtained depends in its application to drafting of policies and decisions, on the extent of promoting market development. In addition, the understanding of movement equilibrium paths of market forces (supply and demand) for a specific commodity or group of produce highly depends on market integration. The level of proximity of the accuracy and speed of diffusion of market price information or spread of information/ price transmission efficiency and price movement are prerequisites for attaining efficient spatial and temporal resource allocation [11]. If markets are efficient and interlinked, price co-movement in such markets can be achieved. However, no research has been done on dry maize grain markets in Kericho County. In addition, the factors causing variations in the market prices of dry maize grains are not fully understood.

Marketing of dry maize grain in Kericho County is one of the ventures that contribute to income generation to majority of the population. Dry maize grains are sold to consumers within the county and bordering counties like Kisumu, Kisii, Nandi, Uasin Gishu, Bomet and Nakuru. Traders also sell their dry maize grains to Kericho, Fort Ternan, Kipkelion and Kedowa National Cereal Produce Board (NCPB) depots [12]. In Kipkelion East and West Sub-Counties, dry maize grains production is of great significance and it contribute 68% of the total county production [13]. This implies that maize marketing in these sub-counties play a vital role in income generation to a larger population. However, if markets are efficient and interlinked, trade will be beneficial to both producers and consumers.

Integrated markets in literature are those markets with negligible differences in price of a given commodity and which allows effectiveness of commodity transfer and inter-market transmission of price shock; thus such markets can trade efficiently [14]. However, this is not the case being observed in the terminal and source markets for the study areas of Kipkelion East and Kipkelion West Sub-Counties in Kericho County. Previous studies carried out in Nairobi, Nakuru, Eldoret and Kitale focused on market integration of dry beans [14]. However, studies on dry maize grain market integration have not been undertaken, especially for the terminal and the source markets in the current study area. The major markets for the dry maize grain in Kericho County are Chepseon, Londiani in Kipkelion East Sub-County and Fort Ternan, Kamasian and Barsiele in Kipkelion West Sub-County.

There is evidence attached to the significance of market integration. Knowledge gap still exists in literature on the extent of dry maize grain inter-markets integration in Kenya. Hence, price information does not reach farmers, traders, and consumers. Therefore, the findings of this study will benefit traders, producers, consumers, processors and policy makers nationally. It will enable traders, producers, consumers and processors organize their resources efficiently and increase specialization. It will also increase their economies of scale in production, minimized costs incurred in marketing, increase access to new varieties of products and obtain dry maize grain in market at lower prices. It will also enable traders and processors to ascertain whether the business they are engaged in will be yielding profit or loss. Policy makers in Kenya will be in a position to draw policy guidelines which will assist the government to regulate the dry maize grains markets.

2. Methodology

2.1. Research Design

This study was done in Kipkelion East and West Sub-Counties of Kericho County, Kenya using descriptive research design. A total of 156 maize traders were sampled and used in the study.

2.2. Sampling Procedure and Sample Size

The study employed purposive and stratified random sampling procedures to get the total sample size of interest for five dry maize grain markets in the two sub counties. The sub counties were stratified into the five dry maize grain markets. Sample selection of maize traders from the market strata was then done using random sampling. Effort was also made to include statistically significant sub samples of dry maize grain producers in each of the sub counties. A total of 156 respondents were sampled and proportionately distributed across the five markets as shown in table 1.

The dry maize grain n^{th} trader was determined by the proportionate size sampling methodology as shown in equation (1).

$$n = \frac{N C^2}{C^2 + (N - 1)e^2} \quad (1)$$

Where n is the sample size, N is the population size (35,500), C is the coefficient of variation (which is 25%), and e is the margin of error (2%) [15]. The sample units were calculated based on equation (1) for the number of dry maize grain traders in each maize market in the two sub counties against the desired sample size of 156 as shown in table 1. Based on the above mentioned criteria, the random sample of dry maize grain traders selling and buying dry maize grains in the two sub counties consisted of 44 traders in Chepseon, 28 in Londiani, 41 in Fort Ternan, 23 in Kamasian and 20 in Barsiele dry maize grain markets respectively. Therefore, based on the above calculations, the sample size of traders was 156 which were then used for data analysis in this study.

Table 1. *Proportionate Sample Size of Dry Maize Grain Traders per Market.*

S. No.	Market	Target population (N)	Percentage	Sample Size (N)
1.	Chepseon	9,900	28	44
2.	Londiani	6,390	18	28
3.	Fort Ternan	9,400	26	41
4.	Kamasian	5,210	15	23
5.	Barsiele	4,600	13	20
	Total	35,500	100	156

2.3. Data Types

Given the objective of identifying the determinants of market integration of dry maize grain in Kipkelion East and Kipkelion West Sub-Counties in Kericho County, Kenya, the population of interest was defined as the primary dry maize grain traders who sold dry maize grains in any of the five source and terminal maize markets. For that reason, traders who did not sell any dry maize grains or sold processed maize grains were not included in the study. Therefore, given this restriction, its uniqueness, the sample for this study could not be directly compared with the county or national official data on the general structure of dry maize grain production.

Data types used encompassed representative sample of dry maize grain representing the five maize markets. Data collected included maize traders' socio-economic characteristics, actual dry maize grains traded, dry maize grain selling and buying prices, mode of transport, transportation costs, marketing information and other incurred costs during the marketing process, average retail price data per month for a four-year period from January 2014-December 2017 from the terminal and source markets, main market players and price transmission. Respondents were also expected to provide information regarding market competitiveness and estimated total number of dry maize grain traded in 90 kilogram bags.

2.4. Data Collection Instruments

Primary data and secondary was used in this study. Primary data was collected directly from the respondents in the markets by use of interview schedules while secondary data was obtained from Ministry of Agriculture, books and other documents that were relevant to the research study. Secondary data was collected by use of a document analysis form and the respondents were the Sub County and County crops and agri-business officers.

2.5. Analytical Frameworks

2.5.1. Theoretical Models

Spatial and temporal transmission of price coupled with its speed will determine the ability of the marketing system to perform its function efficiently hence promoting market efficiency. The study laid its emphasis on spatial market integration that calls on study of price relationships of dry maize grain in spatially differentiated markets. Market integration promotes competition and trade between markets and the producers will increase their production hence attaining better income and improved living standards [16]. Markets will work efficiently if they are fully integrated. However, in reality, an efficient market may fail to operate due to the presence of some factors that prevent its efficiency. For example; high transaction costs impedes the flow of price information of various products in the markets. These transaction costs are categorized as fixed and variable. Fixed transaction costs include costs involved in constructing road network and installing communication facilities, while variable transaction costs comprise of transportation costs. Variable transaction costs depends on the quantity of products being handled, the higher the quantity the lower the costs incurred in trading process and vice versa [17]. Therefore, this study was able to build its analysis on price difference theory which states that; 'the price difference in any two markets trading together equals the transfer costs.' This can be explained as price of a given product e.g. dry maize grain in time t is P_{1t} and $P_{2,t}$ in market 1 and 2 respectively. The two markets will be integrated only if the variation between the prices is the transaction costs as shown in equation 2 [18].

$$P_1=P_2+K \quad (2)$$

Therefore, market 1 and 2 can trade only if $| P_1 - P_2 > K |$

ratifying the theory that ensures the prices of similar products being traded in any two separated markets are equal. However, if this is true, then the Law of One Price (LOP) can apply whose theory postulates that, given prices of a product in two spatially separated markets as $P_{i,\,t}$ and $P_{j,\,t}$ at all points in time, the price difference should be the transfer costs for transporting the product from market i to market j [18]. If the prices in the two markets are found to be having no relationship, then both market integration and price transmission will be lacking, resulting in market segmentation [19]. This is illustrated in equation 3.

$$P_{it}=P_{jt}+C \quad (3)$$

Where, C is the marginal transfer cost from market *i* to market *j*. Therefore, if this theory is depicted in market i and j the two markets are integrated. However, in extreme cases where market integration and price transmission between two markets are lacking due to segmentation, it results in a strong form LOP. This in reality rarely occurs since prices of a product will always vary by an amount at most equal to transfer cost. This can be illustrated in equation 4.

$$P_{it}-P_{jt}\leq C \quad (4)$$

The above represent an equilibrium condition, which indicates that the prices being witnessed in markets may differ from what is being observed in equation 2 but spatially arbitrage will always cause variation between the two prices to move towards the transfer cost.

2.5.2. Econometric Analysis

The econometric analysis consisted of correlation and regression analysis and Pearson's Product-Moment correlation models. Correlation and regression analysis was used to test the relationship between prices in terminal and the source markets. When a long-run linear relation exists among different price series, these series are said to be co-integrated. If terminal and source markets are integrated, then there is an existence of an equilibrium relationship amongst them [20, 21]. Long run equilibrium relationship for analyzing market integration can be illustrated in equation 5.

$$Y_t=\alpha+\beta X_t \quad (5)$$

Where Y_t and X_t= are equal prices of a commodity in two spatially separated markets; source and terminal respectively. α and β are parameters to be estimated. If $\alpha = 0$, then the two market prices are equal. This was based on the Law of One Price (LOP) [20]. However, the objective of this study was analyzed using typical regression model to test for market integration between two spatially separated markets as indicated in equation 6 below.

$$Y=\alpha+\beta X_t+u_t \quad (6)$$

Where X_t is the price series for central (source) market in t time, Y_t is the price series for peripheral (terminal) market in t time, α is the the intercept term, β is a parameter of the slope, and u_t is the error term. If source and terminal markets are perfectly spatially integrated, then $\beta = 1$. If this holds, then price changes in terminal markets will be fully reflected in the source markets and vice versa. When $\beta \neq 1$ (i.e. $\beta < 1$ or $\beta > 1$), then the extent of integration may be evaluated by investigating how far the deviation of α_1 is from unity.

The aim of carrying out regression analysis was to be more reflective of the population than the mean (dependent value, or Y) alone, which would otherwise be the best estimate of the predicted value from a set of the given values. The study was concerned with whether the relationship pattern between two values of variables could be described as a straight line, which was the simplest and most commonly used form. The relationship between the source and the terminal market prices of dry maize grain was tested in the study. From policy researcher perspective regression coefficient, β is typically more important than the intercept, since the policy makers are usually interested with the effect of one variable on another. The greater the regression coefficient, the more influence the independent variable has on the dependent variable, and the more change in Y associated with a change in X.

Pearson's product-moment correlation, *r,* was used to measures the tightness of fit of X, Y coordinates around the regression line of a scatter plot. Computed values of Pearson's *r* can range from -1 to +1 [22]. The larger the absolute value of *r*, the tighter the fit of X, Y-coordinates around the regression line. When the regression line slopes upward, we have a positive correlation. Pearson's r will be positive up to a value of +1, whereas when the regression line slopes downward, we have a negative correlation. Pearson's *r* will be negative down to a value of -1 and finally, when the regression line is flat, we have no correlation and Pearson's *r* = 0.

3. Results and Discussion

3.1. Socio-economic Characteristics of Dry Maize Grain Traders

Table 2 shows the gender distribution of the dry maize grain traders. The analyzed results shows that 53.8% of the dry maize grain traders were males and 46.2% were females. This indicated that dry maize grain trade was dominated by male traders.

Table 2. *Gender Distribution of of Dry Maize Grain Traders.*

Gender	Frequency	Percent (%)
Male	84	53.8
Female	72	46.2
Total	156	100.0

Results in table 3 show the age distribution of the respondents. As shown, 76.9% of the dry maize grain traders were aged more than 36 years. The surveyed dry maize grain traders were aged between 30-35, 24-29 and 18-23 years were 13.5%, 8.3% and 1.3%, respectively.

Table 3. *Respondent's Age Distribution.*

Age Range	Frequency	Percent (%)
18-23 years	2	1.3
24-29 years	13	8.3
30-35 years	21	13.5
Over 36 years	120	76.9
Total	156	100.0

Table 4 presents results on the levels of education attained by the surveyed dry maize grain traders. Results revealed that 46.2% of the dry maize grain traders had attained secondary school level of education, whereas 44.9%, 6.4% and 2.6% of traders had attained primary, college and University levels of education respectively. These results show that most of the dry maize grain traders in the study area have primary and secondary levels of education. Education was found to be playing an important role in the adoption of innovation. Education in itself was considered vital in trading business. Household heads with at least a secondary level of education increased household understanding of market dynamics and hence improved decisions about the quantity of output sold [23].

Table 4. *Education Levels of Respondents.*

Education Level	Frequency	Percentage (%)
Primary	70	44.9
Secondary	72	46.2
College	10	6.4
University	4	2.6
Total	156	100.0

3.2. Determinants of Dry Maize Grain Market Integration Between Terminal and Source Markets

Table 5 of results shows the sources of dry maize grains for the maize traders. The study results shows that 91.7% of the dry maize grain traders sourced their dry maize grain from maize farmers. 6.4%, 6% and 1.3% of surveyed traders sourced their dry maize grain from dry maize grain agents, wholesalers and other sources respectively. Farmers were found to be the main maize producers and hence the major source of bought dry maize grains by the maize traders in both the source and the terminal markets in the study area.

Table 5. *Source of Dry Maize-Grain.*

Source	Frequency	Percent (%)
Farmer	143	91.7
Agent	10	6.4
Wholesalers	1	.6
Other	2	1.3
Total	156	100.0

Table 6 present results on factors that are considered by the maize traders while purchasing dry maize grains in the terminal and the source markets. 64.7% of the sampled respondents reported price as the most influencing factor that was considered by maize traders when making decision on where to purchase dry maize grains. However, 27.6%, and 7.1% of the respondents considered distance and means of transport to be the main two factors that were considered by maize traders while purchasing dry maize grains. Spatial price linkages within maize markets allow efficient movement of products across markets due to efficiency of price information flow [24]. The study further found out that there was critical need to provide more price information to dry maize grain traders to enable them benefit from spatial price difference. This earlier study was found to be convergent with the current study, since in both studies, price was established to be the main determining factor. It was evident from the results that distance contributes to poor maize marketing by the dry maize grain traders across the markets in the study area. Dry maize grain traders consider travelling and transport distance while buying dry maize grain since distance is a function of price and thus, the further the distance from the source to terminal market, the greater the transaction cost, and eventually impacting on the final selling price. A major constraint to the intensity of market participation among traders was distance from the farm to point of sale [25]. Further, result findings shows distance to market has a negative impact on both proportion of marketable load size and the decision to participate in the market [23-26]. These previous findings are in convergence with the findings of the current study. Price and formal market information sources greatly intensify market participation [25]. The current study results are in lined with the findings of the case study of Punjab and Pakistan which showed that, lack of market information, long distances from farm to market and high transportation cost threatened accessibility to terminal market for agricultural produces by small scale producers [27].

Table 6. *Factors Considered when Buying Dry Maize Grains by Maize Traders.*

Factors	Frequency	Percent (%)
Distance	43	27.6
Price	101	64.7
Means of transport	11	7.1
Other	1	0.6
Total	156	100.0

Table 7 presents results of the different types of transaction costs in the source and terminal markets incurred by the dry maize grains traders. From the results, traders incurred on average Kenya Shillings (Ksh.) 72.17 per 90 kilogram (Kg) of dry maize grain as transport cost. This is followed by the cost per trip and offloading costs at an average of Ksh. 64.39 and Ksh. 16.38 per 90 kg of dry maize grain respectively. Cess charges had the lowest average cost of Ksh.10.11 per 90 kg of dry maize. The major component of marketing cost as per the previous study was packaging (82.63%) and transportation charges (10.74%) [28]. However, the author's findings on packaging charges and transport charges were in divergence with the current study findings.

Table 7. *Dry Maize Grain Transaction Costs.*

Type of cost	N	Mean	Std. Deviation
Cost per trip (90kg)	156	64.39	47.798
Labour for loading 90kg bag	156	18.46	12.123
Storage cost	156	34.20	58.559
Offloading cost	156	16.38	10.342
Transport cost	156	72.17	51.945
Market Charges (handling & brokerage charges)	156	28.40	35.786
Packaging cost	156	30.56	15.839
Cess Charges	156	27.05	10.110
Valid N (list wise)	156		

Table 8 of results on access to market information by dry maize grain traders on the study area revealed that 93.6% of the dry maize grain traders accessed market information as compared to 6.4% of the traders who did not. This therefore, implied that issues of oversupply and undersupply of dry maize grain in terminal and source markets need not to arise. Access to market information is critical to both producers and traders in settling on a price and locating a seller or a buyer of dry maize grain. This would increase their shares in the value chain and their bargaining power, thus lowering market manipulation by the few traders and promote market integration and efficiency [29]. The study on whether maize farmers are able to access market information, found out that both rural and peri-urban market farmers had access to market information on prices and quantities of commodities [25]. Access to market information reduces transaction costs and improves bargaining power among small-scale farmers [30]. All these earlier study findings are in convergence with the current study findings. The current study results on access to market information are also in agreement with the findings on determinants of rural and co-operative market choice among small holder yam farmers in the Brong Ahafo region of Ghana [31]. The study results show that access to market information play a key role in determining the choice of market among smallholder yam farmers [31].

Table 8. *Access to Market Information.*

	Frequency	Percent (%)
Yes	146	93.6
No	10	6.4
Total	156	100.0

Table 9 of results shows the various sources of market information for the dry grain maize traders in the study area. Results revealed that 76.9% of the dry maize grain traders received market information on dry maize grains markets by physically visiting the maize market places, whereas 15.4% of the traders received dry maize grain information through electronic media. The remaining 6%, 5% and 1% of the traders received dry maize market information from government officials, NCPB and from agricultural extension officers, respectively. Previous study results shows that most of the households who were involved in rural and peri-urban maize marketing obtained market information through formal and informal sources such as radio, television, newspapers, friends, public or private organizations, social networks of neighbours and relatives [25].

Table 9. *Source of Dry Maize Grain Market Information.*

	Frequency	Percent (%)
By visiting market place	120	76.9
From NCPB	8	5.1
From government officials	1	0.6
From electronic media	24	15.4
From Agricultural extension officers	2	1.3
Others	1	0.6
Total	156	100.0

3.3. Correlation of Dry Maize Grain Prices Between Terminal and Source Markets

Table 10 shows the results of the regression and correlation between the terminal and the source markets for the dry maize grains. Regression and correlation analysis was used with the sole purpose of determining the relationship between the terminal and source markets prices for the study area. The results show that R-squared value of 0.466 means that approximately 46.6% of the variance of terminal market price was accounted for by the model. In this case, the predictor variable was the source market price. The regression coefficients represent the mean change in the terminal market price for one unit change in the source market price while holding other predictors in the model constant.

Table 10. *Correlation between Terminal and Source Markets for Dry Maize Grain.*

Terminal Market	Coefficient	Std. Err.	t	P>t	[95% Conf.	Interval]
Source Market	0.9820277	0.0847116	11.59	0.000	0.814681	1.149374
Constant	395.5004	141.3782	2.80	0.006	116.2094	674.7915

Legend: Number of observations =156, F (1, 154) = 134.39, R-squared= 0.4660, Adj R-squared =0.46, Root MSE = 284.4

The statistical control that the regression provides for this study was important because it isolated the role of one variable from all the others in the model. The *t*-test for source market price equals 11.59, which was statistically significant at 95% confidence interval. This means that the regression coefficient for source market is significantly different from

zero. The coefficient of source market was 0.982, which means that for every unit increase in source market price would result in a 98.2% increase in terminal market price. The constant value was 395.5, and this was the predicted value when the source market value was zero.

Table 11 of results shows the linear relationship between the source and the terminal dry maize grain markets. The results were tested by performing the Pearson's Product-Moment correlation. The test was used to assess the strength of the linear of the relationship between the terminal and the source market prices of dry maize grains among the surveyed 156 maize traders in Kipkelion East and West Sub-Counties in Kericho County. The Pearson's Product-Moment correlation results shows that the correlation coefficient, *r*, was 0.83 with a significant *p*-value less than 0.05. The result shows that there was a strong positive relationship between the terminal and the source market prices of dry maize grains. The coefficient of determination (r^2) for the source market of 0.68 explains 68% of variation in terminal market price which is explained by all the source market prices. This result means that high prices in the source markets would lead to higher prices as well in the terminal markets. The finding will thus promote dry maize grain trading since traders will be willing to participate in the business because the trade would results in better income generation.

Table 11. *Pearson's Correlation between Source and Terminal Dry Maize Grain Markets.*

	Terminal Market	Source Market
Terminal Market	1.0000	0
Source Market	0.6826* 0.0000	1.0000

$r^2 = 0.6826$ $r = 0.83$

According to the study finding on the use of mobile phones in Niger over the years between 2001 and 2006, and its impact on grain markets, results indicates that the usage of mobile phones minimized grain price difference between markets by at least 6.4% and minimized inter-seasonal price variations by 10% [32]. The effect of usage of mobile phones was even higher in areas with poor quality of roads, which was in convergence with the current study findings. However, a study on the Nigerian maize market price to world maize market prices found a weak response but a strong co-movement of domestic maize prices and those of neighbouring West African countries [33]. The study findings on price transmission across Global markets and Sub-Saharan Africa (SSA) domestic maize markets showed that most local price series correlate to regional neighbours maize markets [34]. These findings were also convergent with the current study findings.

4. Conclusions and Recommendations

This study analysed the regression and correlation between the terminal market prices and source market prices of dry maize grain in Kipkelion East and West Sub-Counties, Kericho County, Kenya. The correlation and regression analysis results showed statistically significant correlation between the terminal and source market prices. Regression and correlation results of the study shows that for every unit increase in the dry maize grain source market prices would result in a 98.2% increase in the terminal maize market prices. The Pearson's Product-Moment correlation coefficient results showed that there was a strong positive relationship between the terminal and the source market prices of dry maize grains. The coefficient explained 68% of variation in terminal market price which was also explained by all the source market prices. High prices in the source markets would lead to higher prices as well in the terminal markets. The finding would thus promote dry maize grain trading since traders would be willing to participate in the business because the trade would result in better income generation. Therefore, in order to promote competitiveness between the source and the terminal dry maize grain markets in the county and in the country, and to improve dry maize grain market environment, this study recommends the formulation of relevant maize production and marketing policies by the relevant government agencies, both in the county and in the national government that will help promote competition. There is also need to improve market information flow in the county; particularly the use of information and communication technology (ICT) in order to ensure timely and faster flow of information across the product markets. If traders, producers and consumers are given timely market information, it will reduce cases of price shocks and promote market integration.

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Conflict of Interests

The authors declare that they have no competing interests.

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