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FARMER PREFERENCES AND MARKET INTEGRATION OF COWPEA IN UGANDA

BY

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BSc. Agric (MUK)

A THESIS SUBMITTED TO THE DIRECTORATE OF RESEARCH AND GRADUATE TRAINING IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL AND APPLIED ECONOMICS OF MAKERERE UNIVERSITY

November, 2013

DECLARATION AND APPROVAL

1. Declaration

I hereby declare that this thesis is my original work and has not been presented in this or any other university for any award. All other sources of information have been duly acknowledged.

Signed Date:

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2. Approval

This Thesis has been submitted with our approval as supervisors.

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…… **.....**

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DEDICATION

To my darling wife Annet Ddungu, lovely sons Abraham Ddungu and Aaron Ddungu

&

My darling late Father Jame Musunku Ddungu, I miss your love and care

May your soul rest in eternal peace.

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LIST OF ACRONYMS AND ABBREVIATIONS

ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
AR	Autoregressive
BP	Breush Pagan
IDPs	Internally displaced Peoples‟ Camps
LOP	Low of One Price
LRA	Lord's Resistance Army
Shs	Uganda Shillings
SSA	Sub-Saharan Africa
UBOS	Uganda Bureau of statistics

ABSTRACT

Despite its importance as a legume in Uganda, cowpea has not received much attention over the last two decades. A survey was conducted in northern, mid-northern and eastern agro-ecological zones of Uganda with the purpose of collecting baseline information on cowpea production, preferred attributes and production constraints.

Data was collected from 306 randomly selected farmer respondents in four districts of Northern and Eastern Uganda using a structured questionnaire. Secondary data was also obtained on wholesale prices of cowpeas on a weekly basis from FIT Uganda from 2008 to 2011 for Soroti, Lira and Kampala markets. Data collected included: socio-economic characteristics of farmers, production practices, current varieties grown, and farmers' preferences for the varieties, yields, marketing aspects and production constraints of cowpea.

Data was analyzed using descriptive statistics particularly frequencies and the measures of central tendency. Chi-square and t-tests were used to elicit significant relationships between variables. Results showed that farmers in the region grew three common cowpea varieties. The majority (74%) grew *Ebelat* variety (Erect variety), 17% grew *Ichirikikwai* (spreading type) and 7% grew *Alegi* variety. *Alegi* was exclusively grown in Lira and Pader districts of Northern Uganda while *Ebelat* and *Ichirikukwa* were grown in Kumi and Soroti districts. Farmers preferred *Ebelat* and *Ichirikikwai* because of its quality traiting: include high grain yield, high leaf yield, seed color, early maturity and leaf texture. Pests, diseases, poor varieties, low market prices and price fluctuations were identified as constraints to cowpea production.

Several approaches were used to investigate the degree of cowpea market integration in Uganda, namely: bivariate correlation coefficients, co-integration, and Granger-Causality tests. Results from these tests showed that cowpea markets in northern region (Lira) exhibit integration to the dominant markets in the Kampala. While Soroti did not exhibit market integration with Kampala and, this can be attributed to the fact that traders in this district engage in trade with the neighboring countries like Kenya and South Sudan. In addition to transportation cost, lack of an efficient information flow system resulted into lack of market integration between Soroti and Kampala.

There is no leading market whose price changes influences all other markets since any price changes of cowpea in the markets studied are organized around more than one market. In order to understand these markets better, there is a need to analyze the value chain of cowpea in Uganda. Also, in order to realize the economic potential of cowpea in Uganda, infrastructure and accessibility to markets have to be improved.

Keywords: Cowpea, Farmer preferences, Production constraints, Market integration.

CHAPTER ONE

INTRODUCTION

1.1 Background

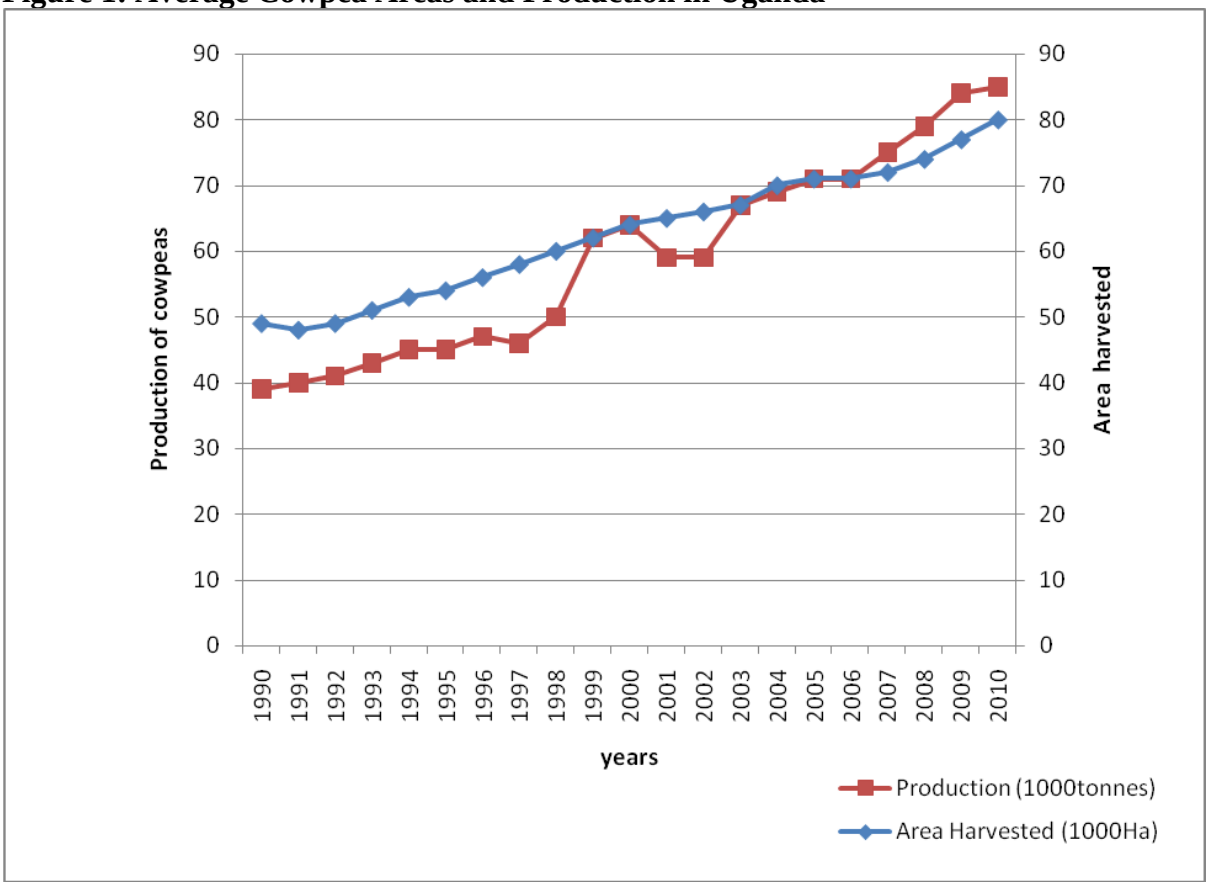
Cowpea (Vigna unguiculata L. Walp) is a global legume whose cultivation is believed to have begun from Africa more than 5000 years ago (Davies et al., 2005 and Jafferson, 2005). At the present, it is the second most important grain legume in Africa (NRC, 2006). It is cultivated around the world particularly in the semi-arid tropics primarily as a pulse, but also as a vegetable (for both grains and the green peas) as well as a cover and fodder crop (Faye, 2005). However, the largest part of the world's production comes from Africa. More than 5.4 million tons of dried cowpeas are produced worldwide, with Africa producing nearly 5.2 million. Nigeria, the largest producer and consumer, accounts for 61% of production in Africa and 58% worldwide. As regards trade, Africa exports and imports negligible amounts of cowpeas (IITA, 2013).

In Uganda, cowpea is ranked third after beans and groundnuts (Adipala *et al.*, 1997) although it is generally consumed countrywide. The young leaves and immature pods are eaten as vegetables. Relative to other grain legumes and vegetable crops, cowpea possesses multiple advantages to farmers including; high yields on poor, sandy soils unsuitable for the production of other crops, high rates of symbiotic nitrogen fixation and lower fertilizer requirements (Carsky *et al.,* 2001; Timko and Singh, 2008). It is thus a valuable component of farming systems in areas where soil fertility is limiting where it is grown in rotation and intercropped with cereals. It is a crop of major importance to the nutrition of poor rural households whose diets tend to heavily rely on starchy foods such as millet, sorghum, maize

and cassava. Therefore, it has a tremendous potential to contribute to the alleviation of malnutrition.

Cowpea is grown by approximately 2.2 million smallholder farmers in Uganda, mainly in eastern and northern regions, using simple traditional methods. Figure 1 below shows the trend of area and production of cowpea for the last two decades (1990-2010). The figure shows relatively similar trend for area while production shows fluctuated trend throughout the period with several increases and decreases and the highest peak observed in 2000 and a fall in 2002. The reasons for such fluctuations are attributed to weather conditions. Indeed, the country often experiences unpredicted dry periods and floods which might have caused the decreases in the harvested areas while good seasons might have resulted in increases in the harvested areas (the ups). Unlike the production, the area trend shows a sustained increase throughout the years independently of the corresponding production fluctuations. This suggests that the production of cowpea is related to increase in the area cultivated. As stated by Coulibaly *et al.*, (2009) the increase in production may also be attributed to be the result of the release, adoption and cultivation of improved cowpea varieties at the early stage of cowpea improvement programs.

Figure 1: Average Cowpea Areas and Production in Uganda



Source: FAOSTAT Database; *http//www.fao.org*

At the national level, the average yields stand at 0.93 MT/ha. However, the average cowpea yield is estimated at 1.5 to 3 MT/ha in on station field trial while farm level yields are as low as 0.5MT/ha due to production constraints such as low yield potential of landraces, lack of improved seed, pests and disease attacks, poor agronomic practices and poor market access (Emaju, 2000).

Minimal value addition of cowpea takes place and involves sorting and grading by type. It is sold as whole grain mostly although in some cases they sell split grain. Cowpea trade has been limited to the local/domestic market and it is slightly picking at regional level mainly South Sudan and Kenya. Cowpea has therefore been thought of having brought for the smallholder farmers in Uganda some hope as a cash crop, especially for varieties demanded

by the export market (NARO/DFID, 2002). Since the Uganda government policy is to diversify exports and introduce non-traditional cash crops, in the economy, cowpea in this regard presents a great economic potential.

1.2 Problem statement

Cowpea is an important food crop in eastern and northern Uganda, where nearly 90% of the country‘s crop is produced (Adipala *et al*., 1997). Production is in transition where it was traditionally grown almost exclusively as a food crop for domestic consumption. The demise of cotton as the main cash crop and the emergence of important external markets resulted into many farmers in the region growing cowpea for cash markets (Sabiti *et al*., 1994). However, despite its importance as legume, cowpea production and improvement have not received much attention over the last two decades.

In realizing the potential of cowpeas as an alternative cash crop, McKnight Foundation supported a breeding programme engaged in breeding cowpea to improve food security in the region. This cannot be achieved before identifying farmer’s preference for cowpeas and production constraints of cowpeas. In the past two decades, no research program have been carried out focusing on; breeding and dissemination of early maturing and high yielding varieties of cowpea to improve production and promote cowpea marketing. However, the cowpea programs implemented in Uganda have focused only on the supply side to ensure enhanced productivity. It is not clearly documented whether in the development of improved varieties farmers preferences and desires farmers have been considered which are essential to any technology adoption. There is need to assist breeders in identifying the farmer preferred traits of cowpea.

Furthermore, the major producing areas have been under political unrest and are recuperating from long-term insurgency for the past two decades resulting into the destruction of infrastructure, government programmes and loss of life. These are among the factors that affect the ways markets for various crops are integrated. In addition lack of market information in many African countries as highlighted by Van der Laan (1999) is principally because marketing research has focused on export crops such as cotton, coffee, cocoa and groundnut and to a lesser extent cereals.

The recent move towards market reform in most developing countries has renewed an interest in the working of agricultural markets as a source of income, employment and food security. The success of the reform process in promoting equity and efficiency is constrained by numerous structural deficiencies in local markets. One of the main consequences of these structural deficiencies is poor market integration resulting into difficulty with which information and trade flows among spatially separated markets (Goletti *et al.*, 1995). Among other things, the reform process needs to take into account the extent of agricultural market integration. However research on cowpea variety improvement and market performance has not received much attention in the last two decades within the two regions. Little is known about how the agricultural markets, especially for staple foods are performing in recent years and whether they are integrated or not.

This study was therefore conducted to gain a better understanding of cowpea market integration which is necessary to enhance production, improve market efficiency and competitiveness which are essential for cowpea market development.

1.3 Objective of the study

The main objective of the study was to determine farmer preferred cowpea attributes and the extent of integration in Uganda's Cowpea market system.

1.3.1 Specific Objectives

i. To determine farmer preferred attributes of cowpea
ii. To determine the existence and level of inter-market cowpea price dependencies.
iii. To examine the causal relationships (which market drives prices) among spatial locations of cowpea markets

1.4 Hypotheses

i. Cowpea markets are integrated
ii. There is a causal relationship between cowpea markets

1.5 Significance of the study

A comprehensive understanding of market integration provide information on cowpea market performance which is necessary for proper policy formulation and macroeconomic modelling which brings forth the identification of market that are closely integrated and the extent of price transmission across different locations within the country. With this in place, government can improve its market liberalization policies, avoid duplication of interventions and as a result decrease fiscal burden on the budget, allows monitoring of price movements, forecast prices in the domestic and regional markets and identify structural factors responsible for the integration. The findings of this study also will contribute to the existing stock of knowledge on farmer behaviour in cowpea markets and can serve as a stepping stone for further research.

Information regarding cowpea preferred attributes and marketing can be regarded as vitally important to producers, marketers, consumers and policy makers. Not only will such information assist producers to produce what consumers want, but it will also assist intermediaries to lower transaction costs through more efficient marketing. Further this will guide policy makers to create a conducive environment through which role-players can interact in a sustainable and profitable manner. Unfortunately, information on cowpea in Africa in general, and in Uganda, in particular is limited. Not only is there little information available, but the sources reporting desired existing information are often conflicting and are spread over many sources. This study attempts to bring together available information related to the farmer's preference and market integration of cowpea since it provides the background to the research problem being addressed in this study.

1.6 Scope of the Study

The study comprised of a sample of cowpea farmers, from Pader, Lira, Kumi and Soroti Districts. Soroti and Kumi districts are located in the Eastern Uganda, while Pader and Lira are in Northern Uganda. The sampled farmers are representative of cowpea farmers in the country given that these districts produce over 90% of the country's cowpea output. Secondary data was obtained from FIT Uganda, on which the integration study was based, 168 weekly prices of cowpeas in three districts of Uganda. The markets under study were: Soroti, Lira, and Kampala mainly because Soroti and Lira are the producing zones while Kampala was considered the central trading zone. Data was collected on farmer's socio-economic and socio-demographic characteristics, production practices, gender issues in production, marketing aspects, and production constraints and farmers perception of their extent.

CHAPTER TWO

LITERATURE REVIEW

2.1 Markets and Market Integration

Many developing countries rely on one or a few primary agricultural commodities for the bulk of their export earnings, though they remain net importers of food. For these commodity-dependent, low-income, food-deficit economies, the price instability that is characteristic of agricultural commodity markets can have pronounced impacts on employment, income, government revenue, and food security. Current efforts to liberalize trade policies, to the extent that they have increased household's exposure to risk, have arguably exacerbated the problem of price fluctuations for the world's poor (Sarris and Hallam, 2006). The availability of market for cowpea both domestically and regionally according to Adipala *et al.*(1999) makes it a potential income and food security crop for the rural poor and so the need to understand its consumers, hence defining the market. From a marketing perspective, a potential market consists of a group of people with similar needs for a particular good or service, sufficient resources to make a purchase, and the willingness and ability to buy. Market is said to exist when buyers and sellers of a particular resource or good freely come together leading to a flow of information.

The marketing of cowpeas like other crops is mainly confined to local markets and farm gate. This is attributed largely to lack of access to urban markets by farmers partly because of the poor road network and poor modes of transportation. Considerable local trade in cowpea therefore exists. Inter-regional trade in cowpea too exists and it is a profitable crop to produce according to Sabiti (1995) and a lot of the crop finds its way to the Kenyan markets.

2.2 Market Integration

Market integration refers to the co-movement of prices and/or flows between them. More generally, it explains the relationship between two markets that are spatially or temporarily separated. Market integration studies attempts to investigate the extent of a market by analyzing the development of prices over time for potential competing products (Asche, *et al*, 2005).

According to Bopape (2002) there are three forms of market integration (1) integration across space, (2) integration across product and (3) integration across time. Markets are integrated across space if, when trade takes between them, price in the importing market equals price in the exporting market plus transportation and other costs of moving the product between the two markets. When integrated across product form, markets are vertically integrated and the price differential between two related commodities should not exceed transportation and processing costs. Markets are said to be integrated across time (inter-temporally integrated) when the expected price differential does not exceed the cost of storage.

The study of market integration can suggest to the producer as to where, when and how much to sell, which in turn will have a bearing on their production strategies and hence resource allocation. Integrated markets are those where prices are determined interdependently (Yogisha, 2006). Fulton et al., (2008); observed that, the examination of the extent of how markets were integrated was an important way of understanding whether sufficient market information was available to the market participants.

Goodwin 2001). Therefore, understanding the dynamics and/or the degree to which food markets are spatially efficient has key implications for policy makers. A well-integrated market system is essential to household food security especially in both food deficit regions of the country. In addition, flexible prices are thought to be responsible for efficient resource allocation and price transmission is useful in integrating markets both vertically and spatially. Without spatial integration of markets, price signals may not be transmitted from urban food deficit to rural food surplus areas thereby leading to increased price volatility.

Understanding if markets are integrated is important for policy reforms. Uganda presents a case where local markets are thought to be fragmented. In fragmented markets, a localized crop scarcity can lead to famine in the area if prices in one local market are not highly responsive to those of another. A well-integrated market system is not only necessary for the efficient allocation of productive resources but also for a reduction in price risks that are likely to impair the wellbeing of economic actors most especially the poor and food insecure households (Ravallion, 1986). This is because the success of market reforms depends to a large extent on the strength of price signals transmitted between different market levels (Moghaddasi, 2009).

The knowledge about the extent to which markets are integrated is important for several reasons. First, by identifying groups of closely integrated markets and by knowing the extent of price transmission across different locations within a country, a government may improve the design of its market liberalization policies. For example, it avoids duplication of interventions and, as a result, decreases the fiscal burden on the budget. Second knowledge of market integration allows monitoring of price moments. For example, the knowledge of the

speed of adjustment to shocks (for example, in a country's key commodity sector) arising in different areas of the country is paramount to more efficiently managing a price stabilization policy. Third, integration models can be used to forecast prices in neighbouring markets which facilitates forecasting analysis. Finally, by identifying the structural factors responsible for market integration, investment policy in the marketing infrastructure can be improved, because this allows policy makers to understand which kind of marketing infrastructure is more relevant to the development of agricultural markets in a country**.** (Scott, 1995)

2.3 Measures of market integration

The measurement of market integration is to understand the interaction among prices in spatially separated markets, the measurement of the extent of spatial market integration is still a matter of considerable debate conceptually and empirically, with especially the type of information (data) requirements that meet the arbitrage conditions i.e. information on prices, trade flows between markets and transfer costs are the ideal information mix for robust analysis of market integration and price transmission (Uchezuba, 2005). On the contrally usually only price information is readily available and empirical tests of market integration concentrate on price analysis, which does not reveal whether there are trade flows among markets due to price differentials.

Several approaches have been used to test spatial market integration using market prices to examine the concept of spatial arbitrage. The Econometric tests employed by some researchers to test the level of market integration include, correlation analysis (Nzuma, 2013), the Law of One Price (LOP) and the application of new econometric techniques of co-

integration using the Johnson approach (Abba (2009), Barret and Li, 2002) and Granger causality (Debaniyu (2013), Takashi and Ayumi, 2010) among others.

Correlations have been used in the study of market integration based on the notion that if markets are integrated then the binary correlation coefficient of prices in the two markets will be both significant and high, and that there will be trade flows between them. However, high correlation coefficients can be a result of other factors, like a steady increase in all prices rather than market integration, and hence correlation analysis does not correct for any existing trends in the price data. Negassa *et. al. (2003*) stated that bivariate correlation coefficient is a simple way to study market integration; it considers the correlation of price series for different markets. However, these traditional tests of market integration focused on correlation coefficients of spatial prices mask the presence of other synchronous factors, such as general price inflation, seasonality, population growth and procurement policy (Goletti *et. al.,* 1995). Several researchers have therefore questioned the usability of bivariate price correlation to investigate the degree of market integration.

Co-integration has been regarded by many researchers as not absolute but a measure of degree of market integration (Gonzalez-Rivera and Helfand, 2001). Spatial market prices that diverge from each other for a long time would have a weak long-run relationship while two prices that co-move are likely to be co integrated. According to Goodwin and Schroeder (1991) various factors affect co-integration, include transaction cost, risk associated in transacting business and influence of volume of trade. Low-volume markets have the tendency of large price variability and the distance between markets has a great influence on

transaction costs. The result is consistent with the findings of Goletti *et al.,* (1995) in describing the influence of structural factors in determining market integration.

According to Barrett (1996), co-integration is unfortunately not a sufficient tool for spatial market analysis. Negassa *et. al.,* (2003) and Barrett (1996) pointed out that, if transaction costs are non-stationary, a failure to find co-integration between two market price series may be completely consistent with market integration. In other words, co-integration may be assumed unnecessary, because price can be co-integrated without the market being integrated or efficient (Negassa *et. al.,* 2003) asserts that the insufficiency of co-integration as a tool for spatial market analysis stems from the fact that, if the coefficient of prices in the central market is negative, a negative relationship is observed, implying that prices move in the opposite direction rather than co-movement as indicated by the concept of market integration.

The task in co-integration analysis is therefore two fold. The first part is to find out if each of the pair of a time series is stationary and if either or both are stationary and secondly, to difference the series until stationarity is achieved (Edriss, 2003).

Another approach to test market integration is Granger Causality Test. A time series prices P_{it} is said to "Granger cause" another time series price P_{jt} if current and lagged values of P_{it} improve prediction of P_{jt} (Gujarati, 1995). In other simple words, causality is basically a measure of the predictability of prices, that is, price movements in one market can be used to forecast price changes in other markets (Minten and Mendonza, 1998). The existence of co-integration among a set of variables implies Granger causality (Shahidur, 2004), which, according to Dawson and Dey (2002), follows the Granger-causality approach and can be tested within Johansen's co-integration framework by standard Wald tests (Shahiudr, 2004).

It should also be noted that analyzing market integration without accounting for transaction cost effects has been criticized since the primary mechanism ensuring market integration is spatial trade and arbitrage (Goodwin and Piggott, 2001). Nevertheless, even if the various measures of the degree of market integration have come under scrutiny there is still no unified approach to evaluate market integration (Meyer, 2003). By using different approaches to measure the degree of market integration, as in this study, it is believed that consistency in the results obtained will be adequate to conclude whether market integration is present or not.

CHAPTER THREE

METHODOLOGY

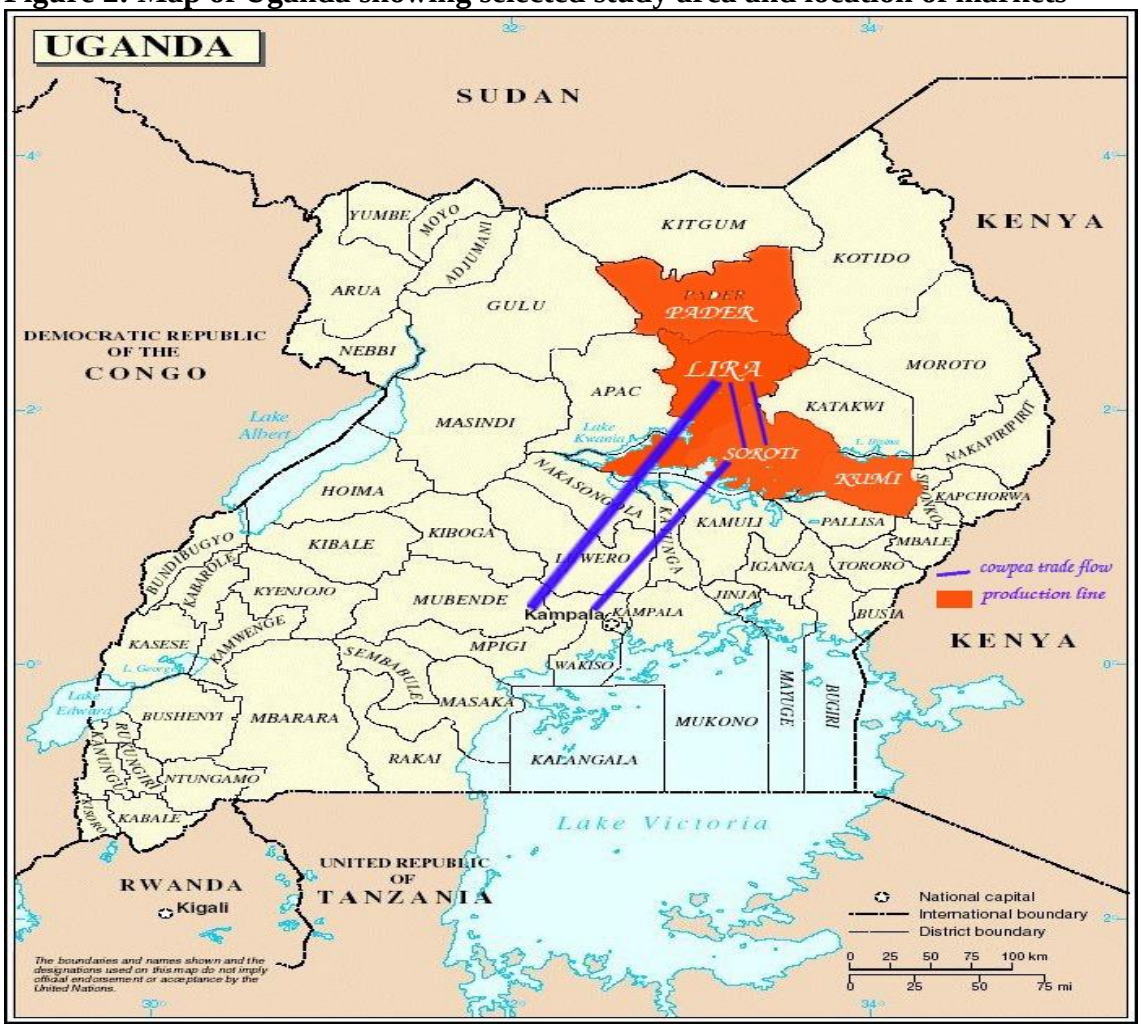
3.1 Study Area and Data Collection

Two districts from each of agro-ecological regions of northern and eastern Uganda were selected for the study of data. A combination of purposive and random sampling techniques was used in selecting the areas and respondents for study. The two districts from each of the regions were purposively selected primarily because cowpea is a widely-grown legume in these areas and random sampled to select cowpea farmers from purposive selected sub-counties based on the reported annual production generated by the areas. From the districts, 11 sub-counties were randomly selected and in each of the sub-counties, using a sampling frame drawn together with extension agents, simple random sampling procedures were used to select 308 farmers. The final sample distribution comprised 50 from Pader, 42 from Lira, 107 from Kumi and 107 from Soroti District. Figure 2 shows the study area, more farmers were sampled in the two districts of Eastern agro-ecological zone due to the importance of the crop in these areas in terms of production. Data were collected on farmer's socio-economic and socio-demographic characteristics, production practices, gender issues in production, marketing aspects, and production constraints and farmers preferred variety attributes.

In carrying out the market integration study, secondary data were obtained from FIT Uganda on weekly wholesale prices of cowpea grains in three districts namely Soroti, Lira and Kampala form 2008 to 2011. The markets studied were Soroti, Lira and Kampala. Soroti and Lira were considered as the producing zones while Kampala was considered a purely

consumption zone. Wholesale prices were used because they are easily transmitted. The markets were selected on the basis of production regions and consumption region. These markets were purposively selected based on a availability of price data and being located in production zone or consumption zone giving a total of three (3) markets. This is shown in figure 2.

Figure 2: Map of Uganda showing selected study area and location of markets



The time series data was cleaned by means of adjusting the prices with two standard deviations from the yearly means as suggested by Goetz and Weber (1986). Missing values were approximated by linearly interpolating the data to account for any missing values between one and three. Where the missing values are more than three, prices from nearby market was used to replace for missing values since it was hypothesized under spatial

arbitrage theory that prices of the same commodity in adjacent markets tend to move in unison and that they do not divert much from each other according to Tomek and Robison (1990). The issues of serial correlation and heteroscedasticity in the error terms of the estimated models was tested, for heteroscedasticity the Breush-Pagan (BP) set up was used. In order to test for serial correction in the error term of the considered model, the Breush-Godfrey approach was applied; using an AR (q) model. The data was analyzed using STATA 9 program, after set to have time series properties and transformed by two major transformations namely natural log and first difference transformations.

3.2 Analytical framework

3.2.1 Descriptive Statistics

Descriptive analysis was carried out using the Statistical Packages for Social Scientists (SPSS) and Statistical Software Package (STATA), means, percentages and standard deviation were obtain. To achieve 1, data was collected from farmers and analyzed and frequencies obtained for the most preferred attributes according to the ranks given by farmers. Chi-square and t-tests were also used to elicit any significant relationships between the variables of interest.

3.2.2 The Concept of Market Integration

In this section, several measures were used to study market integration. Markets are integrated when their price levels are closely related (Stigler, 1969). Econometric tests were conducted to test the level of cowpea market integration, which include stationarity tests, correlation analysis and the application of new econometric techniques of co-integration

analysis using Johansen trace test for bivariate and multivariate models and Granger causality approach (Palaskas and Harriss-White, 1993).

On the basis of the fact that only price information was collected by FIT Uganda from private traders in the study markets, this study tests the existence of co-movement and price relationships among markets using co-integration analyses. Co-integration analysis is based on the existence of a stable relation among prices in different localities (Goletti *et. al*., 1995). Prices move from time to time, and their margins are subject to various shocks. When a long-run linear relation exists among different series, these series are said to be co-integrated. The presence of co-integration between two series was indicative of interdependence; its absence indicates market segmentation. In particular, a segmented link was one were co-integration was rejected in both directions along which the link can be traced. Following Engel and Granger (1987), the co-integration model was composed of two steps: non-stationarity test used the ADF test and co-integration analysis.

One method to measure the significance of price relationships between markets in different geographic areas (across space) is to compute bivariate correlation coefficients (r) which are then used as a proxy for the level of market integration. A high (r) implies market integration and vice versa. The theory of price correlation was explicitly formulated by Stigler (1969). Stigler and Shervin (1985) linked the statistical test for price correlation to market integration when they proposed examining price correlation as a test for market integration. The use of correlation coefficients to ascertain the degree of market integration is quite common (Bopape and Christy, 2002; Fafchamps and Gavian, 1995 and Mbene, 2005). However, the non-stationary nature of agricultural time series price data and some other common factors, such as occurrences of drought and inflationary pressures can influence prices in markets

investigated in such a way that the (r) values suggest market integration even if markets are not really integrated. Hence, testing for market integration by only using correlation coefficients could lead to biased results.

Five steps were followed during data analysis and included the following;

Step 1: Determining the optimum lag length

The dataset was declared time series and a lag-order selection statistic pre-estimated using a combination of the two criterion either the Akaike Information Criterion (AIC), the Hannan-Quinn criterion and the Schwarz criterion to determine the optimal lag length for the cowpea price series. The number of lags included in models was determined using standard information criteria (AIC and SBIC) with priority being given to AIC.

Step 2: Test for Stationarity

The cowpea price series were tested individually for stationarity using the Augmented Dickey Fuller (ADF) test. (Vinuya, 2007; Uchezuba, 2005 and Shahidur, 2002). The ADF test which is also known as the unit root test was used to test the null hypothesis that a given price series P_t is non stationary against the alternative hypothesis that P_t is stationary by calculating a test statistic t for $\beta = 0$ in the equation (1) assuming a random walk process.

Following Gujarati 1995, the model is specified as:

$$P_t = \delta + \rho P_{t-1} + \varepsilon_t \quad \text{..... (1)}$$

Where P_t is the cowpea price at time *t*,

P_{t-1} is the lagged cowpea price

δ is a constant drift,

ρ is the coefficient of lagged cowpea prices and ε is the error term.

t is weekly

The model is transformed into a regression test to determine the slope through application of ordinary least squares (OLS) is what is termed as the Augmented Dickey Fuller (ADF) test. The regression was expressed as in equation (2) according to (Ghosh (2003), Myint and Siegfried, 2005); the test was based on the statistics obtained from applying the ordinary least squares (OLS) method to the following regression equation:

$$\Delta P_{it} = \alpha + \beta P_{it-1} + \delta T + \sum_{\gamma=1}^{k_i} \varphi_\gamma \Delta P_{it-\gamma} + \varepsilon_t \quad \text{..... (2)}$$

Where: T = time trend

Where $\Delta P_t = P_t - P_{t-1}$; $\Delta P_{t-\gamma} = P_{t-\gamma} - P_{t-\gamma-1}$; γ=2, 3, …, n, P_t is the price at time t; α, β, γ and φ_γ are parameters to be estimated and ε_t is the error term. γ = number of lags. The null hypothesis of a unit root is $H_0: \beta = 0$ in equation (2). The regression was run with a time trend. According to Bopape (2002), the trend was only included to rule out the possibility of non stationarity not being due to a deterministic trend. If the observed ADF test statistic is less than the critical values, then the P_t will be stationary and those found to be non-stationary if the critical value is less than the ADF test statistic. For series that were stationary in levels, these were considered to be integrated of order zero that is I (0).

Step 3: Transforming Non-Stationary Series

The non-stationary series were transformed by differencing to obtain stationary series.

If P_t is not stationary at level, it may be stationary at first difference or simply differentiation of this P_t series. The differenced price series was obtained by simply differentiating equation (1) through manipulation by subtracting P_{t-1} from both sides of equation (1) gives:

$$P_t - P_{t-1} = \delta + \rho P_{t-1} P_{t-1} + \varepsilon_t$$
$$\Delta P_t = (\beta - 1) P_{t-1} + \varepsilon_t$$
$$\Delta P_t = \alpha P_{t-1} + \varepsilon_t$$

$\Delta P_t = \alpha P_{t-1} + \varepsilon_t$..... (3).

Where ΔP_t is the price difference (P_t - P_{t-1}), and α is equal to (β_1-1)

To test for stationarity in the differenced time series ΔP_t in consideration, the null hypothesis is that α = 0 so that β = 1, in such a case equation (3) will have a unit root. The series in difference were then tested for stationarity using the ADF test. The alternative hypothesis was accepted for all the series tested meaning that they are integrated of order one that is I(1). The next step therefore was to test for co-integration.

Step 4: Co integration test

If two markets are integrated of order zero I(0), then the series are automatically integrated and hence cointegrated this implies that there is a longrun relationship between them, say $y_t = \beta_1 x_t + u_t$, where u_t is I(0). The two series are not drifting apart over time. If either or both of the series are nonstationary (i.e. integated of order above zero) and of the same oder of integration (which implies that the AR and MA processes are nonstationary), then the series may be integrated provided they are cointegrated (i.e. there is a linear combination of the series and since only one market (Soroti) was of order (1), no co-integration was run. since

Step 5: Causality test

To achieve objective 4, the Granger causality test was used to assess the nature of cowpea price transmission across markets and causal relationships among spatially separated markets. This method was used to determine how price changes in one market could explain price changes in another market. Granger Causality tests focus on the presence of at least unidirectional causality linkages as an indication of some extent of integration (Gupta and Mueller, 1982) and it assesses whether price movement follows a well defined path, that is, if price movement starts around demand or production zones and spreads across other markets.

For the series in level I(0), the Autoregressive Distributed Lag (ADL) model was used to test for causality. The model in level was specified as follows:

$$P_{1t} = \alpha_1 + \delta_1 t + \beta_1 P_{1t-1} + ... + \beta_a P_{1t-a} + \varphi_1 P_{2t-1} + ... + \varphi_q P_{2t-q} + \varepsilon_{1t} \quad \text{..... (4)}$$

$$P_{2t} = \alpha_2 + \delta_2 t + \theta_1 P_{2t-1} + ... + \theta_q P_{2t-q} + \sigma_1 P_{1t-1} + ... + \sigma_a P_{1t-a} + \varepsilon_{2t} \quad \text{..... (5)}$$

Where *a* and *q* are as defined above. Assume two markets; Kampala and Lira, where P_2 is the price of cowpeas in Kampala, and P_1 is the price of cowpeas in Lira. Causation can occur in two ways, unidirectional– where shocks in one market affect another market but not the reverse – and bidirectional where shocks in one individual market are transmitted both ways. Therefore, based on equation 4 and 5, three hypotheses of causality were tested after running a vector auto-regression for each market pair.

1. Unidirectional causality: Kampala prices drives or granger cause Lira prices if any or all the coefficients φ_1 *to* φ_q in equation (4) are statistically different from zero: Lira prices Granger cause Kampala prices if any or all coefficients σ_1*to* σ_a in equation (5) are statistically different from zero
2. Bidirectional causality (both Kampala and Lira Granger cause each other) if any or all coefficients σ_1*to* σ_a in equation 4 or 5 and if any or all φ_1 *to* φ_q in equations 4 and 5 are statistically different from zero.
3. The two markets are independent if all coefficients σ_1*to* σ_a in equation 4 or 5 and φ_1 *to*,φ_q in equations 5 and 4 are not statistically different from zero.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents and discusses the empirical results based on the data collected from 308 farmers of Soroti, Kumi, Lira and Pader districts. In addition, price data collected over 136 weeks from markets in Lira, Soroti and Kampala are presented and discussed. The results are summarized as means, percentages and coefficients. This chapter has four sub sections, the first looks at the socio economic characteristics of the farmers and attitude towards the different varieties of cowpeas. The second part looks at cowpea production constraints. The third part deals with cowpea market integration.

4.2 Cowpea production

4.2.1 Socio-economic Characteristics of Cowpea farmers

Socio-demographic characteristics of farmers interviewed are presented in Table 1. Almost equal numbers of male and female farmers were interviewed in the four districts with 49% being male and 51% being female. This implies that cowpea is grown both male and female farmers. There were more male headed households than female headed households. The mean age of the household heads was 40.5 years with a minimum of 17 and a maximum of 75 years. The majority of farmers in the sample were therefore in the active age group capable of various agricultural activities. There was a significant difference in age of farmers between the two regions with farmers in northern Uganda being older than those in Eastern. The mean household size was approximately eight persons. Being in rural areas, these tend

to be rather large household sizes which have implications on labour needs for various agricultural tasks and consumption needs of the farming households.

In terms of education levels, most households had attained at least six years of primary education. Approximately 5% had no formal education, 66% had primary level of education 26% had secondary level of education, while only 3% had tertiary education. There was a significant difference at 10% level between education level of farmers in northern and eastern Uganda. The political instability and cattle raids experienced in most of northern Uganda probably account for this. There was a significant difference at 1% level in cultivated acreage between farmers in Northern (8.8) and Eastern Uganda (5.4). This is probably due to low population density in northern Uganda as a result of displacement enabling farmers in the north to have large farm sizes.

Table 1: Socio-economic characteristics of cowpea farmers in Eastern and Northern Uganda

Characteristic	Northern Mean	Eastern Mean	Overall Mean	t value
Age (Years)	43	39	40.5	-2.54**
Household size	7.4	8.0	7.7	1.13
Education (years)	5.6	6.5	6.2	1.86*
Total Cultivated acreage	8.8	5.4	7.0	-4.61***
Cowpea acreage				
First Season 1	1.0	1.1	1.1	-0.31
Second Season 2	1.6	1.2	1.2	-3.58**
Beans acreage	1.2	0.7		-2.25**
Groundnuts acreage	1.6	1.2		-2.59**
Green grams acreage	1.1	0.9		-0.66
Cowpea growing experience (Years)	15	11	12.3	-2.53**
Growing frequency per year	2	1	1.5	-4.42***

T test values *. **, *** denote significance at 10%, 5% and 1%

4.2.2 Land tenure system

The predominant system of land holding in all the study districts was the customary type of tenure where the land is owned by the community or clan and individuals have user rights over the land and there is no significant difference in the land tenure system table 2.

The LRA conflict made desert their homes to live in IDPs, a situation that resulted in land conflicts caused by: People forcibly leaving their land for long periods which made it difficult, on return to trace their land demarcations like anthills; Greedy people taking advantage of the conflict situation to acquire land titles at the expense of local communities who have been using the land, denying the communities both ownership and user rights; Disregard of cultural values that traditionally have settled land wrangles in Acholi land; The Possible solution is to strengthen traditional institutions to participate in settling land conflict issues PMA, (2009).

Table 2: Land tenure system in Eastern and Northern Uganda

Characteristic	**Eastern %(n=211)**	**Northern %(n=91)**	**Overall**	***Chi-square***
Owned/titled	13.3	6.6	10.0	14.4
Customary	80.6	84.6	81.0	
Hired/leased	7.1	8.8	16.0	

*. **, *** denote significance at 10%, 5% and 1%

However despite its advantage in terms of ease of access, the main disadvantage of the customary system is environmental in that it may result into "the tragedy of the commons" with farmers investing little on soil fertility and over utilizing what they have leading to soil erosion and degradation.

4.2.3 Reasons for growing cowpea

The majority (70.4%) and (73.6%) of the farmers grow cowpeas for both income and food in while only 24.4% and 17.6% grow cowpeas for food security and only 1.4% and 7.7% grow it for income in eastern and northern regions respectively with a significant difference table 3. Farmers also stated that cowpeas is grown because of its multi-purpose use considering leaves and seeds, in different times of the cultivation period, was considerably important. This demonstrates that there is a potential in developing multi-purpose varieties with good performance, which are well-yielding in both leaves and seeds. It is therefore important to breed varieties which are high-yielding and that can be cultivated throughout the year, thus, small-scale farmers would benefit the most. Moreover, farmers were interested in early-maturing varieties that allow for multiple harvesting over a long production cycle.

The farmers interviewed were very much aware of health benefits in consuming cowpea leaves. Especially the important supply of vitamins, which strengthens their immunity and the improvement of their vision and blood were notably important. These results indicate an existing awareness from the farmers' side. Nevertheless, further promotion activities are needed to broaden the knowledge of health benefits by consuming cowpea leaves.

Table 3: Farmers' reasons for growing cowpea in Eastern and Northern Uganda

Reason	**Eastern %(n=213)**	**Northern %(n=91)**	**Overall**	***Chi-square***
Source of food security	24.4	17.6	22.4	10.7**
Both income and food	70.4	73.6	70.9	
Source of Income	1.4	7.7	3.3	
Cultural	3.3	1.1	2.6	
Both income & food/Cultural	0.5	0.0	0.3	

*. **, *** denote significance at 10%, 5% and 1%

4.2.4 Extension Services

The majority (80.1%) of the farmers had not received any training while only 19.9% had received training on crop production. Farmers in the study area 43% and 27.3% reported accessing extension services from service providers under the National Agricultural Advisory Service programme (NAADS), 31.7% and 0% from research station mainly arapi in eastern region, 2.4% and 54.5% from NGOs in eastern and northern region with a significant difference at 5%.

Table 4: Training Sources for cowpea farmers in northern and eastern Uganda

Sources	Eastern %(n=42)	Northern %(n=19)	Overall	Chi-square
NAADS	43.9	27.3	39.4	33.86**
Research station	31.7	0.0	21.5	
NGOs	2.4	54.5	17.4	
Farmer field schools	14.6	0.0	12.1	
Other farmers	5.0	9.1	5.8	
District Community Development	0.0	9.1	1.9	
Arapai Students	2.4	0.0	1.9	

*. **, *** denote significance at 10%, 5% and 1%

The frequency with which a farmer accesses extension service is of paramount importance because it is through extension that farmers get information on new farming practises and technologies with improves on crop productivity. This assertion is supported in the research work by Dankyii *et al* (2006) in Ghana where they report that farmers contact with extension agents were one of the key factors in their adoption of improved cowpea technologies efficient. They conclude that an efficient extension system is key to effective transfer and adoption of technologies by farmers. Table 5 shows the number of times extension officers visited farmers

Table 5: Frequency of extension visits to cowpea farmers in Eastern and Northern Uganda

Frequency	Eastern %(n=95)	Northern %(n=20)	Overall	Chi-square
Monthly	11.6	15.0	12.2	9.38
Once a season	6.3	10.0	7.0	
Never at all	52.6	25.0	47.8	
When necessary	8.4	20.0	10.4	
Rarely	13.7	30.0	16.5	
Once a week	4.2	0.0	3.5	
Frequently	3.2	0.0	2.6	

The study showed that 52.6% and 25% of farmers in eastern and northern regions respectively had never got any extension visit at all while of those who were visited, only 3.2% of farmers in eastern region received frequent visits by the extension agents.

4.2.5 Cropping systems

Given its short maturity period, cowpea is a crop suited for growing every season. Approximately 80% of the farmers grew the crop every season while only 20% grew it once. Farmers practice three types of cropping systems or a mixture of systems. These included mainly sole cropping (49%) in eastern region while intercropping (55.7%) in northern region with no significant difference table 6.

Table 6 : Cowpea cropping system in northern and eastern Uganda

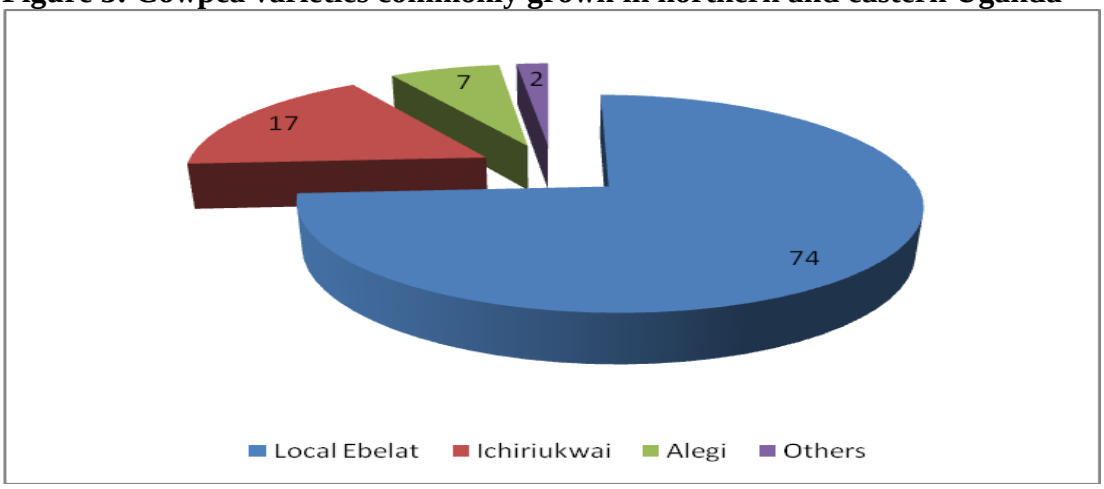
Cropping system	Eastern %(n=200)	Northern %(n=88)	Overall	*Chi-square*
Sole crop	49.0	36.4	45.1	7.15
Intercrop	46.0	55.7	49.0	
Rotational	3.0	2.3	2.8	
Intercrop & Rotational	1.0	1.1	1.0	
Sole crop/Intercrop	1.0	4.6	2.1	

Farmers intercropped their cowpea with other crops. The major cowpea intercrops in order of importance were maize, cassava, beans, sorghum, green grams, simsim and citrus. In addition, farmers in the surveyed areas generally grew a number of crops in addition to cowpeas. These included in order of importance, Cassava, Sweet potato, Ground nuts, Maize ,sorghum, millet, beans, simsim, Green gram, Rice, cotton, tomatoes, soya, green pea, sunflower, pigeon peas, citrus and cabbage.

4.2.6 Cowpea varieties grown

Farmers in the studied districts generally grew a number of varieties. Approximately 74% of the farmers grew local Ebelat variety (Erect) compared to 17% growing Ichiriukwai (Spreading type) figure 3.

Figure 3: Cowpea varieties commonly grown in northern and eastern Uganda



Only 7% grew Alegi variety. Alegi variety was exclusively grown in Lira and Pader districts while Ebelat and Ichirikukwa were grown in Kumi and Soroti districts. Other varieties grown by a few farmers included Ekowo, Ekutukwap, Large white and Kenyan Black beauty. Ichirikukwai and Ebelat cowpea cultivars are local farmer preferred varieties that have been grown for long especially in eastern Uganda but that are susceptible to diseases (Karungi

2005). The variety released by Makerere University Cowpea research project in the 1990s, MU 93, was not reported by any of the farmers though disease resistant. This implies a need to breed for new cowpea varieties which are resistant to the diseases.

4.2.7 Gender aspects in Cowpea Production

Gender issues are important in Uganda's farming systems. In cowpea growing districts, there is a gender differentiation in the various cowpea production and marketing activities. Land clearing is dominated by the men who own most of the land and are heads of the family. The selling of products is another gender differentiated task with men selling the grains and women selling the leaves. These differences are summarized in Table 7.

Table 7: Gender participation in cowpea production in Eastern and Northern Uganda

Activity	***Percentage of farmers citing gender participating in the activity***					
	Women	Men	Both	Children	Women & Children	All Family
Clearing land	12.8	38.0	17.5			
Planting	19.3	30	23.3			7.3
Weeding	28.8					
Harvesting	23.2		25.6		6.8	25.5
Threshing	79.3	0.7	9.1	0.4	7.3	0.4
Drying	76	1.7	8.4			2.7
Storage						
Selling grain	35.7	39	20.2		3.3	
Selling Leaves	80.4	8.4	3.7			

*Table do not add to 100% due to multiple responses

The processing of grain prior to sale is primarily the work of women. This comprises the work of threshing and drying. Traditionally, land ploughing was done mostly by Oxen traction in northern region, but with the LRA insurgency, production was abandoned since the population was living in IDPs camps and most of their oxen were either looted or killed. The dominant implements used to clear and till the land are slashers, pangas and hand hoes and its labour is shared between men and women but with men predominantly ding land clearing. The common practice is communal cultivation and sharing of all subsequent husbandry activities (weeding, harvesting, threshing and winnowing), through household labour groupings known as '*wang tic*' in Lira. This practice, while building social capital, has a weakness of inefficiency and a socio-cultural approach to agricultural development as opposed to the business approach required in commercialising smallholder agriculture (PMA, 2009). In northern Uganda, there also exists the practice of using ox-ploughs and tractors in cultivating the land, mostly on hire basis as few people are able to raise the capital required to purchase ox-ploughs. The mean cost of opening land was 72,601shs/acre.

Planting was mainly done by both men and women with a significant percentage of men. The planting method ranges from row planting to broadcasting, 6.2% of the farmers used row method while 93.8% broadcasted directly into the garden. The common practice in the study area is broadcasting because it is fast and easy, reduces labour demand and farmers consider it as a custom. While a few farmers said that they used row planting because it yields more, easy to weed and spray and also it requires fewer seeds. At the time of the field survey, mean planting costs was 30932shs/acre.

Weeds are a major bottleneck in cowpea production. Weeds are the fourth largest problem the farmers face, following price fluctuations. Weeds are a serious problem in cowpea production and, if not well managed, can harbor pests and reduce both the yield and the quality of the grain. Fodder yield can also be reduced. Cowpea is not a strong competitor with weeds, especially at the early stage of growth. The type of weed control measures adopted should be based on the nature of the problem and the resources available to the farmer. Weed control in cowpea could be during pre-planting and either manual or chemical. It is time consuming/labour intensive and is done twice in a season. Labour costs for weeding are high with a mean of 31643 Shs/acre. The task is predominantly by hand hoe and is done by women since in most cases men shy away from this activity. Row planted cowpea is easier to weed and farmer's own experiences have shown that row planting brings about plant vigour making cowpea to spread, which suppresses weeds.

All family members do carry out harvesting but it is predominantly done by women and children. There are no mechanical harvesters available at smallholder farmer level. After threshing, the straw is used as mulch in subsequent crops. Mean harvesting costs was 28507 Shs/acre.

Women predominantly do threshing although the activity is done by the whole family. Women manually do threshing immediately after harvesting when the crop is dry. The common practice is hitting cowpea on tarpaulins or hard ground surface with sticks to separate the cowpea grains from straw. In some cases, the women gently hit the cowpea against a log of wood to avoid breakages especially when preparing the cowpea as planting seed. The mechanical threshers are simple and can be operated by women.

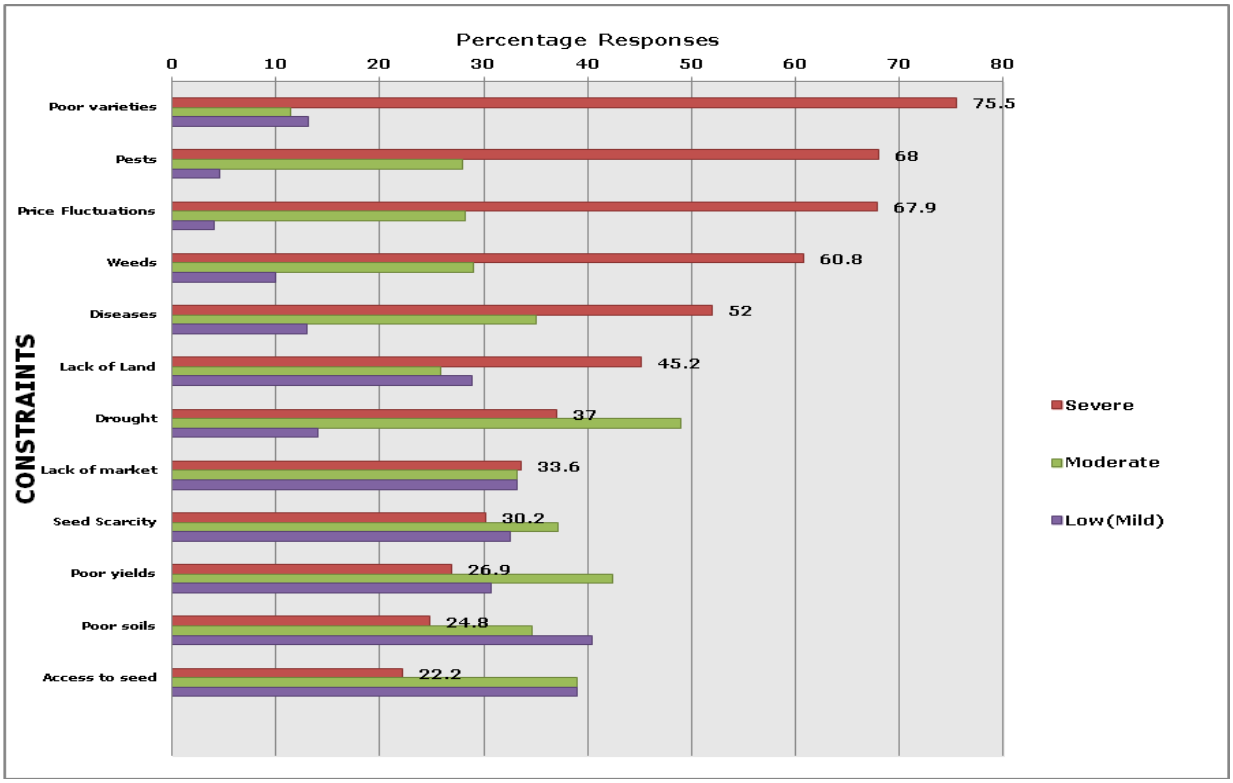
This would save on women's already over burned labour. Although these threshers require significant initial capital investment, they have low operational costs.

4.2.8 Production constraints and managements

4.2.9 Farmer's perception of Severity of Cowpea Production Constraints

Cowpea production has been hampered by a number of constraints. Farmers were asked to indicate the severity of each of these constraints. The results presented in Figure 4 indicate the proportional of farmers level of severity for each constraint that is; pests, diseases, poor varieties, low market prices and price fluctuations as the most severe constraints to cowpea production. Among all these constraints, farmers viewed poor varieties, pest infestation and price fluctuations as most severe.

Figure 4: Production constraints and level of severity of cowpea farmers in Eastern and Northern Uganda



Drought was one of the constraints faced by farmers. This is probably because Uganda experiences wide variability in climate and the country is susceptible to flood and drought events both of which have had a negative effect on yield. The country suffered some of the worst floods in parts of the Eastern and Northern regions in 2007; this was followed by prolonged intervals of drought and spatial rains in 2008 and 2009. These events have been hard hitting to Uganda's economy and resulted in increased migration levels among pastoral communities which in turn have caused ethnic tensions in the Eastern, North eastern and Northern parts of the country. The 2007 flooding resulted in widespread loss of livelihood assets, infrastructure damage, and displacements of persons leaving 1.8-2 million people, especially women children and elderly exposed to malnutrition, illness and poverty. It also triggered a wave of migrations by the youth from rural to urban areas in search of petty jobs and the women and elderly into settlement camps with the hope of accessing humanitarian aid.

Poor soil fertility and agronomic management was another problem, due to lack of technical skills in soil and water conservation and cowpea agronomy; Lack of improved varieties since 75.5% of farmers cited poor varieties and modern inputs, partly due to unavailability of inputs especially fertilizers and partly due to lack of investment finance at farm level.

Price fluctuation was among the major problems and the level of severity was 67.9%. The average cost of cowpea was 1720 Shs/kg with standard deviation of 977.8 Shs, price ranged between 1000 Shs/kg to maximum 3500 Shs/kg. The prices fluctuated mainly because of the weather, depending on the rainy and dry seasons, the supply of cowpeas to the markets which was dependent on price, pests and diseases.

Generally 60.8% of the farmers cited weeds as a severe problem in cowpea production and price fluctuations of cowpeas was cited to be 67.9% and this act as a disincentive to production and this is due to the changes in the consumption patterns in the Uganda.

Farmers also cited pest attacks as a serious problem affecting production of cowpeas. Among the major pests cited were aphids (67%), pod suckers (51%), weevils (49%), and thrips (13%). This has important implications for the breeding work to be undertaken.

Damage by insect pests on cowpea can be as high as 80–100% if not effectively controlled. Dugje *et al* (2009) stated that cowpea pests can be classified into three major groups: pre-flowering, flowering/post-flowering, and storage. The crop is severely attacked at every stage of its growth by a myriad insect that make the use of tolerant varieties and insecticide sprays imperative. The pests and disease attack cowpeas, 73.0% and 85.0% of farmers in eastern and northern regions respectively cited that leaves are the most attacked followed by pods with a statistically significant difference table 8.

Table 8: Part of Cowpea plant attacked by Pests and Diseases in Eastern and Northern Uganda

Part	Eastern (n=196)	Northern (n=80)	Overall	Chi-square
Seed	4.6	2.8	2.1	101.67***
Pods	8.0	6.5	6.7	
Leaves	73.0	85.0	80.2	
Stems	3.1	1.8	1.5	
Roots	6.1	4.0	5.3	
Flowers	5.4	0.0	4.3	

*. **, *** denote significance at 10%, 5% and 1%

Aphids not only cause direct damage to the cowpea plant but also act as a vector in transmitting of *Cowpea aphid*-borne mosaic *virus*. The aphid damages young cowpea seedlings by sucking sap from the undersurface of young leaves and stem tissues, and on the

pods of mature plants. They are frequently responsible for total crop loss. The adult thrips are very tiny black insects, and are found feeding on flower buds and flowers. Severely infested plants do not produce any flowers. When the population of thrips is very high, open flowers are distorted and discolored. Flower buds and flowers fall prematurely without forming any pod. A similar study by Dugje *et al* (2009) found out that pod suckers causes yield losses varying from 30 to 70%. Farmers in both regions stated that pod suckers suck the sap from green pods, causing them to shrivel and dry prematurely, resulting in seed loss.

Cowpea disease was cited by 52% of farmers as a severe problem. These diseases include fungal, bacterial and viral diseases. Different diseases affect different parts of the crop at different stages of growth. The major and common diseases are anthracnose, *Sclerotium* stem, root *Fusarium wilt*, and scab. Control measures used by farmers are shown in table 9.

Table 9: Control Measures of Diseases and Pests practised by farmers in Eastern and Northern Uganda

Part	Eastern %(n=184)	Northern %(n=47)	Overall	Chi-square
Early planting	3.7	16.0	7.2	138.98***
Traditional	1.0	18.6	3.0	
Uprooting	0.0	22.6	5.0	
Spraying	90.6	34.1	80.0	
Inter-cropping	1.7	4.3	2.8	
Crop rotation	3.0	3.2	2.0	
Use of resistant varieties	0.0	1.2	0.8	

*. **, *** denote significance at 10%, 5% and 1%

Generally, 90.6% and 34.1% of farmers in eastern and northern region respectively did spray the infected plants, followed by 3.7% and 16.0% in eastern and northern regions who planted early, 22.6% of farmers in northern region do uproot the infected plants, 18.6% use traditional methods in northern region with only 1% of farmers in eastern region and only

1.2% of farmers used resistant varieties in northern region. Low use of resistant varieties by farmers is because they are not easily accessible to them. Farmers in northern region practiced all the methods because of the extension services in the northern region compared to eastern region partly because of the many NGOs in northern region which have trained farmer's modern farming practices.

4.3 Farmer preference for Cowpea varieties

Breeding improved cowpea varieties that will be adopted by smallholder farmers requires knowledge of farmer preferences for particular traits and factors. Farmers preferences for a given crop variety are based on a number of factors including leaf texture, seed color, cookability, high leaf yield, high grain yield size and early maturity.

In order to establish their preferred cowpea traits, farmers were asked to mention their main preferred attributes of cowpea varieties or seeds (Table. 10). In this study, farmers preferred *Ebelat* variety compared to the *Ichirikukwai*. Leaf texture was considered important by farmers for both *Ebelat* and *Ichirikukwai,* and significant at 1% and 5% levels of significant. Seed color was preferred by farmers and significant at 1% and 5% levels of significant, seed color is found important for farmers to grow a given variety and this result is consistent to a studies by Dankyi et al (2006) for example found that consumers in Ghana preferred white varieties because they are attractive, Mundual, (2010) stated that grain color was important in determining consumers' willingness to pay, 217.8%, for *Icirikukwai, and* 232.6% for *Ebalat* for, a white to brown seed color. Further studies by Watters *et al.*, (2002) and Adipala *et al*., (2002) all found out that farmers preference for grain color plays crucial role in first impression and evaluation of market, local consumption and selection of what to grow for export.

Cookability was also found to be preferred by farmers and had a statically significant difference at 5% level, this is similar to a studies by Dankyi et al (2006) found that consumers in Ghana preferred white varieties because they are cooked faster, Langyintuo *et al*., (2004) also on consumer preference for cowpeas in Cameroon and Ghana revealed that consumer tastes and preferences are reflected in the market through price discounts and premiums that consumers pay for visible grain characteristics. In some cases, these visible indicators are proxies for some biochemical characteristic, such as cooking time, sucrose level or protein content. In other cases, the visible characteristics are directly related to the way cowpeas are used in food preparation.

Table 10: Farmer preferred attributes for the commonly grown varieties in Eastern and Northern Uganda

Farmer variety preferred traits	**Varieties grown**			
	Ebelat **(%)**	***Ichirikukwai*** **(%)**	**Both (%)**	**Chi-square**
Leaf texture	82.6	9.4	8.0	88.8***
Grain texture	87.0	5.8	5.2	2.64
Seed color	87.0	3.8	9.2	9.72***
Grain size	86.7	4.4	8.9	2.68
Stores long	72.7	16.7	10.7	1.03
Cookability	84.0	5.3	10.7	15.95***
Drought resistance	77.3	12.1	10.6	3.49
Pest resistance	74.5	13.7	11.8	3.24
Disease resistance	73.3	11.1	15.6	1.33
High leaf yield	90.1	2.3	7.6	15.04***
High grain yield	87.2	3.8	9.0	7.20**
Early maturity	84.8	5.7	9.6	14.79***

*. **, *** denote significance at 10%, 5% and 1%

Furthermore the high leaf yield was statically significant at 1 % level. It shows the high potential of cowpea leaves for these purposes and, thus, more research, breeding and promotion activities are necessary. The results support earlier research by Chweya and Eyzaguirre (1999) who pointed out the importance of the multi-purpose use of cowpea.

High grain yield was statically significant at 5 % level and farmers who preferred *Ichirikukwai* and *Ebelat* did so due to their potential to yield grain highly its smooth leaf texture, cookability and early maturity. Also Whitbread and Lawrence (2006) described cowpea as one of the most important tropical dual-purpose legumes, being used as leafy vegetable, grain, as fresh cut-and-carry forage, and for hay and silage, which Barrett (1990) similarly highlighted, especially for eastern and southern Africa.

Farmers also preferred *Ebelat* and *Ichirikukwai* because they are early maturing in addition Kitch *et al*., (1998) indicated that farmers seek varieties with particular traits, such as large white seeds that command a premium price. Coulibaly and Lowenberg (2002), on the other hand, observed that market studies are useful in indicating varieties with characteristics preferred by consumers, which sell for a premium price.

4.4 Cowpea marketing and integration of cowpea markets

4.4.1 Cowpea marketing

Cowpea marketing dynamics are important in enabling breeders to select for characteristics which are preferred by consumers. The majority (67.3%) and (53.7%) of farmers sold their cowpeas in the local markets, 21.6% and 7.3% to the nearby local trading centre, 11.1% and 34.2% sold from their farms in eastern and northern regions respectively with a significant

difference while 1.2% from the seed fair, 2.4 from the Road side and only 1.2% sold to NGOs in northern region table 11.

Table 11: Market outlets used by cowpea farmers in Eastern and Northern Uganda

Market outlet	Eastern %(n=153)	Northern %(n=82)	Overall	Chi-square
Farm gate	11.1	34.2	19.0	55.20***
Local market	67.3	53.7	81.0	
Local trading centre	21.6	7.3	21.3	
Seed fair	0.0	1.2	1.6	
Road side	0.0	2.4	1.3	
NGO	0.0	1.2	0.4	

*. **, *** denote significance at 10%, 5% and 1%

The major forms in which cowpea was sold in the markets by framers were four. These included; Dry leaves, whole grain, Split grain and Fresh leaves. As can be discerned form the tables, the majority of farmers (79.5%) and (80.2%) sold their cowpea in form of whole dry grain, followed by fresh leaves (18.0%) and (17.4%) in eastern and northern region respectively with a statistically significant difference at all levels table 12. As observed, part for split grain , virtually no further value addition is done to the cowpea grain by farmers thereby limiting what they could earn form the produce.

Table 12: Forms in which Cowpea is sold in Eastern and Northern Uganda

Form cowpea is sold	Eastern %(n=184)	Northern %(n=47)	Overall	Chi-square
Fresh Leaves	18.0	17.4	36.6	88.15***
Whole Dried grain	79.5	80.2	89.2	
Split Dry grain	1.9	1.2	5.0	
Dry Leaves	0.6	1.2	7.8	

*. **, *** denote significance at 10%, 5% and 1%

The study found that farmers obtained market information regarding prices of cowpeas from traders, fellow farmers, neighbours, radio, NAADS and from the markets, were the main sources through which farmers were getting price information. Traders were the main source of market prices through which 54.2% farmers received price information, 40.2% of farmers received price information from fellow farmers, 23.6% received from neighbours, 22.4% reported that they received price information through use of radio, 2.4% obtained information from NAADS and 1.6% of the farmers received information from physical visits to the markets.

4.4.2 Marketing Constraints

Being a minor crop, farmers face a number of constraints in marketing cowpea. The majority of farmers reported low prices (72.4%) and (70.7%) in eastern and northern region respectively followed by storage pests (12%) in eastern as well as 10% in the northern region with a significant deference at 5% as the most common pressing constraints table 13.

Table 13: Major marketing constraint faced by cowpea farmers in Eastern and Northern Uganda

Marketing constraint	Eastern %(n=126)	Northern %(n=94)	Overall	Chi square
Low prices	72.4	70.7	72.4	34.27**
Oversupply	5.2	8.0	45.2	
Packaging	3.0	1.3	5.0	
Distances to Market	6.2	8.6	36.2	
Storage pests	12.0	10.0	11.8	
Others	1.2	1.4	3.2	

*. **, *** denote significance at 10%, 5% and 1%

Results from the survey indicated that on average farmers sold cowpeas grain at 1720 shs/kg and 66.3% of the farmers mainly sold them in local markets. In order to understand the link between the local markets and other markets in trading cowpeas, market integration of cowpeas was studied in the next section 4.4.3.

4.4.3 Market integration of Cowpea grain

This section shows how different cowpea markets in Uganda are interrelated across space. The following discussion is important since data on storage and processing cost were not collected and was not available at the National Statistic Services. Weekly wholesale prices for cowpeas collected from 2008 to 2011 by the Fit (U) Ltd were used. Data were collected from Kampala, a major consumption area in Uganda, Soroti and Lira that are transition zones from producing to consumption areas. The descriptive statistics of the data used are summarized in table 14.

Table 14: Average Weekly Cowpea Prices in Shs/kg: 2008-2011

Market	*Mean (n=136)*	*Std.Deviation*	*Minimum*	*Maximum*
Kampala	2153.4	368.2	1725.0	3191.7
Lira	1542.9	392.5	866.7	2766.7
Soroti	1171.8	346.8	716.7	2833.3

Source: Fit (U) Ltd, 2012

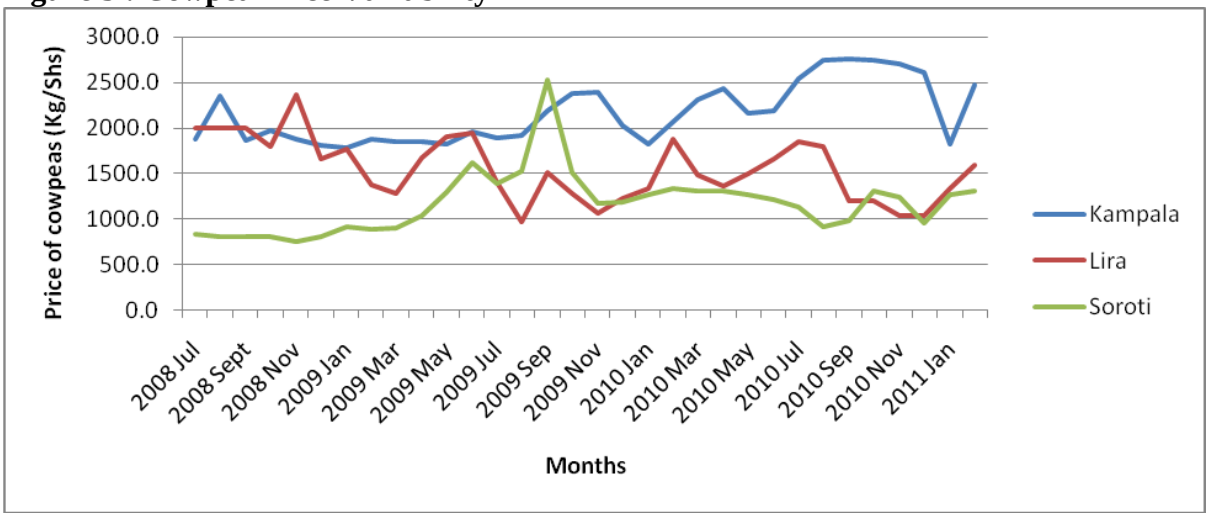
In total, 136 observations on prices were used to test for cowpea market integration. The mean price ranged from 1171.8 Shs/kg in Soroti to 2153.4 Shs/kg in Kampala. The highest and lowest prices were observed in Kampala and Soroti respectively. The lowest price in Soroti was due to the fact that as most of the farmers grew cowpeas, the demand for the grain was bound to be low within the district. Soroti is far from the central market for them to sell.

Hence information flow is likely to be slow and farmers also choose to sell at low price than incurring expensive transport costs to Kampala. While Kampala being the centre, price was highest due to the high demand of cowpeas in Kampala, since virtually no grain is produced here.

4.4.4 Cowpea grain prices

Monthly prices of cowpea collected from six urban markets in three districts (Soroti, Lira and Kampala) from July 2008 to April 2011 indicate seasonal variations (Fig. 5). As expected, the product is generally cheaper during the harvest period and immediately afterwards. There was a clear difference between the prices in different markets. Average cowpea prices ranged from 1250Shs/kg in December (harvest time) to 2100Shs/kg in April (lean period). Generally crop prices set their seasonal low at harvest followed by a post-harvest rally. Post-harvest rallies occur because the supply of the crop is fixed and consumption gradually uses up that supply, causing prices to rise. In terms of the price relationships between Kampala and other markets, Kampala appeared as the dominant market.

Figure 5 : Cowpea Price Variability



Source: Based on monthly price data collected by FIT Uganda

It is noted that there are some short run fluctuations for Soroti and Lira markets while in Kampala market the fluctuations are high and these markets exhibited a non-clear co-movement over time. The lower prices in Soroti and Lira were possibly due to the fact that both Soroti and Lira areas are production zones and therefore, information flow to these markets is very slow due to long distances and poor infrastructure like feeder roads and lack of storage facilities.

Prices for agricultural products in different markets are largely influenced by seasonality in production, fluctuations in production and the general economic growth within a country. As such price variability becomes a common phenomenon in agricultural outputs due to stochastic nature of the products. The stochastic nature of agricultural outputs is heavily linked to natural factors such as weather and economic factors such as structural transformation in markets, length of different marketing channels, transport and other marketing infrastructure. Demand factors such as consumer habits, substitution between products and per capita income also influence prices (Katengeza, 2009).

The consumers and other market participants can be affected by a host of daily events such as shocks that affect their behaviour and their response to prices. In turn their reactions have repercussions on other agents and the ensuing dynamic process leads to determination of prices at each point in time. As such it is of particular importance to understand the variability in prices over time and space in order to give an insight of price behaviour within the period of study.

4.4.5 The price correlation matrix

Correlation coefficients are preliminary tests for market integration (Mbene, 2005). The size of the correlation coefficients indicates the strength of the relationship between two markets whereby a large coefficient represents a strong relationship. Table 15 shows the bivariate correlation coefficients, which range between -0.31 and 0.15. The coefficients are very low indicating a weak relationship between Kampala, Lira and Soroti markets hence very weak market integration. The lowest correlation coefficient (-0.31) was observed between Kampala and Lira. For Lira, the low coefficients (-0.31 to -0.29) seem to be consistent with the hypothesis that long distances and poor transportation infrastructures make arbitrage unprofitable and isolate markets (Timmer, 1974). The probable reason would be the lack of information, the social class of people in terms of consumers preference, substation effect of related commodities like soya peas, beans and groundnuts and the low volume of cowpea consumed and traded.

Table 15: Price correlation matrix

Markets	Kampala	Soroti	Lira
Kampala	1.00		
Soroti	0.15	1.00	
Lira	-0.31	-0.29	1.00

Correlation coefficients however, are not a proof of market integration but rather are rough indicators of integration and efficiency. There have been criticisms against this approach by several authors such as Barrett (1996) and Negassa *et al.,* (2003) who argue that testing of market integration based on correlation coefficients of local prices mask presence of other synchronous factors such as general price inflation, seasonality and population growth among others.

As such Golleti *et. al.* (1995) argued that this problem could be overcome by computing correlation coefficients based on price differences since price differences would largely eliminate the technical problems related to spurious correlation arising from presence of common trends.

4.4.6 Stationarity result

The results, presented in table 16 indicated steps 1 as discussed earlier when using the co-integration test. At 1 per cent and 5 per cent levels of confidence, the t-values for integration were greater than the Augmented Dickey-Fuller critical values except for Lira and Kampala which are stationary [I(0)], implying that these markets are integrated. This implies that these markets did not share the common trend with Soroti market.

Table 16: Stationarity Results Using ADF

	LEVELS		***FIRST DIFFERENCE***		***CRITICAL VALUES***		
Market	**t-statistic**	**No. Lags**	**t-statistic**	**No. Lags**	**Order**	**1%**	**5%**
Lira	-3.78	1			I(0)	-3.15	-3.45
Kampala	-3.50	3			I(0)	-3.15	-3.45
Soroti	-2.32	2	-8.60	1	I(1)	-3.15	-3.45

The market which followed a random walk included Soroti. The Null at 1% and 5 %can't be rejected while Kampala and Lira have no UNIT ROOTs in their current original form. Thus the Null hypothesis at all levels was rejected and concluded that the series are stationary.

Soroti market was considered to be integrated of order one I(1) while results indicates that Lira and Kampala markets were stationary for cowpea price series at levels implying that there exists a long run equilibrium relationship between these markets and that the markets are integrated and spatially linked. The implication here is that prices of cowpea in these two markets move together for a long period of time.

Market integration amongst these markets could be adduced to proper and efficient use of market information flow from Kampala to Lira since Kampala is an upscale market the flow of information to and from is easy. Furthermore the integration is due to the flow of cowpeas from surplus region to the deficit areas hence cowpeas flow from Lira to Kampala. The storability of the cowpeas resulted into integration as stated by Debaniyu, (2013) in which he reported that, the possibility of traders being able to store their products, avails them the opportunity of obtaining reliable information about prices and demand between markets thus promoting integration between markets.

These results indicate an improvement in spatial cowpea market integration in Uganda in the years following the end of the civil war in the Northern. However, this improvement cannot be attributed to peace alone as market integration is a function of so many factors. For example, Goletti *et.al.,* (1995) observed that marketing infrastructure (e.g. roads and communication), volatility of government intervention, and the degree of self-sufficiency in production are the major determinants of market integration.

Kampala and Lira markets were considered to be integrated of I(0) hence confirmed to be co-integrated. It can be concluded from this results that Cowpea markets have a co-integrating relationship with markets in the production and consumption regions, indicating that market participants in this market are well informed about price changes and adapt variously to it. Results further show that Kampala is not co- integrated to Soroti. Traders in Soroti engage in trade with the neighbouring countries like Kenya and South Sudan. Also the lack of co-integration could be attributed to lack of proper and well-functioning infrastructure such as roads means that it is difficult to transfer the commodity from surplus regions to deficit areas. This also masks the presence of high transaction costs which is a key factor in efficient

arbitrage conditions (Uchezuba, 2005). In addition Teravaninthon and Raballand (2009) list the ways that poor roads increase transport costs: higher fuel consumption, higher maintenance costs, faster depreciation of vehicles, tire replacement costs, and lost time due to lower speeds. Several studies have quantified the effect of road quality on transport costs and market integration.

4.5 Granger Causality

In order to determine whether there are any causal relationships in prices among co integrated markets, Granger causality test was carried out and results presented in table 17.

Table 17: Causality results for markets

Number of lags	***Market i***	***Market j***	β_i	P_i***-value***	β_j	P_j***-vale***	**Direction of Causality**
	Lira	Kampala					Independent
1.			-0.03	0.804	0. **037**	0.349	
2.			-0.10	0.450			
3.			-0.09	0.474			

P value =0.05

Results indicate no causality implying Independent causation between markets of Kampala and Lira these markets do not depend on each other, meaning that prices in one market do not react to any deviation or changes of price in the other market from its equilibrium path.

It is concluded that there is no leading market whose price changes influences all other markets as presented in the Granger causality results, revealed that price changes of cowpea in the markets studied are organized around more than one market. This is similar with the nature of markets in Developing countries, where markets are usually more complex than is portrayed by the Ravallion radial configuration of markets.

Co-integration between two variables was proposed by Granger (1986), as indicative of the existence of causality between them. Additionally, if two markets are integrated, the price in one market would be found to have an impact on the price in the other market. The independent causality from the results of Granger causality tests are non consistent with such a statement. On the other hand, lack of Granger causality may not imply an absence of transmission, as price signals may be transmitted instantaneously under special circumstances, which are expected for a staple food commodity like cowpeas (Abdulai, 2006).

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

In realizing the potential of cowpeas as an alternative cash crop in the two regions, McKnight Foundation supported the Cowpea breeding program to improve food security in the region. To achieve this, farmer's preference of cowpeas and production constraints of cowpeas were identified since in the past two decades no research program had been carried out focusing on; breeding and dissemination of early maturing and high yielding varieties of cowpea to improve production and promote cowpea marketing. Whereas the cowpea programs implemented in Uganda have focused only on the supply side to ensure enhanced productivity, there is need to understand how these cowpea markets work. Lack of market information in many African countries as highlighted by Van der Laan (1999) is principally because marketing research has focused on export crops such as cotton, coffee, cocoa and groundnut and to a lesser extent cereals.

Furthermore, the major producing areas have been under political unrest and are recuperating from long-term insurgency for the past two decades resulting into the destruction of infrastructures, government programmes and loss of life. These are among the factors that affect the ways markets for various crops are integrated

The recent move towards market reform in most developing countries has renewed an interest in the working of agricultural markets as a source of income, employment and food security. The success of the reform process in promoting equity and efficiency is constrained by numerous structural deficiencies in local markets. One of the main consequences of these

structural deficiencies is poor market integration resulting into difficulty with which information and trade flows among spatially separated markets (Goletti *et al.,* 1995). Among other things, the reform process needs to take into account the extent of agricultural market integration. However research on cowpea variety improvement and market performance has not received much attention in the last two decades within the two regions. Little is known about how the agricultural markets, especially for staple foods are performing in recent years and whether they are integrated or not.

This study was therefore conducted to gain a better understanding of cowpea market integration which is necessary to enhance production, improve market efficiency and competitiveness which are essential for cowpea market development.

The main objective of the study was to determine farmer preferred cowpea attributes and the extent of integration in Uganda's Cowpea market system with specific objective to determine; farmer preferred attributes of cowpea, the existence and level of inter-market cowpea price dependencies and examine the causal relationships among spatial locations of cowpea markets.

The hypotheses tested were cowpea markets are integrated and there is a causal relationship between cowpea markets. Several approaches were used to investigate the degree of cowpea market integration in Uganda, bivariate correlation coefficients, co-integration and Granger-Causality tests were used to account for the complex interactions of prices in different markets.

Cowpea remains to be an important legume in the three ecological zones of Uganda. However access to improved seed, attack by pests and diseases both in field and in storage, price fluctuations has constrained farmer's production and productivity of this important legume. Farmers have continued to grow the local varieties which are susceptible to diseases and pests and therefore persistently realize low yields. Among the major pests cited by farmers were aphids (67%), pod suckers (51%), weevils (49%), and thrips (13%).

Results show that farmers prefer attributes which include smooth leaf texture, high leaf yield, grain color, high grain yield and early maturity. Producers ranked *Ebelat* as the leading variety, followed by *Ichirikukwai*.

Kampala being the central market had the highest mean cowpea grain price of 2153.4Shs/kg while Soroti had the lowest price 1171.8Shs/kg for the entire 136 weeks of the price data collected.

The extent of Ugandan cowpea market integration has improved in recent years, northern continue to exhibit integration to the dominant markets in the Kampala. While Soroti did not exhibit market integration with Kampala and, this can be attributed to the fact that traders in this district engage in trade with the neighboring countries like Kenya and South Sudan. In addition to transportation cost, lack of an efficient information flow system resulted into lack of market integration between Soroti and Kampala.

No dominant market for cowpeas was found, that is no leading market whose price changes influences all other markets since price changes of cowpea in the markets studied are organized around more than one market and are independent.

5.2 CONCLUSIONS

Cowpeas remain an important legume in the three ecological zones of Uganda. However access to improved seed, attacks by pests and diseases both in field and in storage, price fluctuations have constrained farmer's production and productivity of this important legume. Farmers have continued to grow the local varieties which are susceptible to diseases and pests and therefore persistently release low yields. Among the major pests cited were aphids, pod suckers and weevils.

Farmers preferred smooth leaf texture, high leaf yield, grain color, high grain yield, pest and disease resistant. Producers ranked *Ebelat* as the leading variety, followed by *Ichirikukwai*.

Prices in different markets are not equally responsive to changes in the supply of cowpeas, thus cowpea markets in Uganda as a whole are not fully integrated. This is not a surprising result since it can be linked to the consumer habits, transport costs and general lack of market information.

There is no leading market whose price changes influences all other markets since price changes of cowpea in the markets studied are organized around more than one market. This is similar with the nature of markets in Developing countries, where markets are usually more complex than is portrayed by the Ravallion radial configuration of markets.

5.3 RECOMMENDATIONS

Cowpea breeding work therefore needs to take into account the farmer preferred attributes like grain color, cookability, high grain yield, leaf texture, and high leaf yield as the main characteristics since farmers are more concerned with these when improving the local varieties mainly *Ebelat* and *Ichirikukwai*.

To address production constraints, cowpea agronomic information should be packaged and availed to extension staffs that often have a good outreach to farmers.

To realize the potential of cowpea, infrastructure and accessibility to markets have to be improved. There is need to improve on paved road density, telephone density so as to easy flow of goods and information hence improving cowpea market integration.

There is need to improve on provision of market information on price dissemination to all actors. This can be through improving information access through media information, agricultural shows and forming an efficient information system.

Following the results from this study, two further studies need to be done. Firstly, there is need to empirically test all the hypothesized factors affecting market integration of cowpeas in Uganda. Such a study will need to use annual data that is still difficult to get. Secondly, there is need to analyze the value chain of cowpea in Uganda to map all products, consumption patterns, actors and possible products along the chain in order to fully under standard the flow of cowpea in the domestic market and to regional markets.

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***APPENDIX A**: Questionnaire on Farmer Preferences and Production Constrains in Uganda*

MCKNIGHT COWPEA BASELINE SURVEY QUESTIONNAIRE

INTRODUCTION

Hello, my name is …….. and I am working on the baseline survey of cowpea in the districts of Kumi, Soroti, lira and Pader. We are researchers from Makerere University**.**

You have been randomly selected as one of the farmers where the project will be implemented to participate in this survey. This will not take much of your time. This study will assess respondents existing knowledge, attitude and practices related to cowpea production, consumption and marketing. Information collected will help us to better design the project activities for farmers in this area. Your answers will be kept confidential and your participation is voluntary.

May I begin the interview now?

Name of Interviewer ……

Date……..

LOCATION

1. Region ……. 1) Eastern 2) Northern
2. District…… 1) Pader 2) Lira 3)Soroti 4) Kumi
3. County …….
4. Sub county…….....
5. Parish…….
6. Village……
7. GPS Coordinates……...

SOCIO-DEMOGRAPHICS

8. Gender of Farmer

   1) Male 2) Female
9. Type of Farmer

   1) Small Scale 2) Medium scale 3) Large scale
10. Age of Farmer ……..
11. Marital Status

    1) Single 2) Married 3)Divorced 4) Separated
12. How many members are in your household including yourself……..
13. Number of years of completed education……
14. Which of the following options best describes your income level from various sources per month

    1. Less than 100,000 2. 301,000 to 400,000 3. 501,000 to 600,000

    4. 101,000 to 201,000 5. 401,000 to 500,000 6. 601,000 t0 700,000

7. 701,000 to 800,000 8. 801,000 to 900,000 9. 901,000 to 1million

10. Over 1 million Shs

PRODUCTION ASPECTS

15. Type of land ownership

1. Own Titled Land 3. Customary land

2. Hired 4. Leasehold 5. Other(Specify……

16. Overall cultivated Land Acreage ……..

17. Acreage of Cowpeas in various seasons

Last Season ……This season……..

18. Apart from cowpea list major crops grown and their acreages

Crop	Acreage	Crop	Acreage

19. What Place does cowpea as a crop occupy in your households farming system

……

……

20. For how long have you been growing cowpea (Years)……..

21. Which part of cowpea is of interest to you

1. Grains 2. Leaves 3. Leaves & Grains 4. 1&2 5. 1&3 6. 2&3 7. 1-3

22. What type of Labor do you use in cowpea production

1) Family 2) Hired 3) Both

23. If hired labor was used what was the cost of labor in weeding and other farm operations/per Ha

Planting……. U Shs .

Weeding ……..U Shs

Harvesting…….U Shs

24. Under what cropping system do you grow cowpea

1) Sole Crop 2) Intercrop 3) Rotational

25. If cowpea is grown as intercrop what are common crop mixtures with cowpea

1). Cowpea/Millet 2). Cowpea/ sorghum 3) Others specify……..

26. Which one is the major intercrop……

27. How many seasons do you plant cowpea……..

28. How many times to you grow cowpea in a season……..

29. What varieties of cowpeas do you grow (local name in order of preference)?

Variety or local name	Acreage last season
Ebelat	

30.For each Cowpea variety grown what makes you prefer that variety (tick as appropriate)

preferred attribute / Variety	**Leaf Texture**	**Grain texture**	**Seed color**	**Grain size**	**Stores long**	**Cook Ability**	**Drought resistant**	**Pest resistant**	**Disease Resistant**	**High Leaf Yield**	**High Grain yield**	**Early maturity**
Ebelat												
Ichuriku kwai												

32. What is the source of cowpea seed you grow?

1. Own seed 2. Neighbor/Relatives 3. Seed company

4. Input dealer 5. Research Station 6. Gift

33. How readily available is the cowpea seed?

1. Easily available 2. Often in short supply

34. How long is the distance to the seed source from your home…….

35. If you bought cowpea seed planted what was the cost per kg

……

……

36. What method do you use for planting your cowpeas?

1. Broadcasting 2. Row planting

37. Why do you prefer that type of system?

……

…….....

……....

38. If planting is in rows, what spacing is used between row?

……

39. Did you receive any training regarding cowpea production?

1. Yes 2. No

40. What was the source of the training?

1. Farmer field schools 2. Research station 3. NGOs

4. NAADs 5. Other farmers 6. Others (Specify).....

41. Have you received any extension visits since you stated cowpea production?

1)Yes 2) No

42. Sources of Extension service received

1. Farmer field schools 2. Other farmers 3. NAADs

4. NGOs 5. Research station 6. Others……

43. How frequently do you receive extension visits?

1. Once a month
2. Once a season
3. Never at all
4. When necessary
5. Rarely

44. How far is the extension agent from your home…….

45. Are you a member of a Farmers associations or group?

1. Yes 2. No

46. If yes Name of group

……..

……..

47. What conditions are necessary to join the group……..

……

48. What benefits have you derived from belonging to the farmer Group?

1……

2……..

49. How many are you in the group by gender?

1) Male…… 2) Female……

50. Have you ever participated in a Cowpea research activity in the past?

1. Yes 2. No

51. If yes in what capacity

1. Gave part of my land
2. Participated in variety selection
3. Managed the trial
4. Demonstration farm
5. Gave seeds
6. Others…….

52. How many times did you participate?

…….

…….

53. Which project was it…….

54. What where the benefits

…….

…….

55. What Quantity of cowpeas did you harvest in last season……..kg

56. What Quantity of cowpeas grains did you sell last season?

Quantity Sold last season	Quantity consumed at home

GENDER ROLES

Who does each of the following activities in cowpea production in your household (Tick the boxes as appropriate)

Activity	Women	Men	Children	Youth	Reason why identified person performs activity
1.Clearing land					
2. planting					

3.weeding					
4. Harvesting					
5.Threshing					
6.Drying					
7.Marketing of grains					
8.Marketing of leaves					
9.Processing					
10. Marketing of Processed products					

MARKETING AND CONSUMPTION

57. What is the purpose for producing cowpea?

1. Income 2. Source of food security 3. Both

58. If you sell cowpea, in what form do you sell it?

1) Dry Leaves 2) Whole Grain 3) Split Grain 4) fresh leaves

59. Who sells the cowpea?

1) wife 2) Man 3) both

60. Where did you sell the cowpea?

1. Farm gate 4. Produce buyer in town 7.Other……..
2. Trading center 5. Local Market
3. Road side 6. Seed fair

61. How do you get information on cowpea prices?

1) Neighbours 3) Fellow farmers 5) Traders
2) Radio 4) NAADs

62. Price of cowpea per kg at sale last season

……

63. What major constraints do you experience in marketing your cowpea?

1) Low prices 2) Oversupply (lack of market)
3) Packaging 4) Distance to markets
5) Storage 6)

Others……

64. If you consume cowpea in your household, in what form(s) is it consumed

1) Dry Leaves 2) Whole Grain 3) Split Grain

4) Fresh leaves 5) Others ……

65. Frequency of eating cowpea in a week……

66. Which group consumes it most and why

Members	**Reason**
1) Children under 5 years ……	
2) Pregnant mothers …..……..	
3) Breast feeding mothers	...……...
4) Whole family ……	

67. Do you know of any health benefits associated with consumption of cowpea?

1. Yes 2. No

68. If yes mention them

……..

…….

69. Do you consider cowpea as a food that can help during periods of food shortage?

1. Yes 2.No

70. If yes why?

1. Harvest starts shortly 2. Production can be on limited land

3. Has early maturity 4. Drought tolerant

5. Others……

PRODUCTION CONSTRAINTS AND MANAGEMENTS

71. Do you experience pest or disease attacks on your cowpea crop

1) Yes 2) No

72. How do you call them, and could you describe them?

73. Which part do they attack?75. If yes tick the major pests you have noticed on your cowpea crop

1) Aphids 4) weevils

2) Thrips 5) Others (specify)……..

3) Pod suckers

74. Tick the major diseases

1) Viruses(leaf spot) 2) Bacterial 3) Fungal

75. Level of knowledge farmers has in terms of IPM

1) .....

2) .....

3) .....

76. What methods do you use for controlling pests and diseases?

1) Spray with chemicals 2) Use of traditional pesticides……..

3) Do crop rotation 4) intercropping 5) Resistant varieties

6) Early planting 7) Row planting 8) others…….

77. Major weeds

.....……

……..

78. How do you control the weeds?

1) Hand hoe 2) Spray 3) Making fine seedbed

4) Early planting 5) others specify……..

79. What constraints (production problems) have you encountered in Cowpea production (Tick as appropriate)

Constraint	**Extent of problem (1= severe 2= moderate 3 = low)**
1.Field Pests	
2.Seed Scarcity	
3.Lack of land	
4.Poor yields	
5.Lack of market	
6.Poor soils	
7.Poor varieties	
8.Extension services	
9.Low prices	
10.Price Fluctuation	
11.Drought	
12.Diseases	
13.Access to seed	

14.Storage pests	
15.Weeds	
16. Others specify	

80. What do you want the Cowpea Improvement research project to do?

……

……

……

……

……

……

……

Thank you

APPENDIX B: Market integration result

Determing the Optimal lag Length

```
. varsoc   LnKampala, maxlag(12)

   Selection-order criteria
   Sample:  1960w14 - 1962w33                  Number of obs      =       124
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 |  49.5662                          .02675  -.783326  -.774087  -.760582  |
  |  1 |  106.121  113.11    1  0.000  .010919  -1.67938   -1.6609  -1.63389  |
  |  2 |  109.599  6.9548    1  0.008  .010491  -1.71934  -1.69162   -1.6511  |
  |  3 |  112.026  4.8539    1  0.028  .010253  -1.74235  -1.70539* -1.65137* |
  |  4 |  112.185  .31931    1  0.572  .010393   -1.7288   -1.6826  -1.61508  |
  |  5 |  112.358  .34581    1  0.556  .010533  -1.71546  -1.66002  -1.57899  |
  |  6 |  115.077  5.4365*   1  0.020  .010245* -1.74317*  -1.6785  -1.58396  |
  |  7 |  115.184   .2138    1  0.644  .010395  -1.72877  -1.65485  -1.54681  |
  |  8 |  116.049  1.7306    1  0.188  .010418  -1.72659  -1.64344   -1.5219  |
  |  9 |  116.102  .10589    1  0.745  .010579  -1.71132  -1.61893  -1.48388  |
  | 10 |  116.657  1.1111    1  0.292  .010657  -1.70415  -1.60252  -1.45396  |
  | 11 |  116.991  .66796    1  0.414  .010773  -1.69341  -1.58254  -1.42048  |
  | 12 |  117.421  .85883    1  0.354  .010875   -1.6842  -1.56409  -1.38853  |
  +---------------------------------------------------------------------------+
   Endogenous:  LnKampala
    Exogenous:  _cons

. varsoc  LnLira, maxlag(12)

   Selection-order criteria
   Sample:  1960w14 - 1962w33                  Number of obs      =       124
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 | -3.87189                          .063336   .078579   .087818   .101323  |
  |  1 |  60.2391  128.22*   1  0.000  .022886* -.939341* -.920862* -.893852* |
  |  2 |  60.2512  .02404    1  0.877  .023254  -.923406  -.895688  -.855173  |
  |  3 |  60.4326  .36289    1  0.547  .023563  -.910203  -.873246  -.819226  |
  |  4 |  61.2157  1.5662    1  0.211  .023647  -.906705  -.860508  -.792983  |
  |  5 |  61.7497   1.068    1  0.301  .023826  -.899189  -.843753  -.762724  |
  |  6 |  61.7499  .00033    1  0.986  .024214  -.883062  -.818388  -.723853  |
  |  7 |  62.1694  .83904    1  0.360  .024443    -.8737  -.799786  -.691746  |
  |  8 |  63.1076  1.8764    1  0.171   .02447  -.872703   -.78955  -.668005  |
  |  9 |  63.1681  .12105    1  0.728  .024846   -.85755  -.765158  -.630108  |
  | 10 |  63.7407  1.1452    1  0.285   .02502  -.850657  -.749025  -.600471  |
  | 11 |   64.019  .55649    1  0.456  .025317  -.839016  -.728145  -.566085  |
  | 12 |  64.0197  .00137    1  0.970  .025732  -.822898  -.702788  -.527223  |
  +---------------------------------------------------------------------------+
   Endogenous:  LnLira
    Exogenous:  _cons


. varsoc   LnSoroti, maxlag(12)

   Selection-order criteria
   Sample:  1960w14 - 1962w33                  Number of obs      =       124
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 | -6.44799                          .066023   .120129   .129368   .142873  |
  |  1 |  119.492  251.88    1  0.000  .008801  -1.89503  -1.87655  -1.84954  |
  |  2 |  123.132  7.2804    1  0.007  .008434  -1.93761   -1.9099* -1.86938* |
  |  3 |   124.27  2.2755    1  0.131  .008415* -1.93983* -1.90288  -1.84886  |
  |  4 |  124.334  .12811    1  0.720  .008544  -1.92474  -1.87854  -1.81102  |
  |  5 |  124.664     .66    1  0.417  .008637  -1.91393   -1.8585  -1.77747  |
  |  6 |  124.692  .05597    1  0.813  .008774  -1.89825  -1.83358  -1.73905  |
```

```
  |  7 |  124.771  .15879    1  0.690  .008905  -1.88341  -1.80949  -1.70145  |
  |  8 |  124.776   .0106    1  0.918   .00905  -1.86736  -1.78421  -1.66266  |
  |  9 |  125.411  1.2689    1  0.260  .009104  -1.86147  -1.76907  -1.63402  |
  | 10 |  125.411  .00055    1  0.981  .009254  -1.84534  -1.74371  -1.59516  |
  | 11 |   126.68  2.5385    1  0.111  .009215  -1.84968  -1.73881  -1.57675  |
  | 12 |  130.256  7.1515*   1  0.007  .008841  -1.89123  -1.77112  -1.59555  |
  +-------------------------------------------------------------------------+
   Endogenous:  LnSoroti
    Exogenous:  _cons

. varsoc   DLnSoroti, maxlag(12)

   Selection-order criteria
   Sample:  1960w15 - 1962w33                  Number of obs      =       123
  +-------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+--------------------------------------------------------------------|
  |  0 |  115.395                       .009114  -1.86007  -1.85079  -1.83721  |
  |  1 |  117.835  4.8801    1  0.027  .008903  -1.88349  -1.86491  -1.83776* |
  |  2 |  119.847  4.0253    1  0.045  .008758* -1.89995* -1.87209* -1.83136  |
  |  3 |  120.136  .57699    1  0.447   .00886  -1.88839  -1.85124  -1.79693  |
  |  4 |  120.218  .16463    1  0.685  .008993  -1.87346  -1.82703  -1.75915  |
  |  5 |  120.422  .40883    1  0.523  .009111  -1.86053  -1.80481  -1.72335  |
  |  6 |  120.422  5.8e-07   1  0.999   .00926  -1.84427  -1.77926  -1.68422  |
  |  7 |   120.55  .25502    1  0.614  .009393  -1.83008  -1.75578  -1.64717  |
  |  8 |  121.599  2.0985    1  0.147  .009386  -1.83088   -1.7473  -1.62511  |
  |  9 |  121.652  .10497    1  0.746  .009533  -1.81547   -1.7226  -1.58684  |
  | 10 |  123.304  3.3043    1  0.069  .009434  -1.82608  -1.72392  -1.57458  |
  | 11 |   127.24  7.8728*   1  0.005  .008995  -1.87383  -1.76238  -1.59947  |
  | 12 |  127.266  .05235    1  0.819   .00914  -1.85799  -1.73726  -1.56077  |
  +-------------------------------------------------------------------------+
   Endogenous:  DLnSoroti
    Exogenous:  _cons
```

Stationary test

```
. dfuller  LnKampala,trend regress lags(3)

Augmented Dickey-Fuller test for unit root         Number of obs   =       132

                              ---------- Interpolated Dickey-Fuller ---------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -3.499           -4.029            -3.446            -3.146
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0395


. dfuller  LnLira, trend regress lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =       134

                              ---------- Interpolated Dickey-Fuller ---------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -3.788           -4.029            -3.445            -3.145
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0172


. dfuller  LnSoroti,trend regress lags(2)

Augmented Dickey-Fuller test for unit root         Number of obs   =       133

                              ---------- Interpolated Dickey-Fuller ---------
```

```
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -2.324           -4.029            -3.446           -3.146
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.4206

. dfuller  DLnSoroti,trend regress lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =       133

                              ---------- Interpolated Dickey-Fuller ---------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -8.604           -4.029            -3.446           -3.146
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

Causality result using the ADL model

```
regress  LnKampala LnKampala1 LnKampala2 LnKampala3 LnLira1

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  4,   128) =   46.86
       Model |  2.08356858     4  .520892145           Prob > F      =  0.0000
    Residual |  1.42293442   128  .011116675           R-squared     =  0.5942
-------------+------------------------------           Adj R-squared =  0.5815
       Total |    3.506503   132  .026564417           Root MSE      =  .10544

------------------------------------------------------------------------------
   LnKampala |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  LnKampala1 |   .5160129   .0859028     6.01   0.000     .3460394    .6859863
  LnKampala2 |   .1419284   .0965167     1.47   0.144    -.0490464    .3329031
  LnKampala3 |   .2100911    .087804     2.39   0.018     .0363559    .3838263
     LnLira1 |   .0368074   .0391485     0.94   0.349    -.0406545    .1142693
       _cons |   .7456728   .6891328     1.08   0.281    -.6178942     2.10924
------------------------------------------------------------------------------

. regress   LnLira LnKampala1 LnKampala2 LnKampala3 LnLira1

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  4,   128) =   71.04
       Model |  5.92024897     4  1.48006224           Prob > F      =  0.0000
    Residual |  2.66687404   128  .020834953           R-squared     =  0.6894
-------------+------------------------------           Adj R-squared =  0.6797
       Total |  8.58712301   132  .065053962           Root MSE      =  .14434

------------------------------------------------------------------------------
      LnLira |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  LnKampala1 |  -.0292686   .1176024    -0.25   0.804    -.2619651    .2034279
  LnKampala2 |  -.1001312    .132133    -0.76   0.450    -.3615789    .1613164
  LnKampala3 |   -.086326   .1202052    -0.72   0.474    -.3241725    .1515205
     LnLira1 |   .7687236   .0535949    14.34   0.000     .6626769    .8747702
       _cons |   3.339856   .9434344     3.54   0.001      1.47311    5.206602
------------------------------------------------------------------------------
```