ECONOMIC ANALYSIS OF SPATIAL INTEGRATION OF PULSES MARKET: A CASE OF SELECTED PULSE MARKETS IN ETHIOPIA

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DECLARATION AND APPROVAL

DECLARATION

This thesis is my original work and has not been presented before in any form for the award of a Degree in any other University.

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DEDICATION

I dedicate this thesis to my beloved husband Anteneh Tesfaye and my beloved Brother Senishaw Tameru for their love, courage and sincere support.

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ABSTRACT

Small import-dependent countries in the world, especially in Africa, are deeply affected by the food insecurity and economic crises. To solve this problem, the Government of Ethiopia has adopted a different strategy in agricultural sector by focusing on how to increase the volume of production. However, marketing aspect has been given less attention. In order to improve the market efficiency, significant numbers of empirical studies have been conducted on market integration but they focused mainly on cereal market while pulse market has not been given adequate attention. This study was conducted to investigate the market integration level of pulse market in Ethiopia. The study selected two major pulse group in the country (Horse beans and Chickpeas) based on their volume of production. Average monthly prices (Birr/100 Kg) from January 2003 to December 2013 were obtained from Ethiopian Grain Trade Enterprise (EGTE). The analysis was done using Co-integration model, Error Correction model and Granger Causality model. STATA 11 analysis software was used to process the data. Co integration test results indicate that, all the selected markets are co-integrated at 1% significant level. However, Addis Ababa- Desse for the case of Horse beans and Addis Ababa-Gonder for Chickpeas markets have strong integration and takes 43% and 40% period to adjust towards the long run equilibrium respectively. Looking at the causal relationship, Addis Ababa-Desse, Addis Ababa-Adama, Desse-Diredawa markets are unidirectional while Desse-Adama is bidirectional for Horse beans. For Chickpeas, all the selected markets do not Granger Cause each other in both directions except between Diredawa-Adama which were unidirectional. The finding of the study implies that, any agricultural marketing policy should realise the nature of the markets and need to consider their relationship. The results suggest that geographical difference, distance and volume of production are important factors affecting spatial market integration. The study recommends government intervention in developing infrastructure, improving access to information and strengthening legal enforcement rules especially at the border of the country can reduce the trade barriers existing between markets. A modern way of trading, such as letting commodities to be traded in Ethiopia Commodity Exchange to assure market players the security they need and increase the benefits of all market actors who participate in pulse market so that the level of market integration can improve.

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ACRONYMS AND ABBREVIATIONS

ADF:	Augmented Dickey-Fuller.
CPI:	Consumer Price Index**.**
CSA:	Central Statistics Agency.
DAAD:	Deutscher Akademischer Austausch Dienst.
ECM:	Error Correction Model.
EMA	Ethiopia Mapping Agency.
ECX:	Ethiopian Commodity Exchange.
EGTE:	Ethiopian Grain Trade Enterprise.
EIAR:	Ethiopian Institute of Agricultural Research.
FAO:	Food and Agriculture Organization.
GDP:	Gross Domestic Product.
GTP:	Growth and Transformation Plan.
HHC:	House Hold consumption.
ILRI:	International Livestock Research Institute.
JFIML:	Johansson's Full Information Maximum Likelihood.
Kg:	Kilogram.
MDGs:	Millennium Development Goals.
MoFED:	Ministry of Finance and Economic Development.
MoARD:	Ministry of Agriculture and Rural Development.
MOT:	Ministry Of Trade.
PASDEP:	Plan for Accelerated and Sustained Development to End Poverty.
PP	Phillips-Perron.
PRSP:	Poverty Reduction Strategy Program.
SDPRP:	Sustainable Development and Poverty Reduction Program.
SNNP:	Southern Nations, Nationalities, and Peoples.
TAR:	Threshold Autoregressive.
USD:	United States Dollar.

CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Small import-dependent countries in the world, especially in Africa, are deeply affected by the food insecurity and economic crises. Indeed, many countries are still in crisis in different parts of the world, particularly the Horn of Africa. These crises are challenging most countries efforts to achieve the Millennium Development Goal (MDG) of reducing the proportion of people who suffer from hunger. Even if the MDGs are to be achieved by 2015 some 600 million people in developing countries will still be undernourished. Having 600 million human beings suffering from hunger on a daily basis is never acceptable. The entire international community must act today to forcefully and responsibly banish food insecurity from the planet. Investment in agriculture and improving resilience among farmers remain the key to providing sustained access to food for all and reducing vulnerability to food insecurity and natural disasters such as drought. Improved seeds and farm management techniques, as well as irrigation and fertilizer that sustainably increase productivity and reduce production risk must be delivered to farmers, especially smallholders by both the private and the public sector. On the same way there is a need to focus on market efficiency and performance to sustainable development and growth (FAO, 2011).

More than 80% of the population in the Ethiopia lives in rural areas and their main source of income is agriculture. Agriculture accounts for 45% of the Gross Domestic Product (GDP), employs 85% of the labour force and generates 90% of the export earnings (MoARD, 2010). However, Ethiopian farming is largely characterised by peasant holders growing food mainly for family consumption thus leaving little for commercial purposes. This inadequate volume of production is mainly due to the tardy progress in farming methods and scattered pieces of land holdings. Most of the farm land is cultivated by small scale farmers with traditional way of agricultural practicing.

The diverse climate of the country and the multiple utilizations of crops have prompted the vast majority of agricultural holders to grow various temporary and permanent crops. The major food crops that are commonly grown by the majority of peasant holders are cereals, pulses, oilseeds, vegetables, root crops, fruit crops, stimulant crops and sugar cane. Stimulant crops consist of chat, coffee and hops. These major food crops are produced in almost all regions of the country

in spite of the variation in volume of production across the regions. The variation may be attributed to the extent of area devoted to each crop type, weather change and a shift in preference for the crops grown (CSA, 2011).

The Government of Ethiopia has implemented a five year (2005/06-2009/10) strategic framework, Plan for Accelerated and Sustained Development to End Poverty (PASDEP), which guides overall development activities in the country. This development plan is continuation of the first Phase of Poverty Reduction Strategy Poverty Reduction Program (PRSP) process which began under the Sustainable Development and Poverty Reduction Program (SDPRP), which covered a period of three years, 2002/03-2004/05. PASDEP is one of the medium term plans for the realization of the government's vision to transform the nation into a middle income country and achieve Millennium Development Goals (MDGs) (MoFED, 2006).

The Government has embarked massively on the transformation of the economy by developing a five-year (2010-2015) Growth and Transformation document which is a medium term strategic framework for the five-year period. The plan has been prepared considering growth constraining factors and lessons drawn from the implementation of PASDEP, country's long-term vision, and external shocks. The major goals of the Growth and Transformation Plan (GTP) are achieving Ethiopia's long-term vision, sustain rapid and broad based growth paths witnessed during the past several years, and eventually end poverty (MoFED, 2006).

The Agricultural Development Led Industrialization (ADLI) Strategy is among the pillars of SDPRP. In order to accelerate and expand industrial development and increase overall economic growth, it is essential to develop the agricultural sector which is crucial to ensure the provision of inputs for industries as well as to fulfil food requirements. Furthermore, the sector is the subdivision of the economy where the major human power required for development is engaged in addition to being the foundation for major growth in value added and the source of foreign exchange earned. For stabilization of current agricultural commodity prices fluctuation and improving grain marketing system will address the problems of high seasonal price variability (MoFED, 2006).

Among the agricultural commodities Pulse is the third- largest export crop behind coffee and oil seed, and rakes in more than USD 232.5 million annually. It contributes to small holder income as a higher value crop than cereals and a cost effective source of protein that accounts for approximately 15% of protein intake to their diet (Shahidur *et al.,* 2010). For the successful

implementation of these strategies and plans, a study of agricultural price dynamics is an important input. Knowing about the relationship between spatially separated market mostly producing and consuming market of agricultural produces can assist the government to involve more effective policy intervention.

1.1.1 Pulse in Ethiopia: Overview of Planted land and Production

Pulse have been cultivated and consumed in large quantities in Ethiopia for many years. Pulse crops are important components of crop production in Ethiopia's smallholder's agriculture, providing an economic advantage to small farm holdings as an alternative source of protein, cash income, and food security (ECX, 2012).

There are twelve pulse species grown in the country consisting of Horse beans (Vicia *faba* L.), Field pea (*Pisum sativum* L.), Chickpeas (*Cicer arietinum* L.), Lentil (*Lens cultinaris Medik*.), Grass pea (*Lathyrus sativus* L.), Fenugreek (*Trigonella foenum-graecum* L.) and Lupine (*Lupinus albus L.*) which are categorized as highland pulses and grown in the cooler highlands. Conversely, Haricot bean (*Phaseolus vulgaris* L.), Soya bean (*Glycine max* L.), Cowpea (*Vigna unguiculata* L.), Pigeon pea (*Cajanus cajan L.*) and Mung beans are predominantly grown in the warmer and low land parts of the country (Shahidur *et al.*, 2010).

The major varieties of pulses grown in Ethiopia are: Horse beans, Chickpeas, Haricot beans, Lentils, Dry peas and Vetches. Although the availability of pulses has never been in surplus in the subsistence farming community, recently it has been observed that the production and supply of some pulses is increasing due to the demand increase both in local and international markets (Shahidur *et al.*, 2010). These crops have been used for many years in crop rotation practices. Of the country's total area coverage in hectare grain crops consists 91% and 13.8% was under pulses (Figure 1). Of the country's total area under pulses, 31% and 14% were planted to Horse beans and Chickpeas, respectively (CSA, 2013), as indicated in Table 1.

Table 1: Total Area of Grain Crops for Private Holdings (2012/13 (2005 in Ethiopian Calendar.)), Meher Season.

Crop Category	Total Area in Hectare	%
Cereals	9,601,035.26	78.17
Pulse	1,863,445.42	15.17
Oil Crops	818,449.3	6.66
Grain Crops	**12,282,929.98**	**100.00**

Source: CSA (2013).

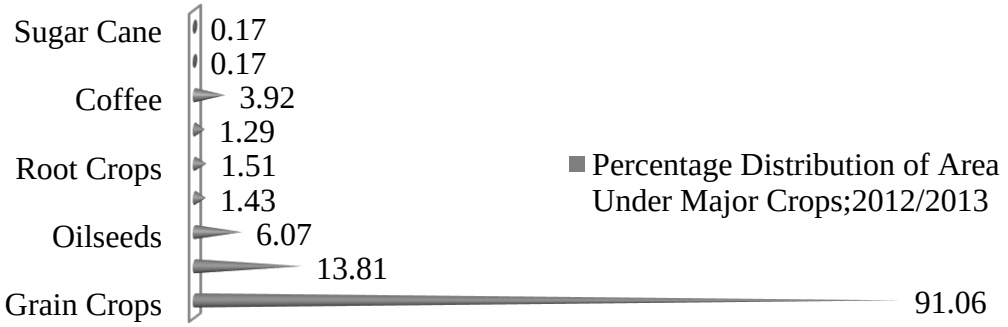

Figure 1: Present Distribution of Area under Major Crops; (2012/13) *Meher* season.

The production obtained from grain crops such as: cereals, pulses and oilseeds, in 2013, were 231,288,471.77 quintals from this pulse consists of 11.89%. The contribution of Horse beans and Chickpeas was 34% and 15% of the country's total pulse production, respectively (CSA, 2013), as indicated in Table 2.

Table 2: Total Production of Grain Crops for Private holdings, (2012/13 (2005 Ethiopian Calendar.)), *Meher* Season

Crop Category	Total Production (100 Kg)	%
Cereals	196,511,515.46	84.96
Pulse	27,510,311.88	11.89
Oil Crops	7,266,644.43	3.14
Grain Crops	**231,288,471.77**	**100**

Source: CSA (2013).

1.1.2 The Concept of Market Integration

A well-integrated market system is central to a well-functioning market economy (Dercon, 1995). Spatial price relationships have been widely used to indicate overall market performance. The usual definition for spatial market integration in different literature is that of markets which are in different places where prices are determined interdependently or situations in which the prices of a commodity in spatially separated markets move together, price signals and information are transmitted smoothly.

A better integrated market may experience more volatility, if the price in one market is higher than the price in another market and given the transaction cost that would be involved if one had to move the product from the market with a low price to the market with a high price, unexploited profits would exist. Rational traders would therefore enter the market and capitalize on these arbitrage opportunities, increasing demand in the market where prices are low and increasing supply in the location where prices are high. These latter two forces will, *ceteris paribus*, drive up the price in the market that had initially a low price and reduce the price in the market that had initially a high price. The result will be that prices adjust up to the point where trade becomes unprofitable again, that is, until the price difference becomes equal to the transaction cost (Bjorn, 2012).

The price risk in a particular location will be spread over a larger geographical area when markets become better integrated. This means that efficient food markets should ensure effective trade between food- deficit and food-surplus locations and therefore, this will lead to specialization

and taking advantage of comparative advantages, which is a major source of economic growth. On the other hand, if prices are not properly transmitted, localized scarcities and surpluses can hurt both consumers and producers thus leading to increased price volatility (Goletti *et al.,* 1995).

1.2 Statement of the Problem

Small import-dependent countries in the world, especially in Africa, are deeply affected by the food insecurity and economic crisis. The Government of Ethiopia has adopted different strategies since the introduction of agricultural extension services in the early 1970s in order to improve the performance of the agricultural sector thus solving the problem of food insecurity. However, most of this strategy has focused on how to increase agricultural productivity at the farm level through the dissemination of improved production technologies while the marketing aspect has been given less attention. Improvement in volume of production without efficient market system may not solve the problem of food security. By considering this a number of studies have been done on market integration to see the level of market efficiency. However, they focused mainly on the cereal market: Maize, Wheat, Sorghum and *Teff* (Negassa, 1998; Negassa *et al*., 2004; Getnet *et al*., 2005; Getnet, 2007; Tadesse and Shively, 2009 and Sinishaw, 2013) while pulse market has not been given adequate attention. Pulse is the third -largest export crop after coffee and oil seed in the country and generates USD 232.5 million. In addition it has been showing a significant growth in export and quantity of pulse in the last decade. It is also a higher value crop than cereal to small-holders farmers who are the majority and a source of cost effective protein intake to their diet (Shahidur *et al.,* 2010). This study is intended to concentrate in pulse market efficiency by investigating all possible pairwise combination of selected markets and assess whether the selected markets are integrated or segmented. Thus, the result will help policy makers to evaluate the market efficiency level in order to take appropriate policy interventions.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of this research is to investigate the market integration level of pulse market in Ethiopia.

1.3.2 Specific Objectives

Specifically, this study was conducted:

i. To determine the existence of spatial integration between the selected pulse markets in Ethiopia.
ii. To estimate the speed of price adjustment in the long run in pulse markets.
iii. To determine the existence of Granger causality between selected pulse markets.

1.4 Research Hypotheses

i. The selected markets are not integrated in Ethiopia.
ii. The speed of adjustment of the prices to the long run equilibrium is low.
iii. There is no Granger causality between the selected markets.

1.5 Justification of the Study

Significant attention has been given to agricultural market integration in developing countries (Goletti and Babu, 1994; Dercon, 1995; Negassa, 1997; Abdulai, 2000; Negassa *et al*., 2003; Van Campenhout, 2005 and Amikuzuno, 2009), illustrating its importance for researchers and policy makers. In Ethiopia, the problem of food insecurity is not mainly because of shortage in production rather it is because of market inefficiency. For example in 1984, there was a serious famine which led a million people to die out of food specially northern region of Tigray and Wollo yet in the same year farmers produced surplus production (Gabre –Madhin, 2012).

Integration of agricultural markets and rural-urban food markets is a pre-condition for effective reform in formerly centrally planned economies. Without integration of markets, price signals will not be transmitted among vertically or spatially separated markets, that is, from surplus to deficit markets or vice versa (Goletti *et al.,* 1995; Barret, 1996; Baulcha, 1997). Market based policy for poverty alleviation and food security could be more effective if markets are integrated. In addition, if markets are integrated, the effect of policy interventions in one market would be transmitted to other markets in order to avoid duplication of interventions and resulting in decrease of the fiscal burden on the budget (Baulcha, 1997). Understanding of market integration also allows monitoring of price movements so as to predict the change in prices of various markets particularly in areas of deficit and sequentially formulate interventional strategies to prevent food insecurity and identify structural factors responsible for market integration in turn improving marketing infrastructure.

There are many reasons for the need to assess the Ethiopian pulse market integration across spatially separated markets; (1) pulse contribute to smallholder income as a higher-value crop than

cereals to their diet, (2) a cost- effective source of protein that accounts for approximately 15% of protein intake. Ethiopia is now one of the top ten producers of total pulses in the world, the second-largest producer of Horse beans after China, and the fifth largest producer of Chickpeas (Shahidur *et al.* 2010). The results of this study helps to assess the nature of price relationships, the direction of causal relationships, and the speed of adjustment (how many days, weeks, or months are needed for prices to be transmitted from one location to another). Moreover, examining the degree of market integration may be helpful in designing and guiding efficient and cost effective government market interventions such as price stabilization and food aid distribution policies (Negassa, 1997).

In Ethiopia grain marketing system, the spatial movements of prices for grain; Wheat, maize, sorghum and *teff,* have been widely studied (Negassa, 1998; Negassa *et al*., 2004; Getnet *et al*., 2005; Getnet, 2007; Tadesse and Shively, 2009). However, this study focused on pulse (Horse beans and Chickpeas) market system, which was not considered by the listed studies. Thus the findings of this study are expected to benefit different stakeholders who are involved in pulse market in Ethiopia such as farmers, marketing agents, consumers, processors and policy makers for informed decision making in order to contribute towards agricultural development and poverty alleviation of rural households.

1.6 Scope and Limitation of the Study

This study examined the extent of pulses market integration in Ethiopia by using monthly average price (Birr/100 Kg) data from January 2003-December 2013, which may not cover earlier periods because of absence of complete data set. In the country, twelve pulse species are grown. Of these, the study deals with only Horse beans (Vicia *faba* L.) and Chickpeas (*Cicer arietinum* L.); the selection of this crop is based on their large proportion of production among other pulse type in the country.

There are five main pulse producing regions in the country but the study selected only two regions based on their volume of production and from these region four different zones were selected. The central cities of these selected zones are the regional markets. The findings of these selected markets might not represent the general view of market in Ethiopia since factors affecting market integration between markets may be different from place to place. However, the study provides results which need to be considered by policy makers for effective policy intervention and a basis for future studies.

1.7 Definition of Terms

Agriculture: The growing of crops and/or rearing of animals for own consumption and /or sale.

Assemblers: Collect some present of marketable surplus from producing market and sell what they collected to wholesale traders in relatively near to Addis Ababa market .They could operate both as agents of the bigger wholesalers or independently.

Belg Season Crop: Any temporary crop harvested between the months of *Megabit* (March) and *Pagume* (August) is considered to be *Belg* Season Crop.

Birr: Ethiopian currency. (1 $=19.86 birr)

Co-integration of Markets: Procedure for evaluating spatial market linkage in the presence of stochastic trends in price series. It requires that deviations from equilibrium conditions between two economic variables, (which are individually non-stationary in the short-run) be stationary in the long-run.

Causality: A concept that shows the relationship between two or more variables as well as the direction of relationship that exists between those variables.

Market: A place where buyers and sellers are gathered for exchange of goods, services and information.

Market Integration: When prices among different locations or related goods follow similar patterns over a long period of time.

Meher (Main) Season Crop: Any temporary crop harvested between the months of *Meskerem* (September) and *Yekatit* (February) is considered as *meher* season crop.

Segmentation of Markets: If price in one market are completely irrelevant to forecast price movements in the other market.

CHAPTER TWO
LITERATURE REVIEW

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2.1 Review of Market Integration

In a more formal approach, following Barret and Li (2002), spatial market integration could be stated as tradability or contestability between markets. This definition would indicate the movement of the respective commodities from the excess supply to lower supply or the transmission of price shocks between the markets. This approach emphasizes that an actual transfer of goods need not be observed to guarantee that markets are spatially integrated (Escobal, 2008).

Market integration is concerned with the free flow of goods, information and involves prices over space and time, which can be related with market efficiency. While vertical integration involves marketing channels or stages, spatial integration is concerned with markets separated over space where as inter temporal integration refers to arbitrage across periods (Barret, 1996).

The benefits of well-integrated market system are widely accepted and acknowledged. Producers make marketing decisions based on information about the market. Weakly integrated markets may reveal inaccurate price information, which leads to inefficient market performance (Escobal, 2008). Campenhout (2005) on his study, "Modelling Trade in Food market integration: Method and application of Tanzanian Maize Markets" stated that developing countries should give attention for the realization of well integrated market because well integrated market have been found contributing significantly towards improvement of the lives of poor rural households.

Market failures are seen as the cause of the large disparities in farm incomes and food insecurity, including famine in extreme cases thus justifying policy interventions to ensure aggregate welfare increases. Policy objectives should focus on improving infrastructure, providing access to information, promoting competition, and developing risk management institutions (Rashid *et al*., 2010).

Various attempts to measure market integration have been made in the past: correlation coefficients, co-integration coefficients, causality and error correction are some. Price correlation coefficients of different markets were considered as a very simple way of analysing market integration. This model was used as an attempt to measure the degree of market integration, in the absence of simultaneous information about price and trade flows (Fatchamps and Gavian, 1996). The major problems with simple bivariate correlation coefficient are that it requires filtering in order to eliminate bias due to problem of non-stationary probably caused by common exogenous trends (for example general inflation), common periodicity (for example agricultural seasonality), or autocorrelation . Further, it did not consider the existence of transaction costs and considered

price co-movement as an indicator for market integration. In addition, it fails to recognize the problem of heteroskedasticity which commonly exists in price data of reasonably high frequency (Barret, 1996). This approach also criticized that it does not indicate, or it is impossible to locate which market among those being analysed is the main central market (if there exists). Moreover, if the price transmission is not contemporary but lagged, the correlation analysis does not reveal real integration, that is, it shows a lower degree of integration even if there is an actual integration (Escobal, 2008).

As a further refinement, co-integration analysis has been suggested and it may indicate the existence of interdependency between two series (market) and its absence, on the other hand indicates market integration. If co- integration is rejected in both directions, markets are said to be segmented, if the test is accepted in both directions, markets can be considered as integrated (Gonzalez *et al*., 2004). The main significant of co-integration analysis is that it confirms deviations from equilibrium conditions between two economic variables, which are individually non-stationary in the short-run and are stationary in the long-run. To find the extent of integration researchers precede adoption of error correction model, and test for short run market integration. It was noted that two prices series have to be co-integrated before an error correction model can be used and when co-integration is observed it is taken as an indication of long run market integration (Perabhat Vase, 2003). If existence of long run market integration is found, then the short-run dynamics that are consistent with this long-run dynamics are tested using error correction techniques (Goodwin and Schroeder, 1991).

There were other methods such as Radial Market Integration Approach (Ravallion, 1986) and Variance Decomposition Approach (Delgado, 1986), but because of their limitations on their assumption and analytical technique they have been criticized by most researchers.

2.2 Empirical Literature on Market Integration

Senishaw (2013), conducted a study on "spatial integration of Cereal market in Ethiopia" based on Ethiopian Grain Trade Enterprise (EGTE) Weekly wholesale price data covering the period July 2001 to November 2011 on four major staples of Ethiopia: *teff*, wheat, maize and sorghum. He analysed the extent of and change in spatial integration of Addis Ababa with the most important regional wholesale market in Ethiopia, where, a Threshold Autoregressive (TAR) Model was used. Results showed that market integration has considerably improved over the last ten years for *teff*, wheat and maize with faster price adjustments and lower estimated transaction costs. On

the other hand, for white sorghum the integration of regional market with Addis Ababa did not improve over the last decade.

Negassa (1997), studied "Vertical and spatial integration of Grain Market in Ethiopia: Implications for grain markets and food security policies", using weekly price data collected from August 1996 to July 1997 deflated by CPI (1995=1995) for Addis Ababa market tried to analyse the vertical and spatial integration of grin market of grain markets in Ethiopia. He used Causality test and found that the grain markets in Ethiopia exhibit a high degree of vertical and spatial market integration.

Bonsun *et al.* (2011), conducted a study on "Efficiency of the plantain marketing system in Ghana: A co- integration analysis", assessed the efficiency of the plantain marketing system in Ghana using monthly wholesale prices in GHS/10 kg covering the period 2004 to 2009. To test the market integration the study used Johansen multivariate co-integration analysis and error correction model. The markets chosen for study are consuming markets; assembling markets and producing markets. The markets were chosen based on the volume of production and trade. The finding indicates that arbitrage in the plantain marketing system is working since there is both long run and short run relationship between central consumption market and the three assembling and three producing markets. However, the speed with which prices are transmitted between the consuming market and the other markets was relatively weak at 27.7%, compared to perfect adjustment of 100% threshold.

Nkendah *et al.* (2007) made use of Error Correction Model, in the study of "Economic analysis of the spatial integration of plantain market in Cameron". In this study analysis, they argued that the co-integration and the correction of errors models became the standard tools to the analysis of the spatial relations of the markets, thus replacing the old empirical tools, such as the regression and correlation coefficient. The findings shows that there is weak integration between producing and consuming markets and the urban consumer price increases because of concentration of information in the hands of certain tradesmen, in particular wholesalers. The asymmetry of price information restricts other wholesalers to penetrate into the plantain marketing chain. That situation results into a weak supply of commodities for some cities and consequently a high price of plantain to the consumers.

Randela *et al.* (2008), on study conducted on the factors enhancing market participation by small-scale cotton farmers, used the following variables which influenced market participation:

distance to market (km), access to market information, general state of the road, access to guaranteed market and proximity to towns. Infrastructural obstacles such as poor state of roads as well as inadequate road networks obviously hinder marketing efficiency. Remote locations of farms coupled with poor road infrastructure results in high transport costs and in cases where buyers provide transport, this further reduces the price that buyers are prepared to pay farmers. Markets removed from major cities/towns are not well integrated and in these markets, competition is often highly imperfect. Finding a buyer in these markets is often a problem. In addition, Makhura (2001) argues that proximity to towns reflects how far farmers have to travel to reach sources of information. Such information sources are located in nearest towns where there are offices and markets. Thus, the farther a household is away from the town, the higher the transaction costs of obtaining information and market outlet. The more information the household has on marketing, the less the transaction costs will be.

Basu, and Dinda (2003), in the study of Market integration of potatoes in Hoogly district in West Bengal used distance from the main city market in kilometres (Sheoraphully market) as parameter in selecting the regional market and Tarakeswar market (40 km) and Champadanga (50 km) far from Sheoraphully market. They found that strong form of market integration between Tarakeswar market and Sheoraphully market and higher speed of adjustment between retail prices of Tarakeswar market and Sheoraphully market. They concluded that this is mainly attributed to close proximity between the markets thus better communication, better infrastructure than the remote market.

2.3 Importance of Pulses in Ethiopia

Pulses contribute to smallholder livelihoods in multiple ways. Firstly, pulses can play a significant role in improving smallholders' food security, as an affordable source of protein (pulses make up approximately 15% of the average Ethiopian diet) and other essential nutrients. Pulses are more affordable for smallholders than meat, fish, and dairy products, and for the 40% of Ethiopians in orthodox Christianity, pulses become the single largest source of protein during the fasting period. Secondly, pulses can have an income benefit for smallholders, both in terms of diversification and because they yield a higher gross margin than cereals. Pulses are generally more profitable than cereals, giving smallholders an economic incentive to increase pulse production. Horse beans provide the highest net return among the crops considered, while Chickpeas provide higher returns than barley and *teff*, but comparable returns to wheat (Shahidur

et al., 2010).

In addition to improving food and nutritional well-being, pulses can also improve soil fertility. Pulses have nitrogen fixing properties that can reduce fertilizer usage for cereals in the next season by up to 60% which contribute towards maintaining soil health. Finally, as the third largest crop export product in terms of total value (USD 232 million), pulses have a positive impact on the trade balance, and contribute to the country's foreign exchange reserves. However, only 356,071 tons out of 2.75 million are exported (MOT, 2012).

2.4 Pulses Production and Area Coverage in Ethiopia

2.4.1 Pulse Production

There has been a substantial growth in the production of pulses in Ethiopia between years 2003/04-2012/13. The production of Horse beans and sorghum doubled (108% and 127% respectively) and Maize production nearly doubled with a 96% growth rate, while wheat production grew by 77% between 2003/04 and 2010/11. Considering such comparisons is believed to serve as area problem indicators for concerned stakeholders to develop and implement corrective measures that could help to accelerate the speed of transforming the existing subsistence agriculture into commercial agriculture (CSA, 2013). Since rainfall was normal and adequate in the crop growing season, the 2012/13 (2005 E.C) main season crop production has shown significant increment both in the cropped land area and volume of grain crops production.

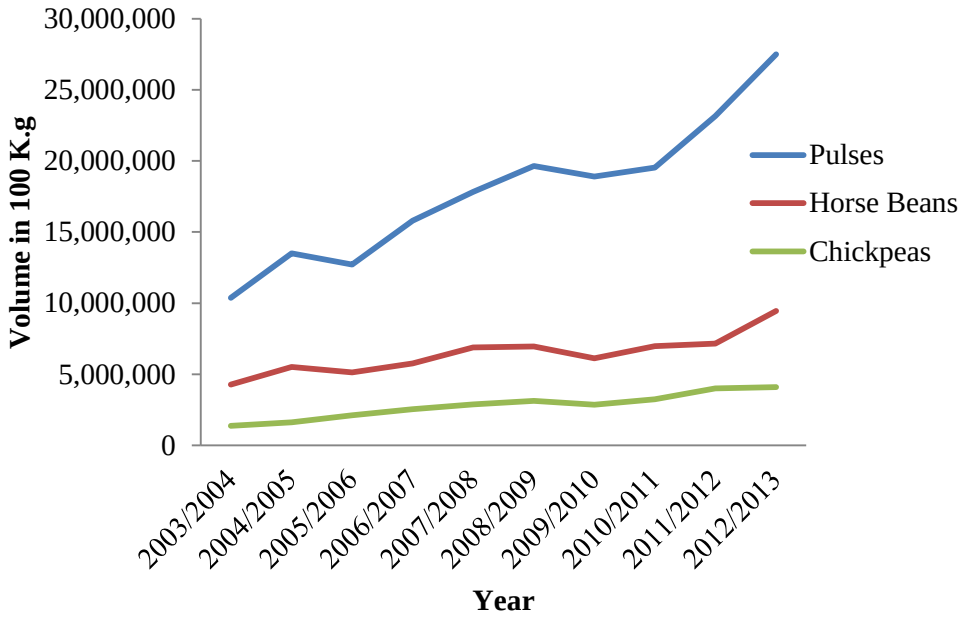


Figure 2: Production in *Meher* Season, Peasant Holding, 2003/04-2012/13

Almost all regions of the country produces pulse but Tigray, Amhara, Oromiya, Benishangulgumz and SNNP regions produce more than 99% of the total national production . Among these regions, 44% of cropped land area and 42% of production is concentrated in the Amhara regions, which account for 55% of Chickpeas production and 39% of Horse beans production. While Oromiya region consists of 42% of total pulse production in the country with 39% of crop land area coverage (CSA, 2013).

Table 3: Pulse Production in Ethiopia by Region

Region	% of Population	Production of Pulse (100 K.g)	Production Shared by Pulse Type	
			Horse Beans	Chickpeas
Amhara	22	11,653,125.21	3,717,380.77	2,250,806.35
Oromiya	37	11,683,118.96	4,262,593.48	1,629,204.96
SNNP	21	2,866,519.91	1,137,129.37	66,363.02
Tigray	6	836,908.59	312,752.36	145,310.21
Benishangulgumz	1	447,663.34	9771.07	5,647.08

Source: CSA (2012 and 2013)

There are two seasons for pulse production in Ethiopia; the short rainy season ranging from March to August (*Belg* season) and the longer rainy season (*Mehere* season), ranging from September to February. The main marketing season is from September to January, with residual trading in February (Ferris and Kaganzi, 2007).

Horse beans and Chickpeas are categorized as highland pulse and grown in the cooler highlands. In reference to Table 3, Oromiya region contributes the largest share in the production of Horse beans (Vicia *faba* L.) while, Amhara region is the largest producer of Chickpeas (*Cicer arietinum* L.). Some of the causes of low production in the other regions include: agro-climatic conditions; limited market access leading to less commercialization (as these regions are further away from main urban centres and seaports leading to limited access to both domestic and international markets), and; low population density.

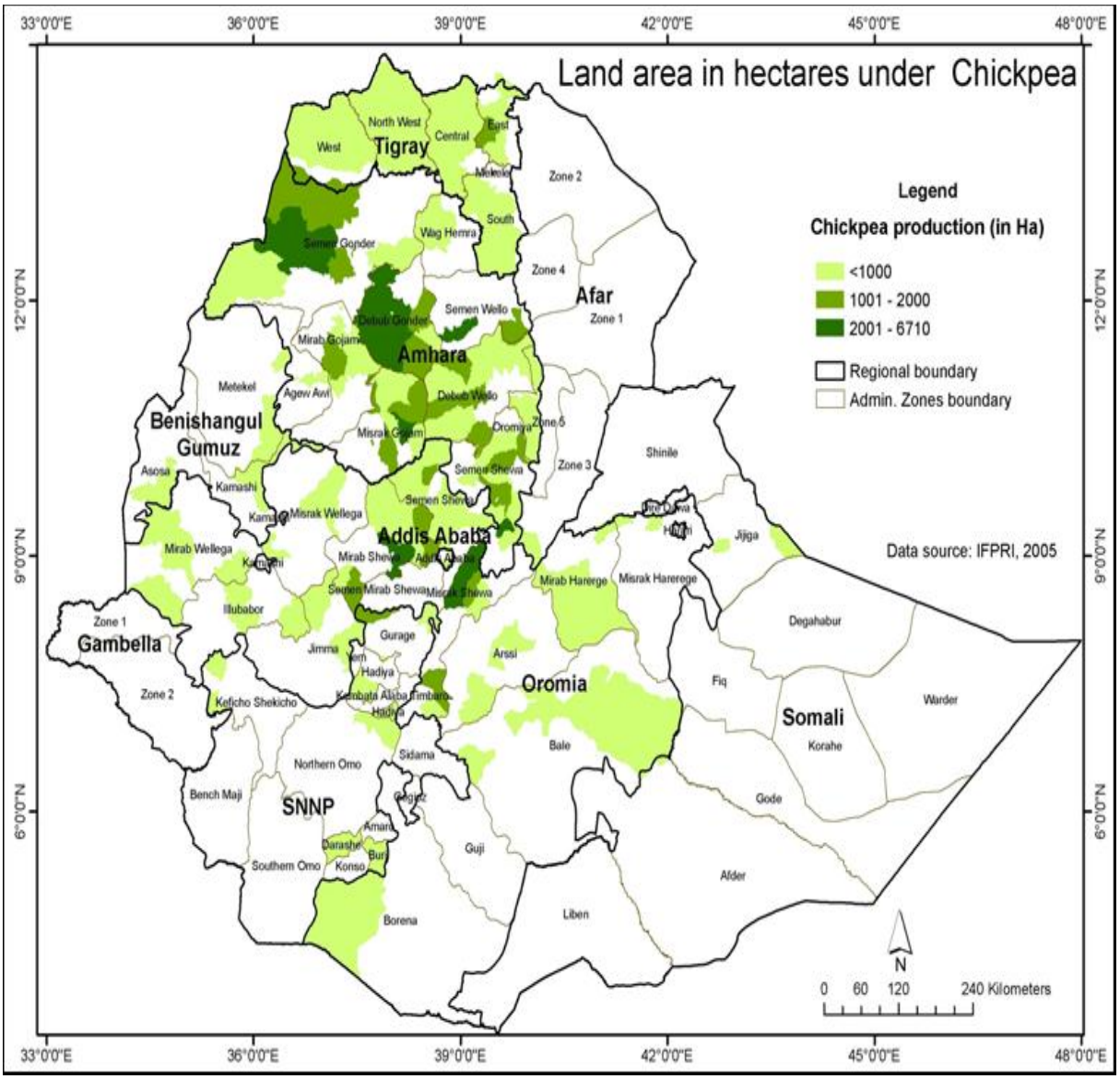
2.4.2 Area Coverage of Pulse in Ethiopia

According to 2012/13 Central Statistics Agency of Ethiopia report, 15.17% (1,863,445.42 hectare) of the total grain crop area was under pulse. Horse beans (Vicia *faba* L.) and Chickpeas (*Cicer arietinum* L.) occupies 29%, (547,060.45 hectare) and 13% (239,512.43 hectare) of the total pulse crop area respectively. As to production Tigray, Amhara, Oromiya, Benishangulgumz and SNNP regions are the major region in area coverage of pulse. Amhara and Oromiya regions independently contribute 44% and 39% to the country's total area of pulse. Amhara region land area is coved by 54% and 45% Chickpeas and Horse beans respectively as reflected by Table 4, Figure 3 and Figure 4.

Table 4: Area Covered by Pulse in Ethiopia by Region

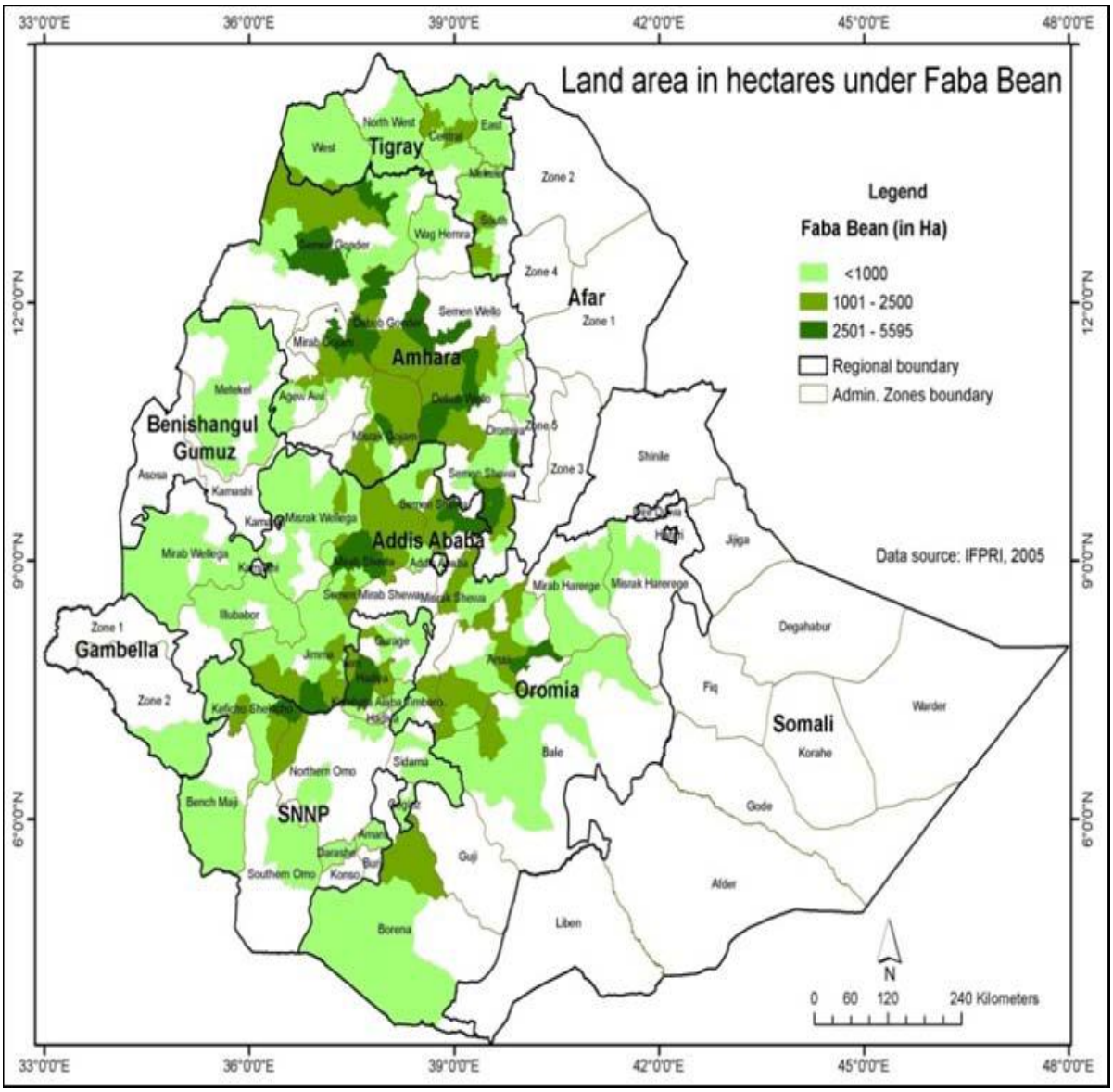
Region	% of Population	Area Covered by Pulse	Area shared by Pulse Types	
			Horse Beans	Chickpeas
Amhara	22	821,900.48	245,066.27	130,381.56
Oromiya	37	734,054.32	237,162.85	90,757.25
SNNP	21	219,357.44	72,520.46	5,896.30
Tigray	6	61,633.99	18,580.11	11,608.22
Benishangulgumz	1	24,703.74	725.87	853.24

Source: CSA (2012 and 2013)



Source: Alemuet (2009)

Figure 3: **Geographic Distributions of Chickpeas**



Source: Alemuet (2009)

Figure 4: Geographic Distribution of Horse Beans

2.5 Utilization of Pulses in Ethiopia

In spite of increased production of pulses over the period 2003/04–2012/13, the biggest share of pulse production is still consumed by the producing household. According to 2013 CSA's Crop and Livestock Utilization Survey (CSA, 2013), 59% of total pulse production is consumed by the producers themselves, with only just over 21% being supplied to the market. Chickpeas

have relatively higher marketable surplus shares at 22% of total production, whereas 16.93% of total production of Horse beans is offered for sale as indicated in Figure 5.

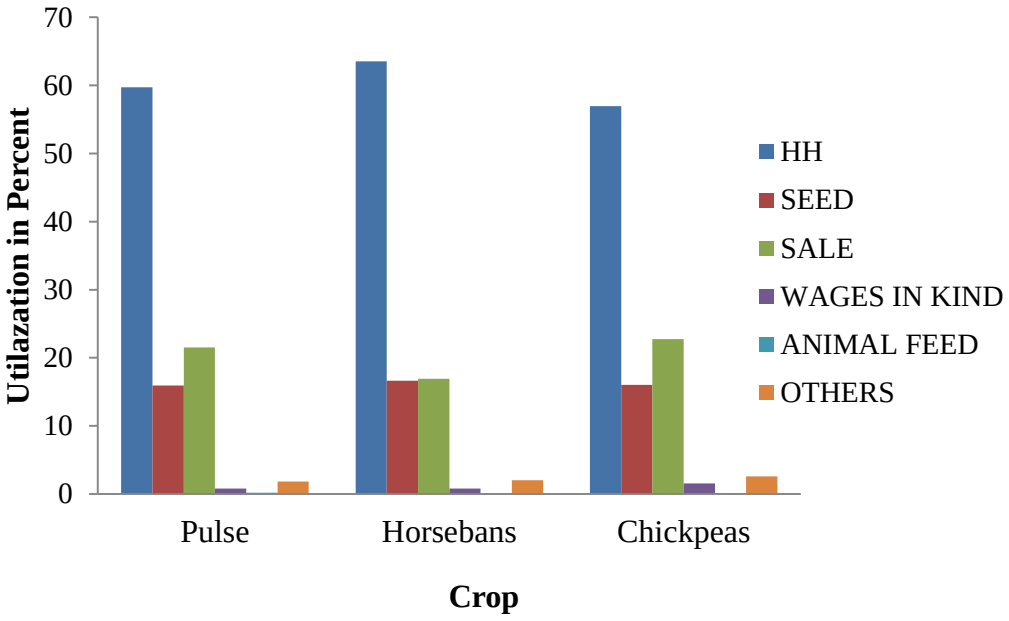


Figure 5: Utilization of Pulses in Ethiopia, 2012/13

The demand for pulses in local and international market is growing (Johnny, 2009). To support this, the Ethiopian Institute of Agricultural Research (EIAR), has developed a range of high yielding, multi-disease resistant varieties. In Ethiopian grain market, Ethiopian Commodity Exchange is trying to change tradition bound agriculture by creating a new marketplace that serves all market actors, from farmers to traders to processors to exporters to consumers. ECX is bringing integrity, security, and efficiency to the market. It also creates opportunities for unparalleled growth in the commodity sector and linked industries, such as transport and logistics, banking and financial services, and others.

Since 2010, the Exchange is trading haricot bean in the trading floor of the Ethiopian commodity exchange and most of the traded items are for export. In the next few months, the Ethiopian Commodity Exchange (ECX) will install another pulse commodity to be traded on its floor which will increase the total export volume of the country (ECX, 2013). The exchange is currently trading Haricot bean, Maize, Coffee, Wheat and sesame seed. As we can see from Figure 6 the export volume of pulse is fluctuating.

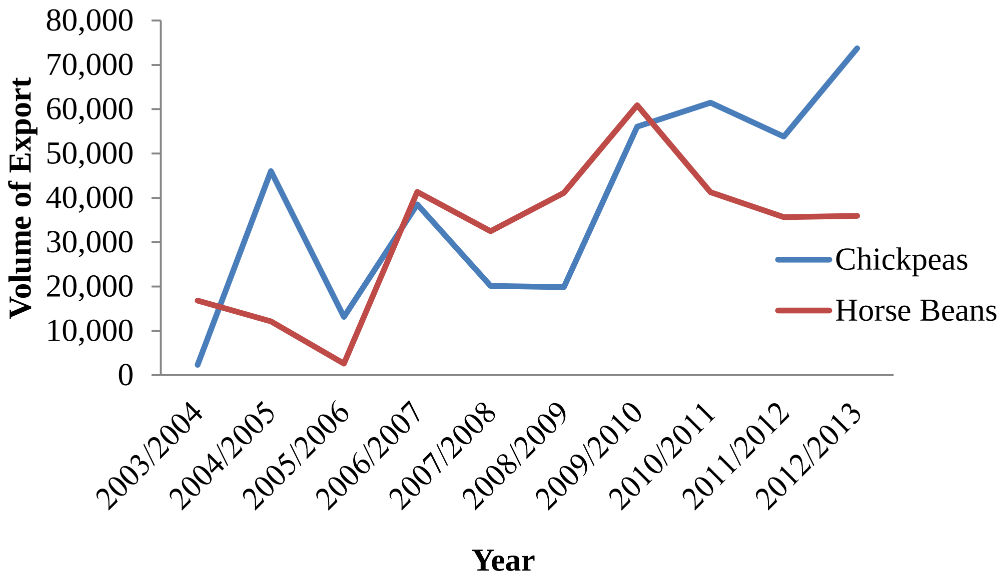


Figure 6: Export Volume of Horse Beans and Chickpeas in Ethiopia

2.6 Theoretical and Conceptual Framework

2.6.1 Theoretical Framework

Barret and Li (2002) defined market integration as tradability or contestability between markets. Market integration can be interpreted as the extent to which price shocks are transmitted between spatially separate markets (Goodwin and Piggott, 2000).

In the classical works of Takayama and Judge (1971) with free flow of information and goods, prices of a homogeneous good in two spatially separated markets should only differ by the transaction costs.

$$p_{1t} = p_{2t} + c \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where: p_{1t} is the price in market1 at time t and p_{2t} is the price in market 2 at time t

This is so because, if the price in one market is larger than the price in another market plus the transaction costs that would be involved if one had to move the product from the market with the low price to the market with the high price, unexploited profits would exist. Rational would therefore enter the market and capitalize on these arbitrage opportunities, increasing demand in

the market where prices are low and increasing supply in the location where prices are high. These latter two forces will, *ceteris paribus*, drive up the price in the market that was initially selling at a low price and reduce the price in the market that had initially a high price. The result will be that prices adjust up to the point where trade becomes unprofitable again, that is until the price difference becomes equal to the transaction cost.

The goal of market integration analysis is to determine marketing efficiency which is basically the extent and speed of price transmission between spatially separated markets (Goleti *et al.*, 1995). It is built on the premise that if a pair of markets is integrated, a price change in one of them will be reflected in a price change of the other. The demand and price of a given unit of commodity in a market would have a dominant effect on the price formation in other trading markets. This would be an indicator for making efficiency since price differences between the given markets would reflect only transaction costs including normal profit (Delgado, 1986). The more integrated market is the more efficient it is.

2.6.2 Conceptual Framework

Considering of two markets and market one is the independent variable and market two is the dependent variable. There are factors which will affect the price of market two such as: Transaction cost, distance from the market, availability of information, means of transportation and government policy. Commodity from market one until it reaches market two may pass though different marketing channels such as Assemblers, Wholesalers and Retailers. As the markets become more integrated it is an indication of market efficiency while if it is segmented it leads to market inefficiency as illustrated in the Figure 7.

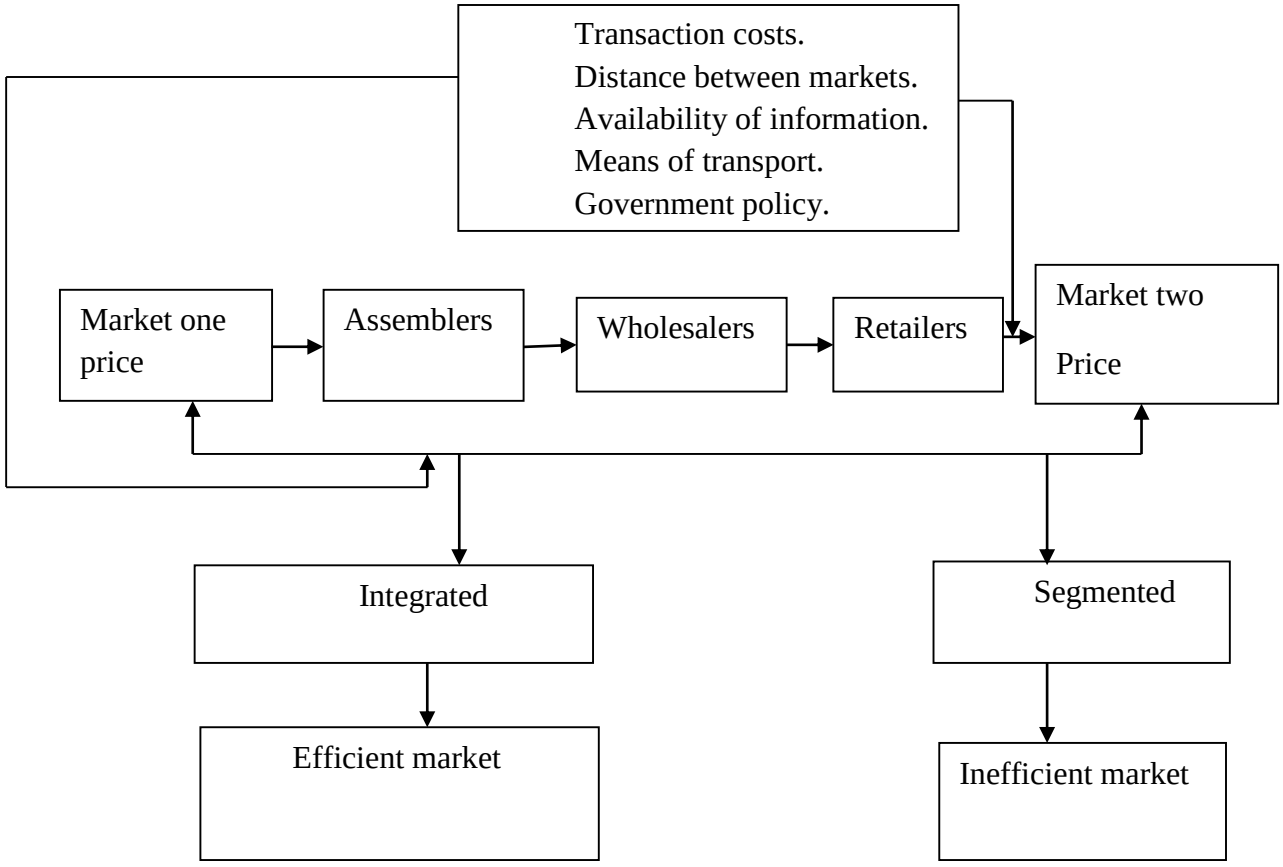


Figure 7: Conceptual Framework

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 General Description of the Study Area

This study was conducted in three different regional markets and one central market for both commodities. The selected markets were Desse, Gonder, Adama and Diredawa regional markets, Addis Ababa market is the central market. The selection of these markets was based on the following criteria:

Desse and Gonder are the major producing market of Horse beans and chickpeas respectively based on their volume of production. Adama and Diredawa were selected both for Horse beans and chickpea based on close proximity and remotest distance from the central market respectively. Addis Ababa is the capital city of Ethiopia and the major consuming market because of large number of population. Note that, even though geographically Diredawa is found in Oromiya region, because of politically sensitive issues the city is not included in Oromiya region thus it has its own city administration and one of two chartered cities in Ethiopia (the other being the capital, Addis Ababa). Since this study focused on geographical location in selecting markets, this study considered Diredawa as one of the study area as referred in Figure 8.

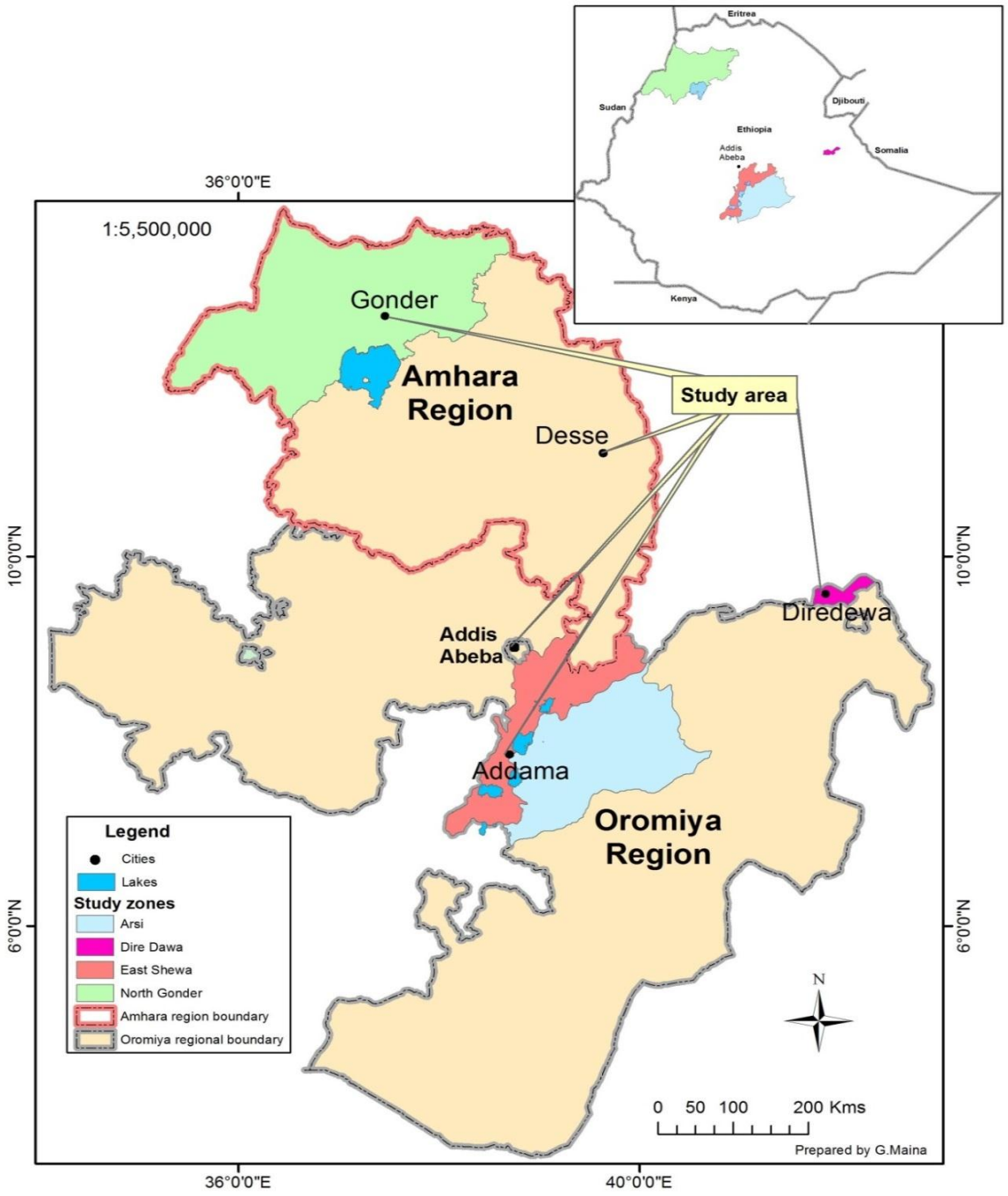


Figure 8: Map of the Study Area

Source: www.wri.org

3.2 Sampling Procedure and Method of Data Collection

This study used purposive sampling to select the markets: Gonder, Desse, Adama, Diredawa as the regional markets while Addis Ababa was the central market. The selection criteria for the regional markets was based on volume of production and the selected markets are Desse and Gonder for Horse Beans and Chickpeas respectively, distance from Addis Ababa was another parameter, Adama and Diredawa were selected markets in the regard. Addis Ababa was selected as a central market because of population number and consumption level.

3.3 Data Type and Source

The study used secondary data from Ethiopian Grain Enterprise (EGTE) covering the period January 2003-December 2013 both for Horse beans and Chickpeas. Average monthly wholesale price (Birr/ 100 Kg) of Horse beans and Chickpeas was used.

3.4 Methods of Data Analysis

Objective One

To identify the existence of spatial integration in pulse market in Ethiopia, Co- integration analysis was used. However, before co-integration was verified, the stationarity of time series was tested using Augmented Dickey–Fuller (ADF) test and Phillips-Perron tests (Phillips and Perron, 1988). Then Co–integration analysis was applied to see if there is price connection between the selected markets based on the model developed by Engle and Granger (1987), and has been applied by Goodwin and Schroeder (1991) in the study of co integration test and spatial price linkages in regional cattle markets, to evaluate the degree of co integration between markets separated by distance.

3.4.1 Stationary and Non-Stationary

A series is said to be stationary if its mean and variance remain constant over the time and the value of the covariance between the two time periods depends only on the distance or lag between the two time periods and not the actual time at which the covariance is computed or in other words remain constant over time (Gujrati, 2005). On the other hand, a series is said to be non-stationary if it fails to satisfy any part of above definition, its mean, variance, or covariance change over time. A stationary series has a tendency to return continuously to its mean value and to fluctuate around it in a more or less constant range, while a non-stationary series has a changing

mean at different points in time and its variance varies with the sampling size over time. For estimation in general to be valid, the error term must be time-invariant, that is, it should be stationary.

To demonstrate the conditions for stationarity, let us see the following first order autoregressive model.

$p_{it} = \varphi\beta p_{i_{t-1}} + \mu_t$ ..... (2)

Where: t =1….. T

If φ < 1, the series p_{i_t} is stationary and if φ = 1, the series is non-stationary and is known as random walk. p_{i_t} can be made stationary after differencing once but it is not necessary that it become stationary after first difference. The number of times series needs to be differenced in order to achieve stationarity depends upon the number of unit roots it contains. If a series becomes stationary after differencing d times, then it contains d unit roots and it is said to be integrated of order d, denoted by I(d) in (1) where φ = 1, p_{i_t} has a unit root and thus $p_{i_t} \approx$ I(1). Since most price series have trends in them is only because of inflation, they are usually I(1) and thus they need differencing once to obtain I(0).

Therefore, the first step in dealing with time series data is to test for the presence of a unit root in the individual time series of each model. There are a number of methods to test the unit root hypothesis but this study used Augmented Dickey Fuller (Dickey and Fuller 1979) and Phillips-Perron tests (PP) (Phillips and Perron, 1988) on testing for a unit root in time series. The numbers of lags in the Augmented Dickey–Fuller (ADF) equation are chosen to ensure that serial correlation. The DF-test requires us to estimate the following by OLS:

$\Delta p_{i_t} = b_0 + b_1 p_{i_{t-1}} + e_t$ ..... (3)

Where, Δp_{i_t} is the difference of price in markets i, $p_{i_{t-1}}$ is the lagged price in market i, b_0 and b_1 are parameters to be estimated and e_t is the error term

To test the hypothesis, the study compared the coefficient of $p_{i_{t-1}}$ with t-statistic.

H_0: p_{i_t} *is non stationary*.

H_1: p_{i_t} *is stationary*.

If we fail to reject the null (*Ho*) in the above then p_{i_t} is not stationary and can be integrated of order one or even higher. To find out the order of integration the test will be repeated with Δp_{i_t} in place of p_{i_t} thus regressing $\Delta\Delta p_{i_t}$ on a constant $\Delta p_{i_{t-1}}$ and several lags of $\Delta\Delta p_{i_t}$ ADF and PP test will be used to test the hypothesis. The process will continue until we establish the order of integration.

We have to test the stationarity of all Horse beans markets prices such as ADDWHB, DESWHB, ADMWHB and DDWHB and ADDWCP, GONWCP, ADMWCP and DDWCP are market price for Chickpeas.

3.4.2 The Concept of Co-integration

The basic idea of co-integration is to identify the long run relationship between variables then divergence from the long run equilibrium path is bounded and the variables are co-integrated. For co-integration, two conditions must be satisfied. First, the series for at least two of the individual variables are integrated of the same order. Second, a linear combination of the variables exist which is integrated to an order lower than the individual variables. Simply, the concept of co-integration is that even though level variables are individually I (1), that is, dominated by the long-run components but the linear combinations of these I (1) variables can be I(0). In this case, the long-run components of these series cancel each other out to produce a stationary series, and such variables are then said to be co-integrated. Alternatively, if the individual variables have a unit root but if there is no unit root in the error term of their linear regression then we can say that the two variables are co integrated. Consider the co-integration regression:

$p_{i_t} = b_2 + b_3 p_{j_t} + E_t$ ..... (4)

where, p_{i_t} is the price in i[th] market , p_{j_t} is the price in j[th] market and E_t is the disturbance term

If the series p_{i_t} and p_{j_t} are integrated of order one I (1), their linear relationship in equation (4) is also I (1). Therefore, their residuals are stationary I (0) then the series are co-integrated of order I (1). In (4), b_3 measures the equilibrium relationship between the series p_{i_t} and p_{j_t}, and E_t is the deviation from long run equilibrium path. Accordingly, equation (4) can be written for any two markets as, for example for ADDW and DESW:

$ADDW_t = b_2 + b_3 DESW_t + E_t$ ..... (5)

Where $ADDW_t$ and $DESW_t$ indicate the wholesale price (birr/quintal) of Addis Ababa and Desse market Price at time t, b_2 and b_3 are estimated parameters, and E_t is the disturbance term which may be serially correlated.

The econometric meaning of co-integration is that if in the long run two or more series p_{i_t} and p_{j_t} are linked together to form an equilibrium relationship, then even though p_{i_t} and p_{j_t} themselves are non-stationary, they will nevertheless move tighter closely over time and the difference between them is constant that is, stationary. Therefore, the concept of co-integration implies the presence of a long run equilibrium to which an economic system moves over times, and μt may thus be interpreted as the equilibrium error, that is, the extent to which the relationship deviates from equilibrium.

In the literature, there are two major approaches to test co integration. These include Residual-based ADF-approach proposed by Engle and Granger (Engle and Granger, 1987) and Johansenos Full Information Maximum Likelihood (JFIML) approach (Johansen, 1988; Johansen and Juselius, 1990). This study used Engle and Granger approach and in the Engle and Granger approach, first step is to test co integration and then in the second step residuals are used in an error correction model to get information on speed of adjustment in the long run.

The Engle and Granger (1987) co-integration test is based on residuals

$$e_t = p_{i_t} - \beta_1 p_{j_t} - b_2 \quad \ldots\ldots (6)$$

For testing co-integration, the following equation was used

$$\Delta e_t = \mu + \eta e_{t-1} + e_t \quad \ldots\ldots (7)$$

To test the co integration we set

$$H_0: \text{no co integration } (\eta = 0)$$

$$H_1: \text{ cointegration } (\eta \neq 0)$$

Residual Test of Co integration Model Specification for Horse beans

Δresidual for market $ADDWHB_t$and $DESWHB_t$= μ+

η one lagged price of residual for market $ADDWHB_t$and $DESWHB_t$+ error term ….. (8)

Residual Test of Co integration Model Specification for Chickpeas

Δresidual for market $ADDWCP_t$and $GONWCP_t$= μ+

η one lagged price of residual for market $ADDWCP_t$and $GONWCP_t$+ error term…….. (9)

Objective Two

Suppose two markets price p_{i_t} and p_{j_t} co-integrated, then it is not enough to simply difference the variables to run a regression rather the long run relationship between the variables must be taken into account, that means an error correction model (ECM) for p_{i_t} and p_{j_t} should be applied. Therefore, the deviation from the long run relationship should be included as an explanatory variable in an Error Correction Model.

$$\Delta p_{i_t} = b_4 + b_5 \Delta p_{j_t} + b_6 U_{t-1} + V \quad \ldots\ldots (10)$$

Where, Δp_{i_t} = the first difference of market i price, Δp_{j_t} = the first difference of market j price. b_4 *and* b_5 are parameters to be estimated, b_6 the speed of adjustment in the long run, U_{t-1} = the one period lag residual of equation (4) and V= the white noise error term.

Now, U_{t-1} is also known as equilibrium error term of one period lag and that guides the variables (price of market i and market j) of the system to restore back to equilibrium. In other words, it corrects disequilibrium. The sign of error correction term should be negative after estimation. The coefficient b_6 tells us at what rate it corrects the previous period disequilibrium of the system or the speed of adjustment. When b_6 is significant and contains negative sign, it validates that there exist along run equilibrium relationship among the markets. To confirm the validity of the model we have to test whether the residuals are normally distributed or not (test of normality).

Error Correction Model Specification for Horse Beans

$\Delta ADDW_t Price\ of\ HB = b_4 + b_5 \Delta DESW_t price\ of\ HB + b_6 U_{t-1} + V$…………..…. (11)

$\Delta ADDW_t Price\ of\ HB = b_4 + b_5 \Delta ADMW_t price\ of\ HB + b_6 U_{t-1} + V$…………..…. (48)

$\Delta ADDW_t Price\ of\ HB = b_4 + b_5 \Delta DDW_t price\ of\ HB + b_6 U_{t-1} + V$……………..... (12)

$\Delta DESW_t Price\ of\ HB = b_4 + b_5 \Delta ADMW_t price\ of\ HB + b_6 U_{t-1} + V$…………….….. (13)

$\Delta DESW_t Price\ of\ HB = b_4 + b_5 \Delta DDW_t price\ of\ HB + b_6 U_{t-1} + V$……………..…. (14)

$\Delta ADMW_t Price\ of\ HB = b_4 + b_5 \Delta DDW_t price\ of\ HB + b_6 U_{t-1} + V$……………..... (15)

Where b_4, b_5 and b_6= parameters while U_t and V are error terms.

Error Correction Model Specification for Chickpeas

$\Delta ADDW_t PriceofCP = b_4 + b_5 \Delta GONW_t priceofCP + b_6 U_{t-1} + V$..... (16)

$\Delta ADDW_t PriceofCP = b_4 + b_5 \Delta ADMW_t priceofCP + b_6 U_{t-1} + V$..... (17)

$\Delta ADDW_t PriceofCP = b_4 + b_5 \Delta DDW_t priceofCP + b_6 U_{t-1} + V$..... (18)

$\Delta GONW_t PriceofCP = b_4 + b_5 \Delta ADMW_t priceofCP + b_6 U_{t-1} + V$..... (19)

$\Delta GONW_t PriceofCP = b_4 + b_5 \Delta DDW_t priceofCP + b_6 U_{t-1} + V$..... (20)

$\Delta ADMW_t PriceofCP = b_4 + b_5 \Delta DDW_t priceofCP + b_6 U_{t-1} + V$..... (21)

Where b_4, b_5 and b_6= parameters while U_t and V are error terms.

Objective Three

Finally, the study found out the direction of causality in price changes or identified the market which Granger causes the prices of commodity in the other market. Hence, the link between co-integrated series and ECMs is intuitive; error correction behaviour induces co-integrated stationary relationship and vice versa when two price series are stationary of the same order and co-integrated, causality test can be carried out on the series. This is because at least one granger causal relationship must exist in a group of co-integrated series, according to Chirwa (2000). So that to find out which market causes the change of price on other market, see the magnitude of causality and the long run effect between to market we will apply Granger Causality Model. To apply this model the price of the markets should be stationary. Since our prices are stationary after differencing ones and we are only interested to see whether the last year price of market j determine the current price of market i (one year lagged price) we write the model as:

$$\Delta p_{i_t} = b_7 + \Sigma \beta_r \Delta p_{i_{t-1}} + \Sigma c_r \Delta p_{j_{t-1}} + u_{t-1} \quad \text{..... (22)}$$

Where: Δp_{i_t} and Δp_{j_t} = price in market i and j after we differencing once respectively. And β_0, β_r and c_r are parameters to be estimated, while u_{t-1} = one year lagged error term.

To find the magnitude of causality we calculated Σc_r..... (23)

To check whether last year price of market j determine current price of market i, (j Granger causes i) we tested hypothesis that H_0: $c_r = 0$ Vs $H_1 : c_r \neq 0$. In the same way in testing whether past price of market i Granger causes the current price of market j,

$$\Delta p_{j_t} = b_8 + \Sigma \beta_r \Delta p_{j_{t-1}} + \Sigma c_r p_{i_{t-1}} + u_{t-1} \quad \text{..... (24).}$$

Where: Δp_{i_t} and Δp_{j_t} = price in market i and j after we differencing once respectively. While,b_7, β_r and c_r are parameters to be estimated and u_{t-1}= one year lagged error term.

CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.1 Overview

This chapter deals with the findings of the study for each objective. Concerning the first objective the correlation coefficient method and Engle and Granger were used separately and the results were compared for both the Horse beans and Chickpeas. For the second objective, Error correction model was applied to analyze the speed of adjustment and for the third objective, Granger Causality model was used.

4.1.1 Traditional Approach for Testing Market Integration Results

In traditional approach, the degree in which price formation in one market is related to the process of price formation in other markets can be shown through a correlation matrix of prices in these markets using simple correlation co-efficient. Table (5) and Table (6) presented the bivariate correlation coefficients among the selected market using wholesale price (Birr/100 Kg) series pairs of Horse beans and Chickpeas, respectively, in Ethiopia. From correlation matrix, it is clear that the wholesale price of the selected both Horse beans and Chickpeas price are strongly correlated.

The high value of correlation coefficients implies that markets are highly interdependent in price formation, whereas if the correlation coefficient between two markets is low, the result implies that that the markets are independent in price formation. However, we cannot tell the long run equilibrium of the market by using this correlation coefficient. In this study, the highest correlation coefficient value for Horse beans was observed for the market pairs of Addis Ababa and Desse and the lowest value was for the market pairs Addis Ababa and Diredawa.

In the same way for Chickpeas markets, the correlation coefficient between Addis Ababa and Gonder is very high compared to the other selected markets and it should be noted that Gonder is the main producing market of Chickpeas and Addis Ababa is the central market. Though the distance between Addis Ababa and Adama is short, the correlation coefficient between Addis Ababa and Adama is relatively low.

It is evident from Table 5 (for Horse beans) and Table 6 (for Chickpeas) that all the correlation coefficients of price are above 0.96. This high value of correlation coefficient implies that the markets are highly interdependent rather than independent in price formation.

Table 5: Correlation Coefficient Matrix of Wholesale Price (Birr/100 K g) of Selected Horse Beans Markets in Ethiopia.

Markets	ADDWHB	DESWHB	ADMWHB	DDWHB
ADDWHB	1.000			
DSEWHB	0.980	1.000		
ADMWHB	0.977	0.979	1.000	
DDWHB	0.964	0.964	0.975	1.000

Where ADDWHB=Addis Ababa wholesale price of Horse beans.

ADMWHB=Adama wholesale price of Horse beans.

DDWHB=Diredawa wholesale price of Horse beans.

DESWHB= Desse wholesale price of horse bean.

Table 6: Correlation Coefficient Matrix of Wholesale Price (Birr/100 Kg) of Selected Chickpeas Markets in Ethiopia.

Markets	ADDWCP	GONWCP	ADMWCP	DDWCP
ADDWCP	1.000			
GONWCP	0.986	1.000		
ADMWCP	0.965	0.969	1.000	
DDWCP	0.976	0.984	0.973	1.000

Where ADDWCP = Addis Ababa wholesale price of Chickpeas.

ADMWCP = Adama wholesale price of Chickpeas.

DDWCP = Diredawa wholesale price of Chickpeas.

GONWCP = Gonder wholesale price of Chickpeas.

4.1.2 Stationarity Test Results

Testing for stationarity and co-integration is relatively a recent development in time series than correlation coefficient. For this study co-integration test is applied to pairs of series that are individually non-stationary. For each selected market price series, to test the null hypothesis of non-stationarity against an alternative of stationarity this study applied both Augmented Dickey-Fuller (Dickey and Fuller, 1979) and the Phillips-Perron tests (Phillips and Perron, 1988). The ADF test is a parametric test (pre-determined parameters) and it has low power whereas PP test is based on non- parametric modification of Augmented Dickey-Fuller tests. Hence, the study gives more priority to PP than ADF. The results of Augmented Dickey fuller test and Phillips-Perron tests was applied to the price of Horse beans and chick pea on selected markets of Ethiopia are presented in Table 7 and Table 8, respectively. For each pair of price, unit root test have been performed to test the stationarity of price data for the selected markets using Augmented Dickey-Fuller (Dickey and Fuller, 1979) and the Phillips-Perron tests (Phillips and Perron, 1988).

Table 7: Unit Root Test for Wholesale Price (Birr/100 K.g) of Selected Horse beans Markets in Ethiopia at level

Markets	**ADF**		**Phillips-Perron**	
	P-value	***t*est statistics**	**P-value**	***t*est statistics**
ADDWHB	0.7021	-1.132	0.6154	-1.330
DESWHB	0.7022	-1.132	0.7659	-1.965
ADMWHB	0.7526	-1.002	0.6830	-1.178
DDWHB	0.6621	-1.226	0.6032	-1.356

* Significant at 10%, ** significant at 5%, ***significant at 1%

Table 8: Unit Root Test for Wholesale Price (Birr/100 Kg) of Selected Chickpeas Market in Ethiopia at level

Markets	ADF		Phillips-Perron	
	P-value	***t*est statistics**	**P-value**	***t*est statistics**
ADDWCP	0.8047	-0.848	0.8262	-0.776
GONWCP	0.7918	-0.888	0.7970	-0.872
ADMWCP	0.6944	-1.151	0.6569	-1.238
DDWCP	0.7858	-0.907	0.7475	-1.016

* Significant at 10%, ** significant at 5%, ***significant at 1%

The results in Table 7 and Table 8 for testing stationarity of price both for Horse Bans and Chickpeas respectively indicates, the null hypothesis of non-stationarity cannot be rejected even at 10% level for any of the price series because the critical values of Mackinnon test for ADF and PP are (-3.5) at 1%; (-2.888) at 5% and (-2.578) at 10%. To reject the null hypothesis, ADF and PP test statistics should be less than the critical value, or in other words, the P-value should be significant at specific level of confidence. Since the null hypothesis was not rejected in all the selected markets at ant convenient significant level, the monthly prices of both Horse beans and Chickpeas in all selected markets had a unit root. We can conclude that all the selected market price data are non- stationary at level.

However, from the results in Table 9 and Table 10, we infer that the Augmented Dickey Fuller (ADF) and the Phillips-Perron test statistics for the first differences of the price series data for all markets were significant at 99% confidence level for the wholesale price of Horse beans and Chickpeas, respectively. This showed that differencing the price series data once, made the data to be stationary, hence the selected markets are integrated of order 1, denoted as I(1).

Table 9: First Difference Unit Root Test for Horse beans Price (Birr/100 Kg) in Selected Markets

Markets	ADF first difference		Phillips-Perron First Difference	
	P-value	*t*est statistics	P-value	*t*est statistics
ADDWHB	0.000	-9.716***	0.000	-9.832***
DESWHB	0.000	-15.206***	0.000	-14.637***
ADMWHB	0.000	-9.575***	0.000	-9.621***
DDWHB	0.000	-9.746***	0.000	-9.723***

* Significant at 10%, ** significant at 5%, ***significant at 1%

Table 10: First Difference Unit Root Test for Chickpeas Price (Birr/100 Kg) in Selected Markets

Markets	ADF first difference		Phillips-Perron First Difference	
	P-value	*t*est statistics	P-value	*t*est statistics
ADDWCP	0.000	-11.290***	0.000	-11.326***
GONWCP	0.000	-12.166***	0.000	-12.150***
ADMWCP	0.000	- 9.030***	0.000	- 9.674***
DDWCP	0.000	-10.185***	0.000	-10.311***

* Significant at 10%, ** significant at 5%, ***significant at 1%

4.1.3 Co-integration Test on Wholesale Price (Birr/100 Kg) of Horse Beans and Chickpeas for Selected Markets in Ethiopia

The co-integration among the different price series for the selected Horse beans and Chick pea market was tested using the Engel-Granger test. All possible pairwise combination of prices for Horse beans and Chickpeas markets was chosen. The long run relationship of the markets was estimated in the form of equation (5), and the markets had to pass a test of co-integration, otherwise the regression would have turned out to be the classical spurious or non-sense regression. All the coefficients of all co-integrated markets are significant at 1% as indicated in Appendix 7 and 8 for Horse beans and chickpeas respectively. The test statistics of the results obtained for all the pairwise markets are seen to be greater than the critical value at 1% level of significance for all the selected Horse beans and chick pea markets.

A test for stationarity of residual was also done using the Engel Granger test. If the residual was found stationary, it meant that the variables in the model are co-integrated or they have long run relationship (they move together). A non-stationary residual, indicates that there is no co-integration among the prices. To test this, the study compared the value of the test statistics against the set of critical values provided by Davidson and MacKinnon (1993) which is given in appendix 6. The regression function have dependent, constant and independent variable, thus we compare our *t* statistics value with the critical value which is given at 1%, 5% and 10% with those indicated in the row which is given as m=3. All *t* statistics values are less than the critical values. The P-values are also less than the 1% that means it is significant, so the null hypothesis of no co-integration is rejected for all selected markets.

Therefore, all the wholesale market pairs of Horse beans like Addis Ababa-Desse, Addis Ababa- Adama, Addis Ababa-Diredawa, Desse-Adama, Desse-Diredawa, Adama-Diredawa are co-integrated at 1% significant level. However, regarding co-integration Phillips-Perron results shows that ADDWHB and DESWHB market pair have better degree of integration than others as showed in Table 11

Table 11: Unit Root Test of Residual for Wholesale Price (Birr/100 Kg) of Selected Horse Beans Markets

	Phillips-Perron	
Residuals	**P-value**	***t*est statistics**
Residual for market ADDWHB and DESWHB	0.0000	-9.202***
Residual for market ADDWHB and ADMWHB	0.0000	-5.759***
Residual for market ADDWHB and DDWHB	0.0000	-5.247***
Residual for market DESWHB and ADMWHB	0.0000	-5.247***
Residual for market DESWHB and DDWHB	0.0000	-7.457***
Residual for market ADDWHB and DDWHB	0.0000	-6.309***

* Significant at 10%, ** significant at 5%, ***significant at 1%

Similarly, all the wholesale price for Chickpeas markets like Addis Ababa- Gonder, Addis Ababa- Diredawa, Gonder- Adama, Gonder -Diredawa, Adama- Diredawa are co-integrated at 1% level of significant. However, ADDWCP and GONWCP have better degree of integration compared with the others as indicated in Table 12. On the other hand, GONWCP and ADMWCP markets are weakly integrated as the Phillips-Perron value shows. Therefore, the null hypothesis of no co-integration can be rejected at 1% significant level. Because the markets are integrated and market mechanism play an important role through influencing the price change in one market to another. The co-integration result is a little bit different with the one generated in correlation coefficient matrix for both hors beans and Chickpeas.

The result that is generated in this study is different from Senishaw (2013) and Negessa (1998). Because both studies' concluded that, markets which have short distance from the other market have better degree of market integration than market which have long distance. In contrary to the above findings, this study showed that distance between markets is not the major factor to make the markets be more integrated rather it is the volume of production. Because as we can see from the result the distance between Adama and Addis Ababa is shorter than the distance between Gonder and Addis Ababa but Gonder and Addis Ababa are batter integrated than Addis Ababa

Adama. The difference in the findings might be because Senishaw (2013) and Negessa (1998) used only distance as a parameter in order to select markets where as this study in addition to distance, volume of production was also considered.

Table 12: Unit Root Test of Residual for Wholesale Price (Birr/100 Kg) of Selected Chickpeas Markets

	Phillips-Perron	
Residuals	**P-value**	***t*est statistics**
Residual for market ADDWCP and GONWCP	0.0000	-6.910***
Residual for market ADDWCP and ADMWCP	0.0226	-3.942**
Residual for market ADDWCP and DDWCP	0.0000	-4.864***
Residual for market GONWCP and ADMWCP	0.0024	-4.864***
Residual for market GONWCP and DDWCP	0.0000	-5.556***
Residual for market ADMWCP and DDWCP	0.0003	-4.270***

* Significant at 10%, ** significant at 5%, ***significant at 1%

4.2 Application of Error Correction Model to the Selected Horse Beans and Chickpeas Markets in Ethiopia

The error correction coefficient tells us the speed at which our model returns to equilibrium after an exogenous shock. As a result, the error correction term should be negatively signed to indicate a move towards long run equilibrium. The coefficient of error term b_6 in equation (10) means that the system corrects its previous period dis-equilibrium at speed of b_6 present monthly, because the data is monthly data. The sign of b_6 should be negative and significant to indicate the validity of long run equilibrium relationship between the paired market prices. A positive sign indicates a move away from equilibrium. The coefficient should lie between 0 and 1, 0 suggests no adjustment one time period later, while 1 indicates full adjustment. Accordingly, all model specification tests were performed in all the equations both for Horse beans and Chickpeas. The error correcting terms presented for Horse beans and Chickpeas and viewed the adjustment

towards the long-term equilibrium. It is revealed that the coefficient of error term is negative and statistically significant for all selected markets for both Horse beans and Chickpeas.

The results in Table 13 showed that in all market pairs, the error correction term coefficients are significant at 1% level except for Diredawa market. This indicates that arbitrage would take place whenever any deviation from the long run equilibrium is observed. However, for all markets which are paired with Diredawa, the coefficients of error correcting term are insignificant at any of the conventional significant level. This could be related to the longer distance between the markets. For this case Addis Ababa, Desse and Adama are assumed to be suppliers for Diredawa. Because of the distance, it would take a relatively longer period (months) for adjustment. It also probably because trucks may not prefer to go to the deficit areas, for they may not get any freight in the return trip. That is there is a time lag between the market which is paired with Diredawa and arbitrage regardless of the level of deviation from the long–term equilibrium, is sluggish. Since the P-values of all the independent variables in the error correction model are significant at less than 1% level, we can say that the short run coefficient variable explains our dependent variable.

For the market which is selected based on volume of production (Horse beans) that is Desse for all paired markets, the speed of adjustment would take relatively less period. That is the error correction term corrects the dis-equilibrium of the system by 43% monthly between Addis Ababa and Desse while the speed of adjustment between Addis Ababa and Adama, which have less distance between, is 32% and they have less distance between each other. The speed of adjustment between Addis Ababa and Diredawa is 10%, which could be attributed to the long distance between Addis Ababa and Diredawa. According to the result of this study, the main producing markets take fewer periods to adjust towards the long run equilibrium. These results have an additional finding that is not considered by other studies (Senishaw, 2013; Negasse, 1997), in cereal markets, which considered that distance between markets was the major factor in influencing the level of market integration and speed of adjustment. Markets with short distance in between are more integrated. However Nkendah *et al.* (2007) findings indicated that, other variables other than the distance and the good infrastructures exist to explain spatial integration and price transmission in the market.

Table 13: Result of Error Correction Model for Selected Horse Beans Markets

ΔADDWHB	=	4.940	+	0.378ΔDESWHB***	-	0.427 U_{t-1}***
ΔADDWHB	=	1.757	+	0.571ΔADMWHB***	-	0.320 U_{t-1}***
ΔADDWHB	=	12.992	+	0.213ΔDDWHB***	-	0.018 U_{t-1}
ΔDESWHB	=	1.845	+	0.617ΔADMWHB***	-	0.754U_{t-1}***
ΔDESWHB	=	2.903	+	0.438ΔDDWHB***	-	0.413U_{t-1}
ΔADMWHB	=	3.595	+	0.298ΔDDWHB***	-	0.107U_{t-1}

* Significant at 10%, ** significant at 5%, ***significant at 1%

In Table 14 the p-values for Chickpeas markets of all the independent variables in the error correction model are significant at less than 1% level, which implies that the short run variable coefficients explains the dependent variable. For all market pairs, error correcting term coefficients are significant at 1% level except for Adama and Diredawa market pair which is significant at 10% level. This indicates that, arbitrage would take place whenever any deviation from the long run equilibrium is observed.

For the Chickpeas market selected based on volume of production (that is Gonder) and for all paired markets, the speed of adjustment would take relatively less time when comparing the speed of adjustment between markets which have less distance. In this case, the error correction term corrects the dis-equilibrium of the system by 40% monthly between Addis Ababa and Gonder, while the speed of adjustment between Addis Ababa and Adama is 17%. Moreover, the adjustment speed between Addis Ababa and Diredawa, Gonder and Adama is almost the same at 21%. A very interesting result is that of Addis Ababa and Adama market even if the distance between these two markets is less than the distance between other paired markets, the speed of adjustment will take relatively a long period towards long run equilibrium which is different from expected. These results are different from the results by Sineshaw (2013) for cereal markets, because on his findings that those markets with less distance had a short adjustment period than markets which are distantly apart.

Table 14: Result of Error Correction Model for Selected Chickpeas Markets

ΔADDWCP	=	2.228	+	0.599ΔGONWCP***	-	$0.408U_{t-1}$***
ΔADDWCP	=	2.895	+	0.462ΔADMWCP***	-	$0.178U_{t-1}$***
ΔADDWCP	=	3.207	+	0.465ΔDDWCP***	-	$0.211U_{t-1}$***
ΔGONWCP	=	3.572	+	0.408ΔADMWCP***	-	$0.218U_{t-1}$***
ΔGONWCP	=	2.294	+	0.609ΔDDWCP***	-	$0.309U_{t-1}$***
ΔADMWCP	=	1.520	+	0.470ΔDDWCP***	-	$0.107U_{t-1}$*

* Significant at 10%, ** significant at 5%, ***significant at 1%

A test of skewness-kurtosis (Jarque- Bera) was used to check whether the residuals from a linear regression model are normally distributed. When the normality test was done using this test, all the p-values are under standard significant level (5%), that shows the null hypothesis of residuals are not normally distributed is rejected so, the results revealed that all the individual equations and the residuals were normally distributed both for Horse beans and Chickpeas as showed in appendix 11 and 12 respectively.

4.3 Granger-Causality Test for Selected Markets

From results the first difference of market price, series are stationary, the study also looked at the first lagged causality between different market pairs. If the number of lags is changed, the results might change. The results of the causality test between the selected markets for Horse beans are presented below from Table 15- Table 20. But for Chickpeas, except for the case of Adama-Diredawa are presented in Table 21, all market pairs (see Appendix 13.a.-13.e.), one market does not granger cause the other. The result looking at the causality between Addis Ababa and Desse, Addis Ababa and Adama, Addis Ababa and Diredawa, Desse and Adama, Desse and Diredawa for horse beans and Addis Ababa and Gonder, Addis Ababa and Adama, Addis Ababa and Diredawa, Gonder and Adama, Gonder and Diredawa for Chickpeas managed to identified which market price Granger causes the other market price.

Table 15: Results for Testing Granger Causality between Addis Ababa and Desse Market Price of Horse Beans

	Coefficient.	**Standard Error**.	***t***	**p>| t |**
$\Delta ADDWHB$				
$\Delta ADDWHB_{t-1}$	0.258	0.099	2.60	0.011
$\Delta DESWHB_{t-1}$	0.027	0.082	0.34	0.737
$RESADISDES_{t-1}$	-0.250	0.092	-2.69	0.008
Cons	3.885	4.794	0.81	0.419
$\Delta DESWHB$				
$\Delta DESWHB_{t-1}$	-0.194	0.092	-2.11	0.037
$\Delta ADDWHB_{t-1}$	0.254	0.111	2.27	0.025**
$RESDESADIS_{t-1}$	0.414	0.104	3.96	0.000
Cons	4.885	5.368	0.91	0.365

* Significant at 10%, ** significant at 5%, ***significant at 1%

From the results in Table 15, the coefficient of $\Delta DESWHB_{t-1}$ was insignificant even at 10 % level, meaning that we failed to reject our null hypothesis which says Desse does not cause Addis Ababa. Moreover, the second equation coefficient for $\Delta ADDWHB_{t-1}$ was significant at 5% level, indicating that the null hypothesis for the price of Horse beans in Addis Ababa does not Granger cause the prices of Horse beans in Desse is rejected. Therefore, we conclude that the relationship between Addis Ababa and Desse market is unidirectional. This might be because of the fact that Addis Ababa market has better rode mode transport and communication. Traders who transport Horse beans from Addis Ababa market to Desse market have to follow the price of Addis Ababa market other than the transaction costs that they incurred.

Table 16: Results for Testing Granger Causality between Addis Ababa and Adama Market Price of Horse Beans

	Coefficient.	**Standard Error.**	***t***	**p>| t |**
$\Delta ADDWHB$				
$\Delta ADDWHB_{t-1}$	0.120	0.103	1.170	0 .246
$\Delta ADMWHB_{t-1}$	0.219	0.105	2.090	0.039**
$RESADISADAM_{t-1}$	-0.191	0.084	-2.270	0.025
Cons	2.917	4.862	0.600	0.550
$\Delta ADMWHB$				
$\Delta ADMWHB_{t-1}$	0.237	0.100	2.36	0.020
$\Delta ADDWHB_{t-1}$	-0.037	0.099	0.37	0.710
$RESADMADIS_{t-1}$	0.271	0.080	3.36	0.001
Cons	3.990	4.660	0.86	0.393

* Significant at 10%, ** significant at 5%, ***significant at 1%

The results shown in Table 16 indicates that, one period lagged price of Adama market Granger causes price of Horse beans in Addis Ababa markets because the coefficient of $\Delta ADMWHB_{t-1}$ is significant at 5% level which is the P-value of the coefficient is less than the critical value. Traders who transported Horse beans from Adama to Addis Ababa factor the price of Horse beans in Addis Ababa. The transportation cost and all other transaction costs such as; cost of communication, cost of negotiating the contract might have impact on the price of the commodity for those who sell to other traders in contractual terms among other costs. There is efficient communication between Adama and Addis Ababa market due to availability of communication networks including mobile phones and the road distance is short which facilitates delivery. However, Addis Ababa market price does not Granger causes price in Adama market hence the relation is unidirectional.

Table 17: Results for Testing Granger Causality between Addis Ababa and Diredawa Market Price of Horse Beans

	Coefficient.	**Standard Error.**	***t***	**p>| t |**
$\Delta ADDWHB$				
$\Delta ADDWHB_{t-1}$	0.089	0.111	0.800	0.425
$\Delta DDWHB_{t-1}$	0.109	0.073	1.480	0.140
$RESADISDRE_{t-1}$	0.027	0.071	0.380	0.701
Cons	3.522	5.100	0.690	0.491
$\Delta DDWHB$				
$\Delta DDWHB_{t-1}$	0.112	0.075	1.49	0.139
$\Delta ADDWHB_{t-1}$	0.063	0.114	0.55	0.581
$RESDREADIS_{t-1}$	0.452	0.073	6.16	0.000
Cons	4.222	5.218	0.81	0.420

* Significant at 10%, ** significant at 5%, ***significant at 1%

Since both the coefficient of $\Delta DDWHB_{t-1}$ in the first equation and the coefficient of $\Delta ADDWHB_{t-1}$ are not significant at any convenient significant level we can conclude that neither Addis Ababa nor Diredawa Granger causes each other. In other words, traders in Addis Ababa did not factor in the prices of Horse beans in Diredawa when setting the price. This might be because of the two markets are unrelated.

Table 18: Results for Testing Granger Causality between Desse and Adama Market Price of Horse Beans

	Coefficient.	**Standard Error**.	***t***	**p>| t |**
$\Delta DESWHB$				
$\Delta DESWHB_{t-1}$	-0.256	0.103	-2.48	0.015
$\Delta ADMWHB_{t-1}$	0.413	0.115	3.57	0.001***
$RESDESADM_{t-1}$	-0.355	0.127	2.79	0.006
Cons	3.605	5.511	0.65	0.514
$\Delta ADMWHB$				
$\Delta ADMWHB_{t-1}$	0.316	0.092	3.42	0.001
$\Delta DESWHB_{t-1}$	-0.178	0.083	-2.15	0.034**
$RESADMDES_{t-1}$	0.445	0.102	4.36	0.000
Cons	5.287	4.392	1.20	0.231

* Significant at 10%, ** significant at 5%, ***significant at 1%

The results in Table 18 indicates that, the relationship that the two markets (Desse and Adama) has is bi-directional because the coefficient of $\Delta ADMWHB_{t-1}$ in the first equation in first equation is significant 1% and the coefficient of $\Delta DESWHB_{t-1}$ in the second equation are significant at 5% level as shown in Table 18. This implies that that the relationship is bi-directional since Adama market Granger causes price in Desse market and price in Desse market Granger causes price in Adama market. These results relates to those generated in the error correction model which indicated the speed of adjustment would take relatively less period (75%) even comparing the speed of adjustment between markets which have less distance and this two markets are highly correlated. This might be because of two effects namely Desse is the main producing market of

Horse beans and Adama is the nearest market to the central market of the country which is Addis Ababa so the information moves smoothly because of good communication and batter infrastructure.

Table 19: Results for Testing Granger Causality between Desse and Diredawa Market Price of Horse Beans

	Coefficient.	**Standard Error.**	***t***	**p>| t |**
$\Delta DESWHB$				
$\Delta DESWHB_{t-1}$	-0.364	0.110	-3.29	0.001
$\Delta DDWHB_{t-1}$	0.235	0.089	2.64	0.009***
$RESDESDRE_{t-1}$	0.005	0.104	0.05	0.958
Cons	5.752	6.096	0.94	0.347
$\Delta DDWHB$				
$\Delta DDWHB_{t-1}$	0.136	0.075	1.81	0.072
$\Delta DESWHB_{t-1}$	-0.152	0.094	-1.62	0.108
$RESDREDES_{t-1}$	0.621	0.088	7.04	0.000
Cons	8.035	5.134	1.56	0.120

* Significant at 10%, ** significant at 5%, ***significant at 1%

The results in Table 19 shows that, Diredawa market price Granger causes price in Desse market, but Desse market price does not Granger cause price in Diredawa market. This is because the coefficient of $\Delta DDWHB_{t-1}$ in the first equation is significant at 1% level while in the second equation the P-value of $\Delta DESWHB_{t-1}$ coefficient is insignificant at any convenient level. Therefore, the relationship between the two markets is unidirectional.

Table 20: Results for Testing Granger Causality between Adama and Diredawa Market Price of Horse Beans

	Coefficient.	**Standard Error.**	***t***	**p>| t |**
$\Delta ADMWHB$				
$\Delta ADMWHB_{t-1}$	0.138	0.120	1.15	0.251
$\Delta DDWHB_{t-1}$	0.031	0.073	0.43	0.667
$RESADMDRE_{t-1}$	0.017	0.088	0.20	0.841
Cons	4.301	0.088	0.88	0.382
$\Delta DDWHB$				
$\Delta DDWHB_{t-1}$	0.119	0.072	1.64	0.104
$\Delta ADMWHB_{t-1}$	0.149	0.120	1.24	0.217
$RESDREADM_{t-1}$	0.566	0.087	6.45	0.000
Cons	3.979	4.882	0.82	0.417

* Significant at 10%, ** significant at 5%, ***significant at 1%

The coefficient of $\Delta DDWHB_{t-1}$ and $\Delta ADMWHB_{t-1}$ in the first and second equation of the results are insignificant at any significant level. These results insure that the two markets do not have Granger causality to each other.

Table 21: Results for Testing Granger Causality between Adama and Diredawa Market Price of Chickpeas

	Coefficient.	**Standard Error**.	***t***	**p>| t |**
$\Delta ADMWCP$				
$\Delta ADMWCP_{t-1}$	0.262	0.112	2.34	0.021
$\Delta DDWCP_{t-1}$	-0.019	0.105	-0.19	0.852
$RESADMDRE_{t-1}$	-0.056	0.073	-0.76	0.446
Cons	3.023	4.456	0.68	0.499
$\Delta DDWCP$				
$\Delta DDWCP_{t-1}$	-0.051	0.080	-0.63	0.527
$\Delta ADMWCP_{t-1}$	0.241	0.085	2.18	0.006***
$RESDREADM_{t-1}$	0.234	0.056	4.16	0.000
Cons	3.593	3.397	1.06	0.292

* Significant at 10%, ** significant at 5%, ***significant at 1%

The results of all Chickpeas markets shown in Appendix 13.a-13.e indicate that the price of Chickpeas in one market is insignificant in determining the price of Chickpeas in another market at any convenient significant level except for the case of Adama- Diredawa which is presented in Table 21. The market price in Adama market Granger caused the price of Chickpeas in Diredawa market because the coefficient of $\Delta ADMWCP_{t-1}$ was significant at 1% level. However, Diredawa market does not Granger cause price in Adama. Therefore, we can conclude that the relationship between these two markets is unidirectional.

CHAPTER FIVE
CONCLUSSION AND POLICY RECOMMENDATIONS

5.1 Conclusions

The selected markets in general have high value of correlation coefficient but the highest value of correlation coefficient was observed between Addis Ababa and Desse market for Horse beans and between Addis Ababa and Gonder for Chickpeas when compared to the other selected markets. The strong integration result based on the higher values of correlation coefficient has been challenged by the co-integration approach. The correlation matrix's reveal that Ababa market and Desse market are strongly correlated compared to other selected Horse beans markets. All markets pairs with Diredawa markets, the coefficient of error correction term are insignificant in the case of Horse beans market. This could be related to the longer distance between the markets. For this case Addis Ababa, Desse and Adama is assumed to be supplier for Diredawa. As a result it would take relatively longer period (months) for adjustment and probably due to the fact that trucks may not prefer to go to the deficit areas, for they may not get any freight in the return trip. For the case of Chickpeas markets, the Addis Ababa - Gonder have better degree of integration and takes fewer periods to adjust towards to the long run equilibrium. This is because Gonder is the main producing market of Chickpeas in the country.

For some markets, because of close proximity, good communication facilities and availability of good infrastructure among the market centres there exist causality even in both direction for Horse beans market but for Chickpeas almost all the selected market does not grange cause each other in both direction and one period lagged. However, the analysis does not consider the analysis of village level market where producers have direct connection with the traders. Concerning Causality

The result of Granger causality of the selected Horse beans markets is unidirectional: Addis Ababa market Granger causes Desse, Adama market Granger cause Addis Ababa, and Diredawa market Granger cause Desse. For the cases of Adama –Desse, the relationship was bi-directional. The relationship between Addis Ababa- Diredawa and Diredawa - Adama, the markets does not granger cause each other. For Chickpeas markets, except Adama-Diredawa (Adama Granger causes Diredawa) all other markets does not Granger cause each other.

5.2 Recommendation

The first recommendation is that to solve the problem of food insecurity in the country focusing only on production aspect will not be effective without a well-functioning market. Therefor we need to give attention, evaluate the market efficiency and performance of the marets by applying market integration evaluation. Accordingly, identifying those markets in the same integration circle would contribute a lot in proper implementation of any agricultural policy and in the effort to realize a well-developed agricultural sector. It has been mentioned in many articles (Negassa, 1998), that a well-integrated market is typified by a higher level of private sector participation in the arbitraging activity which helps in stabilizing prices across the surplus and deficit areas. If markets are well integrated, government can easily affect all the integrated markets by intervening only in few important markets without worrying to intervening in all the markets so that we can save time and money.

The second recommendation is that most of the problems associated with level and degree of market integration, in one way or another, are related to production level, infrastructure, information and institutions. The development of these will lift up the level of market integration and avoids the trade barriers existing between markets. Given the Government objectives of promoting structural transformation, and the development of well-functioning markets does have diverse importance in the process of the realization of agricultural development, agricultural productivity growth and food security. Generally, a coordinated development of: infrastructure, information and institutions may require a mechanism through which they can be integrated towards a single channel in such a way they would assist the realization of a well-developed agricultural marketing system.

The third recommendation is that the country also needs to modernize way of trading system for Pulse markets for example exchange market. The Ethiopia Commodity Exchange (ECX) is a new initiative for Ethiopia and the first of its kind in Africa and aimed to revolutionize Ethiopia's traditional bound agriculture through creating a new marketplace that serves all stakeholders, from farmers, to traders, processors, exporters and consumers. This creates opportunities for unparalleled growth in the commodity sector and linked industries, such as transport and logistics, banking and financial services, and others. It assures all commodity market players the security they need in the market through providing a secure and reliable End-to-End system for handling, grading, storing commodities, matching offers and bids for commodity

transactions, and a risk-free payment and goods delivery system to settle transactions, while serving all parties fairly and efficiently since it commenced trading operation in April 2008. The exchange is currently trading only Haricot bean, Maize, Coffee, Wheat and sesame seed. Therefore, there is a need to include pulse commodities in the exchange to increase the benefit of all market actors who participate in pulse markets, farmers, traders, processors, exporters and consumers.

Lastly, the government need to provide for trade participant a smooth, efficient and effective way of service delivery system especially in custom area. From the results of this study, Diredawa market has less level of market integration than the others do. This is because the city is bordered by Djibouti, where is a high chance of finding contraband material especially electronics in the market. To protect the local manufacturers the Government puts a high restriction that discourages traders to trade with Diredawa market. Therefore, there is a need to put high taxation at the border to discourage those illegal importers.

5.3 Areas for Further Research

In the country, there are twelve different type of pulse. However, due to time and availability of data the study considered only two pulse types. In the same way, this study considered only three regional markets and one central market. Hence, there is a need of a study which will consider more pulse types and more markets; it is obvious that the market efficiency will come at a better level of efficiency than the current level.

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APPENDICES

APPENDEX 1: Production of Pulse in Oromia Region

	Zone	Production of Pulses in (100 Kg)	Production of Hors bean in (100 Kg)	Production of Chickpeas in (100 Kg)
1	East Shewa	1,864,878.09	289,946.47	481,935.21
2	South West Shewa	1,737,069.35	234,653.77	778,157.74
3	North Shewa	1,469,912.32	814,423.93	126,759.99
4	Arsi	1,355,730.32	851,525.72	-
5	West Shewa	1,233,691.51	549,459.12	122,035.09
6	Jimma	558,742.54	374,488.48	-
7	Guji	539,547.73	163,253.04	-
8	Bale	525,215.60	299,609.11	-
9	West Arsi	442,073.04	124,925.36	-
10	Illubabor	341,505.39	108,260.00	-
11	Horoguduru	341,409.90	157,620.95	-
12	East Welega	295,013.90	106,793.63	8,564.77
13	West Harerge	288,110.62	14,976.04	-
14	East Harerge	222,771.10	-	1,848.22
15	KelemWelega	216,366.35	79,884.38	15,644.17
16	West Welrga	144,713.08	36,579.79	-
17	Borena	106,368.20	2,315.24	-

Source: CSA (2013), Area and Production Report

APPENDEX 2: Production of Pulse in Amhara Region

	Zone	Production of pulses in (100 Kg)	Production of Hors beans in (100 Kg)	Production of Chick peas in (100 Kg)
1	North Gonder	1,996,041.38	540,221.95	825,741.27
2	East Gojjam	1,911,541.91	734,663.02	158,203.36
3	North Shewa	1,822,809.86	746,183.74	402,197.46
4	South Wello	1,694,146.26	473,861.89	275,929.02
5	South Gonder	1,585,573.06	269,785.95	293,870.36
6	West Gojjam	1,183,736.91	454,780.22	147,169.53
7	North Wello	794,838.87	298,600.62	110,487.45
8	Awi	830,201.24	99,855.18	-
9	Waghemera	236,831.24	99,245.62	5,934.94

Source: CSA (2013)

APPENDEX 3: Regional Market of Horse Beans and Chickpeas.

	Rigion	Zone	Distance (Km) from Addis Ababa	Crop	Production in (100 Kg)	Parameter of selection	Central city
1	Oromia	Arsi	170	Horse beans	851,525.72	Volume of production	Desse
2	Amhara	North Gonder	740	Chickpeas	746,183.74	Volume of production	Gonder
3	Oromia	Diredawa	515	Horse beans& Chickpeas	14,976.04	Distance from Addis Ababa	Diredawa
4	Oromia	Adama	99	Horse beans& Chickpeas	722,486.59	Distance from Addis Ababa	Adama

Source: CSA (2013)

APPENDEX 4 Discussion of Model Used for Co integration Test

After examination of the stationarity of price series the test of market integration using Engel and Granger (1987) was used both for Horse beans and Chickpeas market.

Co-integration Model Specification for Horse beans

$\mathrm{ADDW_t Price\ of\ HB} = \beta_0 + \beta_1 \mathrm{DESW_t\ of\ HB} + \text{error term}$…….. (4.1)

$\mathrm{ADDW_t Price\ of\ HB} = \beta_0 + \beta_1 \mathrm{ADMW_t\ of\ HB} + \text{error term}$…….. (4.2)

$\mathrm{ADDW_t Price\ of\ HB} = \beta_0 + \beta_1 \mathrm{DDW_t\ of\ HB} + \text{errorterm}$……..…..(4.3)

$\mathrm{DESW_t Price\ of\ HB} = \beta_0 + \beta_1 \mathrm{ADMW_t\ of\ HB} + \text{errorterm}$…….(4.4).

$\mathrm{DESW_t Price\ of\ HB} = \beta_0 + \beta_1 \mathrm{DDW_t\ of\ HB} + \text{errorterm}$…….…(4.5)

$\mathrm{ADMW_t Price\ of\ HB} = \beta_0 + \beta_1 \mathrm{DDW_t\ of\ HB} + \text{errorterm}$……..…... (4.6)

Where: $ADDW_t, DES\mathrm{W}_t, ADM\mathrm{W}_t\ and\ DD\mathrm{W}_t$ indicates the whole price of Addis Ababa, Desse, Adama and, Diredawa at time t, respectively; $\beta_0\ and\ \beta_1$ are parameters to be estimated. HB represents Horse beans.

Co-integration Model Specification for Chickpeas

$ADDW_t Price\ of\ CP = \beta_0 + \beta_1 GON\mathrm{W}_t\ of\ CP + error\ term$……..…... (4.7)

$ADDW_t Price\ of\ CP = \beta_0 + \beta_1 ADM\mathrm{W}_t\ of\ CP + error\ term$…….… (4.8)

$ADDW_t Price\ of\ CP = \beta_0 + \beta_1 DD\mathrm{W}_t\ of\ CP + errorterm$…….(4.9)

$\mathrm{GONW_t Price\ of\ CP} = \beta_0 + \beta_1 \mathrm{ADMW_t\ of\ CP} + \text{errorterm}$……..…(4.10)

$\mathrm{GONW_t Price\ of\ CP} = \beta_0 + \beta_1 \mathrm{DDW_t\ of\ CP} + \text{errorterm}$…….(4.11)

$\mathrm{ADMW_t Price\ of\ CP} = \beta_0 + \beta_1 \mathrm{DDW_t\ of\ CP} + \text{errorterm}$……..…... (4.12)

Where: $ADDW_t,\ GON\mathrm{W}_t,\ ADM\mathrm{W}_t\ and\ DD\mathrm{W}_t$ indicates the whole price of Addis Ababa, Gonder, Adama and, Diredawa at time t, respectively; $\beta_0\ and\ \beta_1$ are parameters to be estimated. CP represents Chickpeas.

Residual Model Specification for Horse Beans

ESTIADDESS = $\beta_0 + \beta_1 DES\mathrm{W}_t\ of\ HB$ ……..…… (4.13)

ESTADADMA = $\beta_0 + \beta_1 ADM\mathrm{W}_t\ of\ HB$ ……..…… (4.14)

ESTIADSDRE = $\beta_0 + \beta_1 DD\mathrm{W}_t\ of\ HB$ ……..…… (4.15)

ESTIDESADMA = $\beta_0 + \beta_1 ADM\mathrm{W}_t\ of\ HB$ ……..... (4.16)

ESTIDESDD = $\beta_0 + \beta_1 DD\mathrm{W}_t\ of\ HB$ ……..…….... (4.17)

ESTIADMDDRE = $\beta_0 + \beta_1 DD\mathrm{W}_t\ of\ HB$ ……..…… (4.18)

Where, ESTIADDESS = Estimated value of Addis Ababa and Desse market.

ESTIADADMA = Estimated value of Addis Ababa and Adama market.

ESTIADSDRE = Estimated value of Addis Ababa and Diredawa market.

ESTIDESADMA = Estimated value of Desse and Adama market.

ESTIDESDD = Estimated value of Desse and Diredawa market.

ESTIADMDDRE = Estimated value of Adama and Diredawa market.

residual for market $\mathrm{ADDWHB_t}$and $\mathrm{DESWHB_t} = \mathrm{ADDWHB_t} - \mathrm{ESTIADDESS}$…… (4.19)

residual for market $\mathrm{ADDWHB_t}$and $\mathrm{ADMWHB_t} = \mathrm{ADDWHB_t} - \mathrm{ESTIADADMA}$..... (4.20)

residual for market $\mathrm{ADDWHB_t}$and $\mathrm{DDWHB_t} = \mathrm{ADDWHB_t} - \mathrm{ESTIADSDRE}$…….. (4.21)

residual for market $\mathrm{DESWHB_t}$and $\mathrm{ADMWHB_t} = \mathrm{DESWHB_t} - \mathrm{ESTIDESADMA}$….. (4.22)

residual for market $\mathrm{DESWHB_t}$and $\mathrm{DDWHB_t} = \mathrm{DESWHB_t} - \mathrm{ESTIDESDD}$……..... (4.23)

residual for market $\mathrm{ADMWHB_t}$and $\mathrm{DDWHB_t} = \mathrm{ADMWHB_t} - \mathrm{ESTIADMDDRE}$….. (4.24)

Residual Model Specification for Chickpeas

ESTIADDGON = $\beta_0 + \beta_1 GONW_t\ of\ CP$ ……..... (4.25)

ESTIADDADM = $\beta_0 + \beta_1 ADMW_t\ of\ CP$ ……..... (4.26)

ESTIADDSDREE = $\beta_0 + \beta_1 DDW_t\ of\ CP$ ……...… (4.27)

ESTIGONADMA = $\beta_0 + \beta_1 ADMW_t\ of\ CP$ ……..... (4.28)

ESTIGONDREE = $\beta_0 + \beta_1 DDW_t\ of\ CP$ ……..……...… (4.29)

ESTIADMDREE = $\beta_0 + \beta_1 DDW_t\ of\ CP$……..... (4.30)

Where, ESTIADDGON = Estimated value of Addis Ababa and Gonder market.

ESTIADDADM = Estimated value of Addis Ababa and Adama market.

ESTIADDSDREE = Estimated value of Addis Ababa and Diredawa market.

ESTIGONADMA = Estimated value of Gonder and Adama market.

ESTIGONDREE = Estimated value of Gonder and Diredawa market.

ESTIADMDREE = Estimated value of Adama and Diredawa market.

residual for market $\mathrm{ADDWCP_t}$and $\mathrm{GONWCP_t} = \mathrm{ADDWCP_t} - \mathrm{ESTIADDGON}$…….. (4.31)

residual for market $\mathrm{ADDWCP_t}$and $\mathrm{ADMWCP_t} = \mathrm{ADDWCP_t} - \mathrm{ESTIADDADM}$……. (4.32)

residual for market $\mathrm{ADDWCP_t}$and $\mathrm{DDWCP_t} = \mathrm{ADDWCP_t} - \mathrm{ESTIADDSDREE}$……. (4.33)

residual for market $\mathrm{GONWCP_t}$and $\mathrm{ADMWCP_t} = \mathrm{GONWCP_t} - \mathrm{ESTIGONADMA}$….. (4.34)

residual for market $\mathrm{GONWCP_t}$and $\mathrm{DDWCP_t} = \mathrm{ASSWCP_t} - \mathrm{ESTIGONDREE}$……. (4.35)

residual for market $\mathrm{ADMWCP_t}$and $\mathrm{DDWCP_t} = \mathrm{ADMWCP_t} - \mathrm{ESTIADMDREE}$…….. (4.36)

APPENDEX 5 Discussion of Model Used for Granger Causality Model

To establish the existence of causality between the selected pulse markets, Granger causality tests, enables the understanding of the direction of causality in price changes. Cointegration does not reveal the direction of the causal relationship between variables, but if two variables are found to be cointegrated, it follows that there must be Granger causality in at least one direction (Schimmelpfenning and Thirtle, 1994).

Granger Causality Model Specification for Horse Beans

$\Delta ADDWHB_t = \beta_0 + \Sigma\beta_r \Delta ADDWHB_{t-1} + \Sigma c_r \Delta DESWHB_{t-1} + e_{t-1}$…… ….. (5.1)

$\Delta DESWHB_t = \beta_0 + \Sigma\beta_r \Delta DESWHB_{t-1} + \Sigma c_r \Delta ADDWHB_{t-1} + e_{t-1}$…….…… (5.2)

$\Delta ADDWHB_t = \beta_0 + \Sigma\beta_r \Delta ADDWHB_{t-1} + \Sigma c_r \Delta ADMWHB_{t-1} + e_{t-1}$…… (5.3)

$\Delta ADMWHB_t = \beta_0 + \Sigma\beta_r \Delta ADMWHB_{t-1} + \Sigma c_r \Delta ADDWHB_{t-1} + e_{t-1}$…… (5.4)

$\Delta ADDWHB_t = \beta_0 + \Sigma\beta_r \Delta ADDWHB_{t-1} + \Sigma c_r \Delta DDWHB_{t-1} + e_{t-1}$…… (5.5)

$\Delta DDWHB_t = \beta_0 + \Sigma\beta_r \Delta DDWHB_{t-1} + \Sigma c_r \Delta ADDWHB_{t-1} + e_{t-1}$……..…… (5.6)

$\Delta DESWHB_t = \beta_0 + \Sigma\beta_r \Delta DESWHB_{t-1} + \Sigma c_r \Delta ADMWHB_{t-1} + e_{t-1}$..…… (5.7)

$\Delta ADMWHB_t = \beta_0 + \Sigma\beta_r \Delta ADMWHB_{t-1} + \Sigma c_r \Delta DESWHB_{t-1} + e_{t-1}$..…… (5.8)

$\Delta DESWHB_t = \beta_0 + \Sigma\beta_r \Delta DESWHB_{t-1} + \Sigma c_r \Delta DDWHB_{t-1} + e_{t-1}$……..…… (5.9)

$\Delta DDWHB_t = \beta_0 + \Sigma\beta_r \Delta DDWHB_{t-1} + \Sigma c_r \Delta DESWHB_{t-1} + e_{t-1}$…… (5.10)

$\Delta ADMWHB_t = \beta_0 + \Sigma\beta_r \Delta ADMWHB_{t-1} + \Sigma c_r \Delta DDWHB_{t-1} + e_{t-1}$……..……..… (5.11)

$\Delta DDWHB_t = \beta_0 + \Sigma\beta_r \Delta DDWHB_{t-1} + \Sigma c_r \Delta ADMWHB_{t-1} + e_{t-1}$…… (5.12)

Granger Causality Model Specification for Chickpeas

$\Delta ADDWCP_t = \beta_0 + \Sigma\beta_r \Delta ADDWCP_{t-1} + \Sigma c_r \Delta GONWCP_{t-1} + e_{t-1}$…… (5.13)

$\Delta GONWCP_t = \beta_0 + \Sigma\beta_r \Delta GONWCP_{t-1} + \Sigma c_r \Delta ADDWCP_{t-1} + e_{t-1}$…… (5.14)

$\Delta ADDWCP_t = \beta_0 + \Sigma\beta_r \Delta ADDWCP_{t-1} + \Sigma c_r \Delta ADMWCP_{t-1} + e_{t-1}$……..… (5.15)

$\Delta ADMWCP_t = \beta_0 + \Sigma\beta_r \Delta ADMWCP_{t-1} + \Sigma c_r \Delta ADDWCP_{t-1} + e_{t-1}$…… …. (5.16)

$\Delta ADDWCP_t = \beta_0 + \Sigma\beta_r \Delta ADDWCP_{t-1} + \Sigma c_r \Delta DDWCP_{t-1} + e_{t-1}$ ..... (5.17)

$\Delta DDWCP_t = \beta_0 + \Sigma\beta_r \Delta DDWCP_{t-1} + \Sigma c_r \Delta ADDWCP_{t-1} + e_{t-1}$ ..... (5.18)

$\Delta GONWCP_t = \beta_0 + \Sigma\beta_r \Delta GONWCP_{t-1} + \Sigma c_r \Delta ADMWCP_{t-1} + e_{t-1}$ ..... (5.19)

$\Delta ADMWCP_t = \beta_0 + \Sigma\beta_r \Delta ADMWCP_{t-1} + \Sigma c_r \Delta GONWCP_{t-1} + e_{t-1}$ ..... (5.20)

$\Delta GONWCP_t = \beta_0 + \Sigma\beta_r \Delta GONWCP_{t-1} + \Sigma c_r \Delta DDCP_{t-1} + e_{t-1}$ ..... (5.21)

$\Delta DDWCP_t = \beta_0 + \Sigma\beta_r \Delta DDWCP_{t-1} + \Sigma c_r \Delta GONWCP_{t-1} + e_{t-1}$ ..... (5.22)

$\Delta ADMWCP_t = \beta_0 + \Sigma\beta_r \Delta ADMWCP_{t-1} + \Sigma c_r \Delta DDWCP_{t-1} + e_{t-1}$ ..... (5.23)

$\Delta DDWCP_t = \beta_0 + \Sigma\beta_r \Delta DDWCP_{t-1} + \Sigma c_r \Delta ADMWCP_{t-1} + e_{t-1}$ ..... (5.24)

APPENDEX 6: Davidson and MacKinnon (1993) Generated the Correct Critical Value for Co-integration Test-Engle-Granger Approach

Asymptotic critical values for co-integration tested

	1%	5%	10%
M=2			
Constant	-3.90	-3.34	-3.04
Constant + trend	-4.32	-3.78	-3.50
M=3			
Constant	-4.29	-3.74	-3.45
Constant + trend	-4.66	-4.12	-3.84
M=4			
Constant	-4.64	-4.10	-3.81
Constant + trend	-4.97	-4.43	-4.15
M=5			
Constant	-4.96	-4.42	-4.13
Constant + trend	-5.25	4.72	-4.43
M=6			
Constant	-5.25	-4.71	-4.42
Constant + trend	5.52	-4.98	-4.70

Source: Davidson and Mackinnon, 1993. Table 20.2.p.722

APPENDEX 7: Summary of Co-integration Regression Function for Wholesale Price (Birr/100 Kg) of Selected Horse Beans Market Pairs

Model				
	Coefficient.	Standard. Errors	*t*	p>| *t* |
ADDWHB				
ADESWHB	1.074	0.020	51.180	0.000***
Constant	12.691	11.203	1.130	0.259
ADDWHB				
ADMWHB	0.980	0.017	56.600	0.000***
Constant	13.182	10.512	1.250	0.212
ADDWHB				
DDWHB	0.868	0.020	41.610	0.000***
Constant	-0.118	14.503	-0.010	0.994
DESWHB				
ADMWHB	0.892	0.016	54.930	0.000***
Constant	10.155	9.502	1.070	0.287
DESWHB				
DDWHB	0.797	0.019	40.770	0.000***
Constant	-4.649	13.056	-0.360	0.722
ADMWHB				
DDWHB	0.877	0.017	50.430	0.000***

Constant	-9.047	12.095	-0.750	0.456

* Significant at 10%, ** significant at 5%, ***significant at 1%

APPENDEX 8: Summary of Co-integration Regression Function for Wholesale Price (Birr/100 Kg) of Selected Chickpeas Market Pairs

Model				
	Coefficient.	Standard. Errors	*t*	p>| *t* |
ADDWCP				
GONWCP	0.096	0.014	67.650	0.000***
Constant	-18.445	9.215	-2.000	0.047
ADDWCP				
ADMWCP	0.919	0.021	43.700	0.000***
Constant	44.084	13.024	3.38	0.001
ADDWCP				
DDWCP	0.903	0.017	51.130	0.000***
Constant	-15.083	12.104	-1.250	0.215
GONWCP				
ADMWCP	0.942	0.019	47.280	0.000***
Constant	68.523	12.341	5.550	0.000
GONWCP				
DDWCP	0.928	0.014	64.030	0.000***
Constant	6.435	9.941	0.650	0.519
ADMWCP				
DDWCP	0.928	0.018	48.970	0.000***

Constant	-24.640	12.985	-1.880	0.062

* Significant at 10%, ** significant at 5%, ***significant at 1%

APPENDEX: 9 Result of Error Correction Model for Horse Beans

Model				
	Coef .	Std. Error	*t*	p>| *t* |
ΔADDWHB				
ΔDESWHB	0.378	0.078	4.85	0.000
L_1resadisdese	-0.427	0.088	-5.23	
				0.000***
Constant	4.940	4.638	1.07	0.289
ΔADDWHB				
ΔADMWHB	0.571	0.079	7.21	0.000
L_1resadisadama	-0.320	0.067	-4.72	
				0.000***
Constant	1.757	4.232	0.42	0.679
ΔADDWHB				
ΔDDWHB	0.213	0.068	3.12	0.002
L_1resadisdre	-0.018	0.025	-1.19	0.236
Constant	12.992	9.431	1.38	0.171
ΔDESWHB				
ΔADMWHB	0.617	0.095	6.44	0.000
L_1resdeseadama	-0.754	0.090	-8.33	
				0.000***
Constant	1.845	4.929	0.37	0.709
ΔDESWHB				
ΔDDWHB	0.438	0.104	4.21	0.000
L_1resdesedre	-0.413	0.094	-4.38	0.201
Constant	2.903	5.889	0.49	0.623

ΔADMWHB				
ΔDDWHB	0.298	0.083	3.60	0.000
L_1resadamadre	-0.107	0.083	-1.29	0.200
Constant	3.595	4.641	0.77	0.440

* Significant at 10%, ** significant at 5%, ***significant at 1%

APPENDEX: 10 Result of Error Correction Model for Chickpeas

Model

	Coef .	Std. Error	*t*	p>| *t* |
ΔADDWCP				
ΔGONWCP	0.599	0.081	7.38	0.000
L_1resadisgon	-0.408	0.079	-5.17	0.000***
Constant	2.228	3.892	0.57	0.568
ΔADDWCP				
ΔADMWCP	0.462	0.081	5.65	0.000
L_1resadiisadama	-0.178	0.053	-3.31	0.001***
Constant	2.895	4.097	0.71	0.481
ΔADDWCP				
ΔDDWCP	0.465	0.107	4.35	0.000
L_1resadisdrre	-0.211	0.070	-2.98	0.003***
Constant	3.207	4.396	0.73	0.467
ΔGONWCP				
ΔADMWCP	0.408	0.081	5.04	0.000
L_1resgonadama	-0.218	0.055	-3.91	0.000***
Constant	3.572	4.054	0.88	0.380
ΔGONWCP				
ΔDDWCP	0.420	0.092	4.53	0.000

L_1resgondre	-0.144	0.057	-2.51	0.013***
Constant	13.323	5.693	2.34	0.021
ΔADMWCP				
ΔDDWCP	0.470	0.107	4.40	0.000
L_1resadamadrre	-0.107	0.067	-1.61	0.110*
Constant	1.520	4.164	0.37	0.716

* Significant at 10%, ** significant at 5%, ***significant at 1%

APPENDEX 11: Skewness Tests for Normality of Horse Beans Price

Variable	Obs	Pr (Skewness)	*Adj chi2(2)*	Pro>chi2
Residual of ADDWHB and DESSWHB	132	0.0000	26.73	0.0000***
Residual of ADDWHB and ADMWHB	132	0.0065	25.79	0.0000***
Residual of ADDWHB and DDWHB	132	0.0183	12.11	0.002***
Residual of DESSWHB and ADMWHB	132	0.1497	15.19	0.0005***
Residual of DESSWHB and DDWHB	132	0.0404	14.06	0.0009***
Residual of ADMWHB and DDWHB	132	0.2470	5.55	0.00625***

* Significant at 10%, ** significant at 5%, ***significant at 1%

APPENDEX 12: Skewness Tests for Normality of Chickpeas Price

Variable	Obs	Pr(Skewness)	*Adj chi2(2)*	Pro>chi2
Residual of ADDWCP and GONWCP	132	0.4244	11.04	0.0040***
Residual of ADDWCP and ADMWCP	119	0.0000	40.76	0.0000***
Residual of ADDWCP and DDWCP	132	0.0012	16.12	0.0003***
Residual of GONWCP and ADMWCP	119	0.0001	27.33	0.0000***
Residual of GONWCP and DDWCP	132	0.1373	8.99	0.0112***
Residual of ADMWCP and DDWCP	119	0.0411	10.25	0.0059***

* Significant at 10%, ** significant at 5%, ***significant at 1%

APPENDEX 13.a: Result of Testing Granger Causality between Addis Ababa and Gonder Market Price of Chickpeas

	Coefficient.	Standard Error.	*t*	p>| *t* |
$\Delta ADDWCP$				
$\Delta ADDWCP_{t-1}$	0.029	0.113	0.260	0.793
$\Delta GONWCP_{t-1}$	0.119	0.108	1.110	0.271
$RESADIDGON_{t-1}$	-0.187	0.103	-1.810	0.073
Cons	4.821	4.667	1.030	0.304
$\Delta GONWCP$				
$\Delta GONWCP_{t-1}$	0.005	0.099	0.050	0.959
$\Delta ADDWCP_{t-1}$	-0.074	0.103	-0.750	0.472
$RESGONADIS_{t-1}$	0.398	0.095	4.190	0.000
Cons	6.071	4.283	1.420	0.159

* Significant at 10%, ** significant at 5%, ***significant at 1%

APPENDEX 13.b: Result of Testing Granger Causality between Addis Ababa and Adama Market Price of Chickpeas

	Coefficient.	Standard Error.	*t*	p>| *t* |
$\Delta ADDWCP$				
$\Delta ADDWCP_{t-1}$	0.090	0.101	0.880	0.378
$\Delta ADMWCP_{t-1}$	-0.027	0.110	-0.250	0.806

$RESADISADM_{t-1}$	-0.175	0.067	-2.620	0.010
Cons	4.973	4.582	1.090	0.280
$\Delta ADMWCP$				
$\Delta ADMWCP_{t-1}$	0.166	0.105	1.580	0.117
$\Delta ADDWCP_{t-1}$	0.133	0.097	1.370	0.172
$RESADMADIS_{t-1}$	0.037	0.064	0.590	0.559
Cons	2.619	4.404	0.590	0.553

* Significant at 10%, ** significant at 5%, ***significant at 1%

APPENDEX: 13.c. Result of Testing Granger Causality between Addis Ababa and Diredawa Market Price of Chickpeas

	Coefficient.	Standard Error.	*t*	p>| *t* |
$\Delta ADDWCP$				
$\Delta ADDWCP_{t-1}$	0.050	0.106	0.47	0.639
$\Delta DDWCP_{t-1}$	0.091	0.110	0.82	0.411
$RESADISDRE_{t-1}$	0.107	0.081	-1.33	0.184
Cons	4.917	4.757	1.03	0.303
$\Delta DDWCP$				
$\Delta DDWCP_{t-1}$	0.040	0.084	0.48	0.634
$\Delta ADDWCP_{t-1}$	0.095	0.082	1.16	1.247
$RESDREADIS_{t-1}$	0.236	0.062	3.81	0.000
Cons	4.137	3.651	1.13	0.259

* Significant at 10%, ** significant at 5%, ***significant at 1%

APPENDEX: 13.d. Result of Testing Granger Causality between Gonder and Adama Market Price of Chickpeas

	Coefficient.	Standard Error.	*t*	p>| *t* |
$\Delta GONWCP$				
$\Delta GONWCP_{t-1}$	-0.024	0.103	-0.24	0.809
$\Delta ADMWCP_{t-1}$	0.022	0.108	0.21	0.837
$RESGONADM_{t-1}$	-0.190	0.071	-2.67	0.009

Cons	5.466	4.514	1.21	0.228
$\Delta ADMWCP$				
$\Delta ADMWCP_{t-1}$	0.330	0.105	3.14	0.002
$\Delta GONCP_{t-1}$	-0.133	0.100	-1.34	0.183
$RESADMGON_{t-1}$	0.144	0.068	2.09	0.039
Cons	3.684	4.393	0.84	0.403

* Significant at 10%, ** significant at 5%, ***significant at 1%

APPENDEX: 13.e. Result of Testing Granger Causality between Gonder and Diredawa Market Price of Chickpeas

	Coefficient.	Standard Error.	*t*	p>| *t* |
$\Delta GONWCP$				
$\Delta GONWCP_{t-1}$	0.014	0.115	0.13	0.897
$\Delta DDWCP_{t-1}$	-0.055	0.113	-0.49	0.627
$RESGONDER_{t-1}$	-0.137	0.096	-1.43	0.156
Cons	5.629	4.596	1.22	0.223
$\Delta DDWCP$				
$\Delta DDWCP_{t-1}$	0.067	0.092	0.72	0.047
$\Delta AGONWCP_{t-1}$	0.050	0.094	0.53	0.595
$RESDERGON_{t-1}$	0.269	0.078	3.42	0.001
Cons	4.169	3.747	1.11	0.268

* Significant at 10%, ** significant at 5%, ***significant at 1%

APPENDEX: 14 Publications

Wintana O. Ali, Hillary K. Bett , Symon K. Kiprop, Hillary K. Chiryot (2014). Economic Analysis of Spatial Integration of Pulse Market: A case of Selected Pulse markets in Ethiopia**.** *Journal of International Institute for Science, Technology and Education (IISTE).*