



## **VARIATION IN STAPLE FOOD PRICES IN TANZANIA: A CASE OF DAR ES SALAAM AND DODOMA RICE WHOLESALE MARKETS.**

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### **ABSTRACT**

*This paper examined the spatial price variations for staple food between the two major consumer rice markets of Dodoma and Dar es Salaam and extent of price transmission. This follows the dearth in information regarding the extent of price variation in local markets and how these variations are transmitted from one market to another. The Error Correction Model was used in analyzing both the short and long run price relationship between the two markets using time series data on monthly wholesale prices for rice from 2004 to 2015. However, the Augmented Dickey Fuller and Phillip-Perron tests were employed in testing the unit root problem while Johannes test was used to test the co-integration of the two markets. Findings indicate that, rice price trends varied between the two markets whereby prices fluctuates more in Dodoma as compared to that at the Dar es Salaam market. Moreover, Dodoma market was found to be linked to Dar es Salaam markets with price elasticity of transmission of 0.37. This suggests that, about 37% of the changes in prices at Dar es Salaam markets are transmitted to Dodoma market. Therefore, it is concluded that, there is a significant weak relationship between the rice prices in Dodoma and those in Dar es Salaam. The study recommend that, government and other stakeholder should formulate policies and strategies that could improve the market access in Dodoma through improving roads and markets infrastructures so as to reduce price variability between producers and wholesale markets in the region and over the country.*

**Keywords:** Price; variation; staple food; error correction model; Tanzania

### **INTRODUCTION**

World food prices, especially for key staple crops such as maize, rice, wheat and soya-beans had increased at unprecedented rates in sub-Saharan Africa (SSA) since 2007/08 and 2011, leading to the current food price crisis among millions of people (Minot, 2013; FAO, 2015). The rising in global food prices for most key staple crops had created unpredicted effects (price variation) on local markets prices especially for rice and maize crops which created a policy concerns especially in SSA (Baltze, 2013; Maro and Mwaijande, 2014). Following this price raise, most of major food producing countries in SSA experienced higher food prices volatility and variations. This situation is thought not to disappear soon because it results from the circumstances that characterize the majority developing countries economy (FAO, 2015; Friedrich and Kassam, 2016). A study by Minot (2013) has defied price variation as the state of unpredictability in the price trends over time. Therefore, food price variability and volatility can have negative effects both on consumers and producers welfares (Jayne, Mason, Myers, Ferris, Mather, Beaver, Lenski, Chapoto and Boughton, 2010; Kaminski, Christiansen and Gilbert, 2014). Moreover, Minot (2013) and Nzuma (2013) noted that, instability (variation) in the price of staple food like rice is an important source of risks in



developing countries like Tanzania especially for poor households in the rural and urban areas who spent for about 70% of their income on consumption.

However, in Tanzania rice is ranked second among the preferred staple food crops after maize which is highly consumed both in urban and rural areas (URT, 2014; Minot, 2010). Studies by KI (2011) and Moshi (2013) argued that, rice prices in Tanzania have been experiencing a seasonal trend variation from lowest during harvest to highest in lean period. In connection to such circumstances, Minot (2014) pointed out different causes of price variations in the country, including inadequate storage capacity, poor rural road networks and crop failure due to climatic changes. Inadequate storage capacity and distribution will implies that, farmers and traders have little choice on the timing of sales and will be forced to sell during or immediately after harvest when there is a glut on the market and prices are low. Similarly, findings by FAO (2015) indicated that, uncertain yields and price fluctuations could discourage farmers from investing in improved seed, fertilizer, post-harvest grading or other quality improvements. This on the other hand could reduce the country production capacity and fail to move with the increased domestic demand for rice in Tanzania which grew at an annual average of 4.92 percent between 2001 and 2011. Moreover, demand for rice in Tanzania is expected to increase threefold between 2010 and 2020 as a result of population growth, increased economic growth of 7 percent per annum and the continued urbanization which grow at the rate of 5 percent per annum (NBS, 2014; FAO, 2015; Friedrich and Kassam, 2016).

To foster rice production and trade in Tanzania, well-functioning trade relationships between markets which are based on transmission of price signals between shortage and surplus regions are crucial components in this context. This is because price fluctuation (variability) in most cases tends to affect the spatial price difference of staple foods between markets (Ihle and von Cramon-Taubadel, 2010; IFPRI, 2013; Kaminski *et al.*, 2014). This situation is in conflict with the price transmission requirement that, for well integrated markets once there is a change in price at one market usually the surplus one, this change is passed through to the deficit market for equilibrium adjustments (Kilima, Kenkel and Mbiha, 2008; Amikuzuno and Ogundari, 2012; Minot, 2014). Consequently, a higher price variation between two geographical locations could reduce the connectivity of markets in the country which in turn can enhance food insecurity to deficit regions. Major consumer wholesale markets such as Dar es Salaam and Dodoma can play a great role in eliminating such problem in Tanzania. Dodoma rice market represents the central urban market and Dar es Salaam as the main end-consumer market which receives rice from different regions in Tanzania. Therefore, a clear understanding on how changes in prices for leading markets (like Dar es Salaam) influences price formation on other consumer markets is of imperative for both government and policy makers. This is because movements of prices between these two markets have potential indications for future trend prediction of staple food prices and production in Tanzania and in other developing countries.

However, a number of previous studies had been conducted on price variation (transmission) in Tanzania, but most of the concentrated on the relationship between international and local markets (except those of Maro and Mwaijande, 2014; Minot, 2011), and as a result making relatively little information available on the integration among local markets especially the major end-consumer markets like Dodoma and Dar es Salaam. Moreover, domestic rice prices can also differ substantially from the trend of international prices because of local production shocks, transaction costs, size of market and arbitrary trade barriers imposed by the government. It is under these grounds the current study analysed the trend of rice price variations and to what extent are these



variation are transmitted from one markets to another particularly for major consumers markets (Dar es Salaam and Dodoma markets). This is because the issue of changes in food prices for major food crop such as rice has important implications for policy makers and food security in the country like Tanzania. This could ultimately assist the government in devising policies that would ensure improved food security in the country.

## **2.0 REVIEW PRICE VARIATIONS**

### **2.1 Staple food price variations**

Price volatility and variability should be distinguished from the economic point of view; this is because the latter is characterized with the element of shocks. This implies that, shocks in the production and consumption are transmitted into price variability (Minot, 2013; Gerard *et al.*, 2011). To cement the argument, Minot (2010) reported that, speculation and stockholding or purchasing and sell at relatively high prices in future also determine the degree of food price variability in the given country. In addition, excessive variability in the staple food prices to a large extent is a reflection of lack of market integration across spaces. On the other hand, Chapoto and Jayne (2009) and Maître d'hôtel *et al.*, (2013) defined price volatility as the unanticipated component of price instability which implies the conditional variance. Other scholars defined price instability as a variation over time in the price of food.

Globally, food prices have been varying dramatically especially in the recent years due to a number of reasons such as fluctuation of world oil prices, low levels of world cereal stocks, crop failures in major exporting countries, population growth and urbanization (Maro and Mwijande, 2014; FAO, 2015). Findings from FEWSNET (2012) and FAO (2015) showed that, food prices (including rice) in Tanzania experienced an upward trend relative to past five years from 2009 to 2013. Prices for rice and maize increased to 40-60% above their five years average. Moreover, studies by Kilima *et al.*, (2008) and Maro and Mwinande (2014) analyzed the trend and variability of rice and maize prices using monthly wholesale prices data from seven regions between 1983 and 1998 and 2004 and 2013. Results from these studies indicated that, market liberalization increased the variability in maize and rice in Tanzania. The price for rice surged since 2004 (Except in 2007/08) to 2013, for example, from January 2010 to August 2013, the margin between local and international prices for rice prices increased from 26 to 52 percent, with the local market having higher prices (Maro and Mwijande, 2014). This implies that, rice prices in Tanzania markets appeared to be linked to the world rice markets. Therefore, stability in rice price in Tanzania could increase the tradability of the crop both domestically and internationally. On the other hand, these studies did not considered the linkages among local consumer markets and how price variations are transmitted from one market to another. Thus, the current study was intended to address toward this end.

### **2.2 Rice Consumption in Tanzania**

Tanzania has been one of the fastest growing urban populations in East Africa, rising at 4.7 percent per year; the growing middle class prefer more rice over other staples (Moshi, 2013; Lwesya, 2016). Rice being the second most preferred staple after maize, it is more preferred in urban areas, in institutions such as hospitals and schools and in restaurants. The preference for rice in restaurants and institutions is mainly due to its convenience in terms of catering. The per capita consumption for rice in Tanzania is about 16 Kg, ranked as a third crop after maize (73 Kg) and cassava (157Kg) and contributes for about 8% of caloric intake among Tanzanians (Minot, 2010; URT, 2014;



Maziku, Hella and Makindara, 2015). Rice is more preferred staple crop in the sense that as income rises, consumers (mostly in urban areas) shift from sorghum and maize toward rice and wheat products consumption. In terms of consumer preference ranking, rice from Kyela–Mbeya is considered to be of the highest quality, followed by rice from Shinyanga, Tabora, Morogoro and Moshi in order of decreasing preference (Moshi, 2013; URT, 2014). These preferences are fully reflected in the prices of the different types of rice in various markets in the country.

Given the importance of rice as food and commercial crop in Tanzania, and the rapid growth of cities that we witness today, an increase in price and odd price fluctuations of rice might affect consumers adversely. Consumers in rice deficit regions like Dodoma, Lind and Mtwara tend to experience the hardest hit from the price hikes (FAO, 2015; Lwesya, 2016). However, the existence of market integration in the country could lessen the negative consequences brought about by increases in rice price and anomalous price variability. Furthermore, Golettiet *al.* (1995) argues that, market integration ensures that a regional balance occurs among food deficit and surplus producing regions in a given country. Therefore, an understanding on the nature of rice market integration and the extent of price transmission between major consumer markets in Tanzania is imperative. This could save as inputs to government and policy makers to address food shortage in other markets, since price changes in one market due to increased supply can be transmitted to another markets.

### **3.0 RESEARCH METHODOLOGY**

The effects of price variation at one market (usually the lead one) can be transmitted to another market if the two markets are integrated. This study employed the longitudinal research design in which time series data for ten (10) years on monthly wholesale prices from Dar es Salaam and Dodoma rice markets were involved in the analysis. The two markets were selected on the basis that, Dar es Salaam market is the main consumer market in Tanzania and receive rice from all regions while Dodoma in wholesale markets in the deficit region and also supply rice to Dar es Salaam market. However, several analytical models for analysing price variability and transmission are recommended in the spatial market integration literatures. The commonly and suitable used models as suggested by Abidoye and Labuschagne (2012); Minot (2010) and Rapsomanikis and Karfakis (2008) included; Error correction model, Threshold Autoregressive (TAR) and Parity Bound Models (PBM). But in the context of this study, the Vector error correction model (VECM) was used in examining the price transmission between two domestic food markets in Tanzania (Dar es Salaam and Dodoma) for the period ranging from January, 2004 to December 2015. In this period, the two markets experienced high price variation trends which call for an investigation on the phenomenon. The VECM was selected because of its ability to take into account the non-stationary and allow long-run relationship as well as the speed of adjustment and it assumes that, the parameters quantifying the adjustment are said to be constant (Minot,2011). Moreover, the VECM recognizes the influence of transaction costs faced by traders on the spatial market integration without using actual transaction costs data (Abidoye and Labuschagne, 2012; Minot, 2010). However, data for rice prices were obtained from National Bureau of Statistics (NBS), Ministry of Industry, Trade and Investment (MITI) and FEWSNET. These institutions collect daily and weekly spot prices in all larger markets including Dar es Salaam and Dodoma consumer markets around the country. The data were estimated in monthly average prices and entered into the VECM model for estimation of coefficient parameters for price transmission.



### 3.1 Model Specification

Before estimating the price relationship between the two wholesale markets (Dodoma and Dar es Salaam), two tests were conducted on price variables time series data in order to establish whether they are non-stationary or not. To accomplish this task, the Augmented Dickey Fuller (ADF) and Phillip-Perron (PP) tests were employed to test the existence of Unit root on the data. On the other hand, the Johansen test was used to determine whether the two series were co-integrated and if the Johansen test indicated presence of a long run relationship between the two variables, then the price transmission was estimated using ECM. In this regard, the ECM model was presented in the following general equation form:

$$\Delta P_t = \alpha_i + \varpi P_{t-1} + \sum_{i=1}^p \eta_i \Delta P_{t-1} + \varepsilon_t \dots\dots\dots (1)$$

**Whereby:**  $p_t$  is an  $n \times 1$  vector of  $n$  price variables,  
 $\Delta$  is the difference operator, given as  $\Delta P_t = P_t - P_{t-1}$ ,  
 $\varepsilon_t$  is an  $n \times 1$  vector of error terms, and  
 $\alpha$  is an  $n \times 1$  vector of estimated parameters that describe the trend component  
 $\eta$  is an  $n \times n$  matrix of estimated parameters that describe the long-term relationship and the error correction adjustment.

The VECM tested the effects of rice prices in Dar es Salaam wholesale markets ( $P^{dar}$ ) on rice price in Dodoma markets ( $P^{dom}$ ). However, in this study, Dares Salaam market was taken as a leading market as it receives rice from all regions in the country including Dodoma. In addition, the Akaike Information Criterion (AIC) test indicated that one lagged term on monthly data was generally sufficient for the study (Minot, 2014). Thus, this study regarded one lag to be sufficient enough in the estimation of the price transmission. The ECM for this purpose was represented in the following equation:

$$\Delta P_t^{dom} = \alpha + \theta \left( P_{t-1}^{dom} - \beta P_{t-1}^{dar} \right) + \delta \Delta P_{t-1}^{dar} + \rho \Delta P_{t-1}^{dom} + \varepsilon_t \dots\dots\dots (2)$$

**Where:**  $P^{dom}$  is the log of price at Dodoma market in Tshs;  
 $P^{dar}$  is the log of rice price at Dar es Salaam market of the same commodity in Tshs;  
 $\Delta$  is the difference operator, presented as  $\Delta P_t = P_t - P_{t-1}$ ;  
 $\alpha$ ,  $\theta$ ,  $\beta$ ,  $\delta$ , and  $\rho$  are coefficient parameters estimated from the model; and  $\varepsilon_t$  is the error term.

Since the original rice price series for the two markets are non-stationary i.e.  $I(1)$ , then the first differences ( $\Delta p$ ) will be stationary i.e.  $I(0)$ . Therefore, coefficients in the error correction model (ECM) as presented in equation (2) can be interpreted as follows:  $\beta$  is the long-run elasticity of price transmission and  $\theta$  is the error correction coefficient reflecting the speed of adjustment. Whereby,  $\delta$  is the short-run elasticity of the Dodoma rice price relative to the rice price at Dar es Salaam and it represents the percentage adjustment of rice price at Dodoma market in one period after a one percent shock in rice price at Dar es Salaam Market.  $\rho$  is the autoregressive term, reflecting the effect of each change in the Dodoma rice price on the change in Dar es Salaam price.

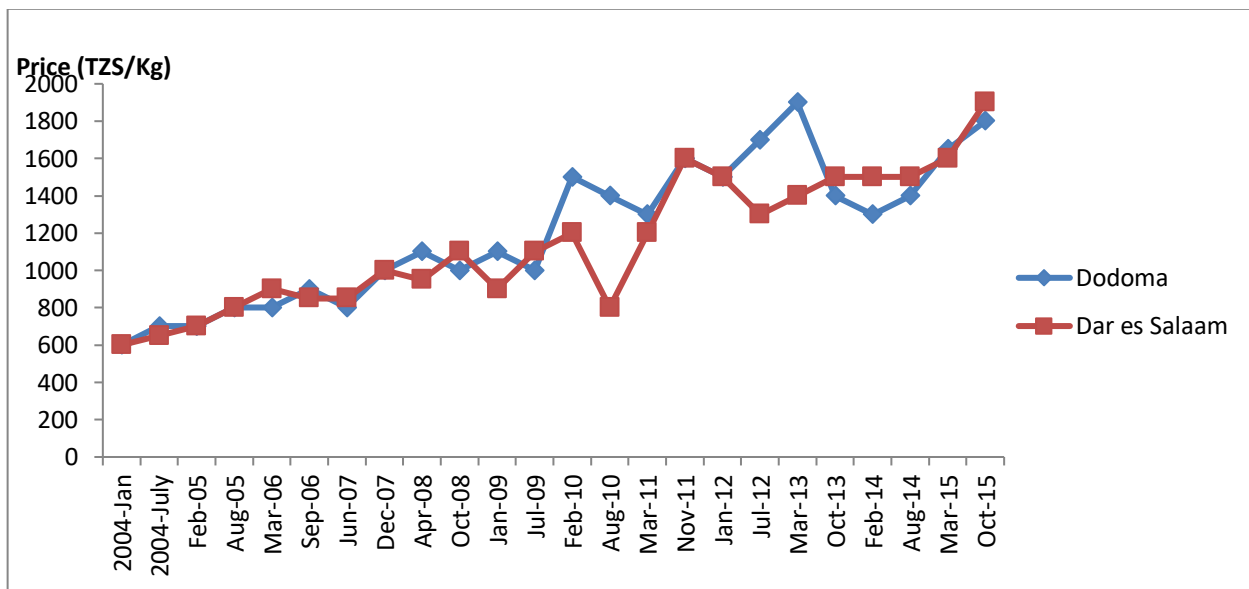


#### 4.0 RESULTS AND DISCUSSION

The result section is divided into two parts. Section 4.1 examines the trends in rice prices at the two markets for the period of 2004–2015. Section 4.2 presents the results on the relationship between rice prices at Dar es Salaam and Dodoma wholesale markets using error correction model.

##### 4.1 The trends of rice price for Dar es Salaam and Dodoma markets

Trends in rice prices for the period of 2004-2015 are presented on the Fig 1; results indicate that, rice prices experienced a significant increasing trend for both markets since 2004 moving in the same direction with somehow opposite fluctuations. However, Dodoma prices experienced higher fluctuation (variations) as compared to those in Dar es Salaam market (Fig 1). This can be explained by the fact that, Dar es Salaam as the major consumer market receives rice from all regions over the country including Dodoma which help in buffering the prices. On the other hand, Dodoma market is located in the deficit area (central zone) characterised with poor road networks and market infrastructures contributing to increased market and transaction costs. Also, the region is highly vulnerable to climate changes, the conditions which could influence the supply of rice making prices to vary from lean and bumper harvest seasons. Moreover, rice prices in the two markets exhibited a seasonality variation with the highest level in March and December, reaching their lowest levels in July and August (Fig.1). This situation can be explained by fact that, the bumper harvest in the surplus producer regions reaches their peaks in July and August in every season. This creates a supply glut effects on the urban markets which lower prices based on the law of demand and supply. These results concur with those by FAO (2015) and Minot (2011) who found that, rice prices in Tanzania reaches their maximum level in March of the next season. Similar results were obtained by Bank of Tanzania (2015) that, prices of cereals such as rice, maize and beans in 2013 and 2014 experienced an increase during the period of cultivation which runs from February to May in most part of the country.



*Fig 1: Rice price Trend in Dar es Salaam and Dodoma wholesale markets during 2004 to 2015. Source: Ministry of Industry, Trade and Investment, Tanzania and FEWSNET (2017)*



Moreover, rice price surged more in Dodoma in the year 2010 and 2013 (up by 64%) as compared with those in Dar es Salaam, due to poor harvest in the major supply regions of Shinyanga and Mwanza. Contrarily, during the same period rice prices were low in Dar es Salaam markets, the situation which can be linked to export ban on staple foods (rice and Maize) by the government in 2011 and 2013 for food security purpose (Fig 1). This makes surplus regions located to the country borders such as Mbeya, Katavi and Rukwa to rely only on Dar es Salaam market for their rice produce. This situation caused an overflow of rice from these surplus regions to Dar es Salaam markets. These findings are in line with those of Minot (2010) and Maro and Mwaijande (2014) who found the similar situation in Tanzania rice markets.

#### 4.2 Unit root test results for Dar es Salaam and Dodoma markets

Results on the unit root test are presented in Table 1. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests indicate that, rice prices for the two markets were having unit roots i.e. follows a “random walk” without any tendency to return to a long-run average. But, following the first differential, both tests indicated stationary in price series for the two markets (Table 1). This gives the necessity of the study to use the change in price (Price differences) rather than an auto-regressive model (AR) in econometric analysis using an error-correction model (Minot, 2010; Maro and Mwaijande, 2014). Also, these results make us to accept the null hypothesis that the price data have a unit root which need first differential to be stationary. The ADF and PP tests results concurs to those of Ihle and von Cramon-Taubadel (2010) and Lwesya (2016) who found that, rice and maize price series in Dar es salaam, Dodoma and Arusha consumer markets experienced a unit root. However, results from the Johansen trace test on the co-integration indicated that, there was a long run relationship between rice prices of Dodoma and those of Dar es Salaam market (even though is relatively weak) (Table 2). This allowed the study to use ECM in estimating the Dodoma price as a function of the one- month lagged price in Dar es Salaam in logarithms form.

*Table 1: Unit root tests results for rice monthly prices from 2004 to 2015 for two markets*

Market	Unit Root tests at I(1)			Unit Root test for First difference (P <sub>t</sub> -P <sub>t-1</sub> )		
	ADF	Philips-Perron	Remarks	ADF	Philips-Perron	Remarks
Dar es Salaam	0.561	0.452	Non- stationary	-6.83*	-7.21*	Stationary
Dodoma	0.141	0.421	Non- stationary	-7.02*	-8.62*	Stationary

Note: \* Indicates significant level at 5%

#### 4.3 Transmission of Dar es Salaam rice price to prices in Dodoma Markets

Results from econometric analysis using VECM for the co-integration (link) between Dodoma and Dar es Salaam wholesale prices are summarised in Table 2. The results indicated that, Dodoma rice markets appeared to be linked with Dares Salaam wholesale markets. This implies that, rice prices in Dodoma have a significant long-relationship with rice prices in Dar es Salaam markets. Thus, a change in price for Dar es Salaam market can lead to a proportion change in price in Dodoma markets. This was revealed by the elasticity of price transmission which was 0.37, suggesting that, for about 37% of the variation in rice prices in Dar es Salaam markets is transmitted to the rice prices in Dodoma markets. However, this coefficient of price transmission (0.37) between the two markets is relatively small as compared to those reported by previous studies between leading



markets (Urban) and follower markets (Rural) in Tanzania. For instance, Maro and Mwaijage reported that, about 70% and 86% of price variation in Dar es Salaam and Arusha rice markets (leading) is transmitted to rice markets in Mbeya and Shinyanga (followers) respectively. The small elasticity of price transmission between the two markets could be explained by the fact that, the two markets are both consumer markets and therefore it was not profitable for Dodoma traders or producers to transport frequently rice to Dar es Salaam where prices sometimes are lower than in Dodoma (Fig 1). These results are similar to those by Minot (2010) who reported that, leading markets were found to transmit relatively small effects (20 percent) to their counterpart follower markets in the rural areas in Tanzania.

Table 2: Co-integration and Price transmission results for Dar es Salaam and Dodoma Markets

Johansen test results for co-integrations				Price Transmission results from VECM			
Market pairs	Trace statistic	Eigen value	Critical Value - 95%	Sig.	t-value	Price transmission	Speed of transmission Adjustment
DSM-DOM	22.54	0.15	15.41	0.002	4.71	0.37	6.52

Also, coefficients of adjustment indicated that, it takes more than 6months for the prices in Dar es Salaam market to be transmitted to Dodoma market. This implies that, markets in Dodoma contain many layers of market actors along the rice value chain and traders are price makers whereby producers from the rural areas being price takers. This kind of monopoly from trader and middlemen aggravates the price volatility in the deficit regions like Dodoma and consumers are forced to pay more in the urban areas, hence, affecting affordability of majority net buyer consumers. These results were also supported by those of Rugumamu (2014) who found that, marketing of rice in Tanzania was highly fragmented, with millers and brokers playing a central role in the trading process and thus, making rice to pass through many hands before reaching the final consumer. This contributed much to price volatility for most of staple food crops like rice and forced consumers to buy the product at high market prices particularly in the deficit regions. On the other hand, the weak price transmissions indicate that, Dodoma market is not a perfect follower to Dar es Salaam wholesale market.

However, even though the findings indicated that, the two markets are fairly weak integrated, yet Dar es Salaam market remains being a largest consuming market, consuming about 60% of country rice (FAO, 2015). This is due to reason that, it receives rice from all surplus and deficit regions in the country and thus it determines the level of prices over all the country. Therefore, a small change in prices in Dare s Salaam markets could yet bring a huge price variation on the overall rice prices in Tanzania. This call for improvement on its integration not only with producer markets in the rural, but also to other consumer markets like Dodoma markets. This is because; the well linkage of Dar es Salaam market with other wholesale markets in the country will ensure regional balance to occur among food deficit and surplus producing regions.

## 5. CONCLUSION AND RECOMMENDATIONS

The main objective of this paper was to assess the trends and the extent of price transmission between two major consumer rice markets in Tanzania (Dodoma and Dar es Salaam). Findings from this study revealed that, rice prices fluctuate more in Dodoma markets as compared to those





in Dar es Salaam for the period ranging from 2004 to 2015. This implies that, the nature of market infrastructures in Dodoma and its main suppliers regions (Shinyang and Mwanza) are poorly connected to rural areas making price to fluctuate more as a result of high transaction costs. Moreover, results from ECM indicated that, the two markets are fairly weak integrated with only 37 % of price transmission between them which is also reflected by the low speed of adjustment of more than 6 months for Dodoma market prices to respond on change in price in Dar es Salaam. This trend signifies the presence of higher market transaction costs incurred by traders which reduce their profit margins and thus limit them to transport their merchandised to Dar es Salaam. On the other hand, the reduced market information flow due to high transaction costs usually leads to insulating regions and householders from reaching major markets and may result in inefficient outcomes like of poor market integrations.

Basing on these findings, it is recommended that, government should venture on policies that target toward infrastructure development and market integration between major markets and follower markets. This could be helpful in reducing the spatial rice price volatility and variation and thus improving market integrations. For instance, government through its Ministries responsible for infrastructures and marketing could support remote markets by linking them through better roads to major consumption centers across the country as well as in neighboring countries like Kenya, Zambia and Uganda. However, this study on other hand, can serve as a starting point for future research on what extent the major consumer markets can influence the overall prices in Tanzania and other African countries.

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