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Farm-level Crop Price as a Factor for Increased Maize Production in Ludewa District, Tanzania: Estimation of Koyck Lag Model

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Abstract

Farm-level crop price is an important predictor of production increase, yet, little has been done about how food crop production is responsive to the expected price. Hence, this paper uses primary data to analyze the contribution of expected farm-level prices to the current production of crops. The primary data was collected from 427 sampled household heads through the interview conducted using an interview schedule. The Koyck lag model which is a simple expectation model was employed to estimate the relationship between current crop production and expected price. The main findings indicated that price is significant driver ($\rho = 0.069$) for increased crop production. From the results, it is concluded that the output market aspect (farm-level price) is equally important for increased crop production. The study findings have important policy implications that output marketing barriers that increase the transaction costs cause low farm-level prices hence low crop production. Therefore, to increase maize production there should be a balance between costs of inputs and output price.

Keywords: Farm-level price, Koyck lag model, marketing participation, Transaction costs

1.0 INTRODUCTION

Most of the African countries' economic growth depends on the agricultural sector. According to Tomšík et al. (2015), agriculture dominates the Gross Domestic Products (GDP) and employment in Sub-Saharan countries. Likewise, Chongela (2015) found that subsectors of agriculture in Tanzania namely crops, livestock, and fisheries contribute 18.93%, 4.70%, and 2.25% to the national economy respectively making a total contribution of 25.88%. Notably, Statista (2021) showed that the agricultural sector is the second-largest contributor to economic growth after the services sector for the years between 2010 and 2020 (Table 1). As agriculture is an equally important sector for economic growth, its development and transformation are inevitable. In this regard, the Tanzania Five Year Development Plan I which was launched in 2011 insists on agricultural sector modernization, commercialization, and productivity enhancement to reduce poverty and improve the economic growth of the country (United Republic of Tanzania – URT, 2015).

Table 1: Share of economic sectors in the GDP from 2010 to 2020 in Tanzania

Sector/Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Agriculture (%)	25.58	24.98	26.55	26.79	25.8	26.75	27.44	28.74	27.87	26.55	26.74
Industry (%)	23.56	26.38	25.4	25.45	25.14	24.79	24.86	25.1	27.01	28.62	28.67
Services (%)	43.32	41.41	40.61	40.27	41.3	40.43	37.45	37.92	37.24	36.77	36.25

Source: Statista (2021)

In this connection, it is important to note that, one of the vital factors for agricultural sector modernization, commercialization, and productivity enhancement is an efficient crop market. An efficient crop market reduces transaction costs; hence smallholders become certain about the markets of their farm products. Put differently, the improved market infrastructure helps to reduce transaction costs and therefore high farmers' prices, especially for those living in the marginalized rural areas. A study by Benfica et al. (2014:1) found "a strong correlation between market participation and productivity". They revealed that "improved market participation which is the outcome of high price, motivated households to invest in improved agricultural technologies and put more effort in increasing agricultural productivity". This means that without attractive farm-level prices, other efforts may end up with little impact on agricultural production. Abu et al. (2016) found that "farmers sell their produce at farm-level at a discounted (low) price to avoid transaction costs associated with reaching high-value markets. This implies that agricultural prices are victims of high transaction costs and therefore they are proxies to transaction costs."

As highlighted earlier one particular economical outcome of poor agricultural production in Tanzania are the hidden costs of inputs and low profit margin on highly variable prices of commodities. Access to affordable and high-quality agricultural inputs such as certified improved seeds, inorganic fertilizers, pesticides, and other technologies is still difficult for smallholders, given the high and constantly rising costs while the price of their farm outputs is persistently remaining low. As noted by Razzano et al. (2020) marketing of crops is underdeveloped and inefficient in Africa and Tanzania in particular. This is exacerbated by the inaccessibility of rural areas, inadequate logistic and power infrastructure, and inadequate storage facilities which on the other hand directly affect the price, the profitability, and the competitiveness of the agricultural market. Inaccessibility of markets by smallholders occurs either as immaterial marginalization (i.e. lack of market and agricultural information) or as geographical, socio-economical, and commercial marginalization (i.e. inaccessible rural areas, lack of road, power, and communication infrastructures, and lack of trusted traders and intermediaries). High transport cost occurs due to bad roads conditions that become inaccessible, especially during the rainy season and harvest period. Similarly, many intermediaries and traders are usually involved in bringing agricultural products from farms to markets, as production takes place in scattered areas and it is hard for just one actor to bear all the costs and risks. This means that farmers that sell at farm gates have very low power over prices, which are in turn decided by buyers (Razzano et al. 2020).

Generally, transaction costs are obstacles to farmers' market participation that have been resulting in low agricultural production. Improved marketing infrastructures lower the transaction costs; this attracts competition among traders and thus high farmers' prices. As pointed out by Abu et al (2016), "the difference between farm-level and urban prices is accounted for by transaction costs." It is these marketing barriers that lead to the underutilization of land in Tanzania whereby out of 44 million hectares of arable land only 24% is under cultivation and the production is less than the potential yield, roughly 3 ton/ha which is far less than potential production of 6 –7.5 ton/ha (URT, 2015:5). Despite the good explanation of the relationship between production and marketing constraints (or transaction costs), little has been said about how farm-level price (a proxy for transaction costs) relates to the size of land allocated to maize production (proxy to the level of crop production). Therefore, the study hypothesized that "*there is no relationship between the expected farm-level price and size of land allocated to maize production*".

Theoretical Framework

The study is guided by the Transaction Cost Theory (TCT) which is based on the work of Coase (1937). Coase tried to describe the link that exists between the firm and a market. The relevance of the theory to the study in question is that it describes how the investment decision of economic agents in any economic activity is guided by transaction cost. "The main question that TCT seeks to address is why economic transactions are organized in the way that they are in the modern society" (Williamson, 1994; Martins et al. 2010: 2). Furthermore, "transaction cost theory aims to answer the question of when activities would occur within the market and when they would occur within the firm" (Williamson, 1991). Specifically, Williamson insisted "why do firms do what they do the general conclusion is that activities are internalized inside the firm when there is some form of market failure".

Furthermore, Cuevas (2014) added that TCT has been in so many fields. In different circumstances, transaction costs have been defined to mean unseen costs related to goods and services exchanged. Although the theory is based on the side of inputs transactions it is also applicable to the output transactions. That is why Boudreau et al. (2007) indicated that transaction costs can be extended to other economic exchanges. "Transaction costs can significantly affect agents' decisions on whether or not to participate in the market" (Key et al. 2000). In particular, Key et al. (2000) revealed that proportional transaction costs have a significant effect on a household's market supply decision. Therefore, the authors used the TCT by looking at how the farm-level price (a proxy for transaction costs) relates to the size of land allocated to maize production.

2.0 LITERATURE REVIEW

Marketing constraints and transaction costs

The constraints along the marketing chain lead to high transaction costs which in turn result in market inefficiency. Ngaruko *et al.* (2014) showed that "the existence of different forms of trade impediments results in different forms of transaction costs". Okoye et al. (2016:2) revealed that "the relative magnitudes of transaction costs depend on farmers' access to infrastructure facilities, particularly roads". "For limited or poor quality roads and rail links inhibit timely access to inputs, increase input costs, and decrease access to output markets, thereby reducing the transmission of market signals" (Okoye *et al.*, 2016: 2 - 3). Jagwe (2011:4) revealed that "numerous constraints and barriers which include costs associated with exchanging goods or services hinder smallholder farmers and traders to fully participate in the markets especially in the developing countries."

Transaction costs and farm-level prices

According to Cuevas (2014:24) "Transaction costs can take one of two forms, inputs or resources including time by a buyer and/or a seller or a margin between buying and selling price of a commodity in a given market". The effect of transaction costs including taxation is the reduction of farmers' revenue from crop sales (Ngaruko et al. 2014). The transaction cost influences the decision of the farmers to where to sale their produce and also the price of produce. Jagwe (2011) indicated that the decision of farmers to whether sale at home or travel to regional markets where they can fetch high prices is determined by the magnitude of transaction costs along the marketing chain.

Among many factors, transaction costs including transportation costs harm farm-level prices. According to Jack (2013:17), "transport and other infrastructure challenges tend to reduce competition among input suppliers and middlemen, which potentially allow them to charge higher input prices and pay lower prices for outputs to compensation for the costs incurred." This results in wide bands between the sale and purchase price which is a sign of market failure (Cuevas, 2014). "Transaction costs aspects raise the price effectively paid by buyers and lower the price effectively received by sellers of a good, thus creating the price band within which some households may find it unprofitable to either sell or buy" (Cuevas, 2014:30). Ebata et al. (2015) pointed out that market participation which is the result of attractive output price is a key to poverty alleviation.

Farm-level prices and agricultural production

Agricultural production is responsive to crop prices and planting decisions are made after forecasting the prices for the new crop and not price realizations. Kyaw et al. (2018) revealed that one of the factors which hinder farmers to participate in the production for the market is the low product price. Furthermore, Collinson et al. (2002) show that the long-term sustainability of the agricultural sector is threatened by low producer prices near or below the cost of production. The improvement of prices received by poor farmers is the right strategy for poverty eradication as it encourages the growth of commercial farming amongst the rural poor (Collison, 2002). In addition, Dana and Gilbert (2008) found that high price induces expansion of the area under cultivation.

The existing gap from the previous studies

In the reviewed literature it is clearly explained that the price band in agriculture makes many subsistence farmers fail to access profitable market opportunities and therefore produce for home consumption. Anh and Bokelmann (2019) explained that "constraints including poor infrastructure and distance from the market increase transportation costs, high marketing margins due to merchants with local monopoly power". Even though the effects of agriculture constraints on transaction costs and hence farm-level price are adequately documented, little has been done to empirically analyze the influence of expected farm-level price on the level of crop production. This knowledge gap necessitated the undertaking of this study.

3.0 METHODOLOGY

Description of the study area

The study was undertaken in Ludewa district of Njombe region, Tanzania. Ludewa district is one of four districts in the Njombe region, located between latitude -10.1067° or 10° 6' 24" south and longitude 34.6923° or 34° 41' 32" east. It is bordered to the north by the Njombe district and Makete district, to the south-east by the Ruvuma region, and to the south-west by the country of Malawi across lake Nyasa (Fig. 1). The weather condition of Ludewa district is still conducive for crop production including maize production despite the current climate change effects in other places. Ludewa district lies 1,301 meters above the mean sea level. The average temperature in Ludewa is 19.2 °C and the precipitation averages at 1215 millimeters. Ludewa district is also one of the districts that benefited from subsidized agricultural inputs (e.g. certified seeds, fertilizer, herbicides, and pesticides). Generally, the selection of Ludewa district as a study area was based on its potentiality in maize production and its remoteness.

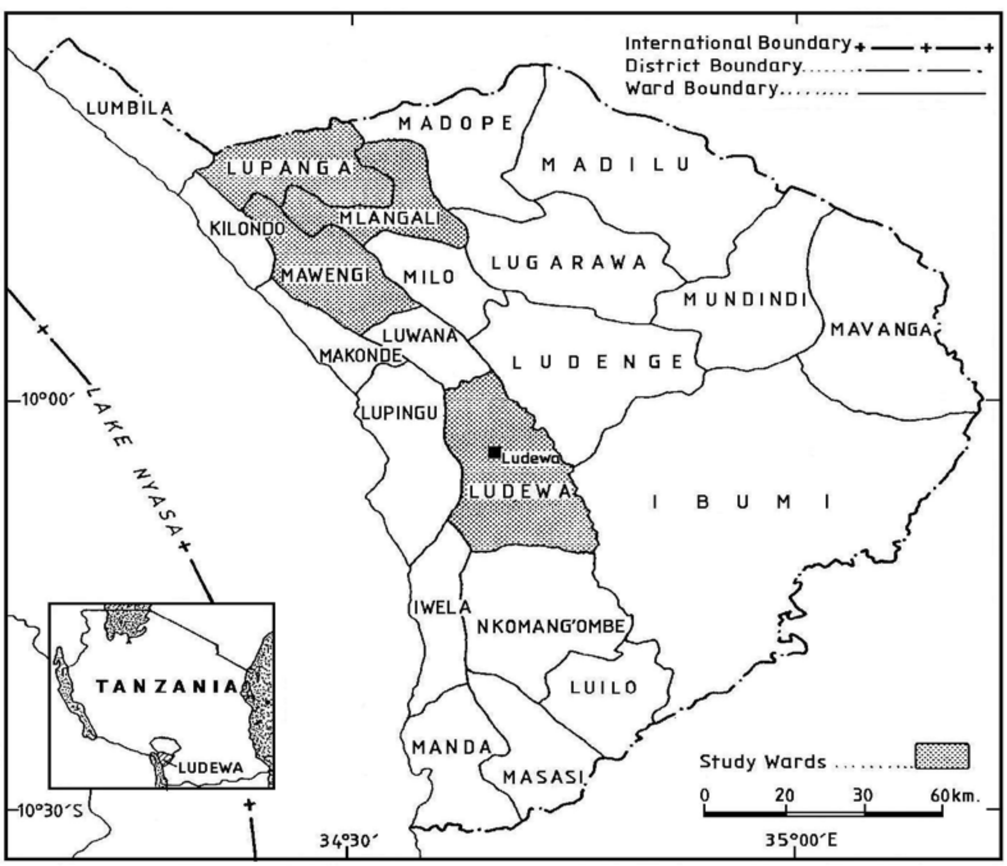

Fig. 1: Map of Ludewa District

Research design

A cross-sectional research design (also often called a survey design) was employed in this study. Various reasons necessitated the researchers to use this research design including but not limited to: First, across-section designs are used in most survey research, and this study was/is pure survey research. Second, the cross-sectional design is quick and cheap to collect quantitative data and examine the relationships between variables. This is because, it allows researchers to collect data on a sample of cases and at a single point in time to collect a body of quantitative or quantifiable data in connection with two or more variables, which are then examined to detect patterns of association (Bryman, 2016). Third, the cross-sectional design allowed the researchers to spell out the procedures for selecting respondents; designing measures of concepts; administering research instruments (i.e. structured interview schedule); analysing data, and giving inferences (or generalization).

Sample size and sampling procedure

The targeted population for this study was the households of smallholder farmers growing maize in Ludewa district. It was recognized in the pilot survey that the percentage of farming households in the study area is 85% of all households. The study employed purposive and simple random sampling to arrive at the sample from which data were collected. These sampling techniques were employed at different stages of the sampling process. The region, district, divisions, wards, and villages were purposively selected. The criterion for selecting the region, districts, divisions, wards, and villages were based on their potentiality and leading in maize production. Out of five divisions, two divisions namely Mawengi and Mlangali were selected for this study, and out of twenty-five wards, only four wards (Ludewa, Mawengi, Mlangali, and Lupanga) were selected. Households were selected using a simple random sampling technique. Eight villages with approximately 2,400 households were sampled. The lottery method was adopted in this study to obtain a sample size of 427 households. Each farmer on the list was assigned a unique number and numbers were placed in the box and mixed thoroughly. A blindfolded researcher picked numbered tags from the box until the intended sample size of 427 households was reached. The "Power Stata Analysis" was conducted to confirm the power of the sample size and found to be 0.89 which is highly recommended.

Methods and instruments of data collection

Interview with sampled heads of households was conducted using a structured interview schedule. Before starting the actual data collection exercise, training of two days was conducted to the enumerators to equip them with different skills on ethical issues, and data collection techniques, to make them understand the demand of the interview schedule and objectives of the study. Also, during the data collection exercise, the principal researcher supervised the enumerators daily by checking completed interview schedules and addressing problems and weaknesses observed.

Data analysis

Quantitative data collected from households farming maize were coded and entered into SPSS, 18 versions, and cleaned to remove missing information to ensure high-quality data. Thereafter, model specification and estimation, and data analysis were performed as explained in detail in the following sub-section.

Model specification and estimation

Among other factors, crop production is responsive to prices. Farmers are primarily interested in net revenue which is a price multiplied by the output produced. The farmer is somewhat self-insured if prices have increased. German (2008) pointed out that "revenue variability is likely to transfer into the variability of consumption, and also an investment, including investment in new technologies." Price uncertainty leads to less application of costly inputs which in turn reduce yields. Leyaro et al. (2014) revealed that producers can respond positively to the price of food crops. This implies that the motive and incentive of farmers to increase the supply of food crops is not only food but also income earning. Also, it implies that increased agricultural production is not only fueled by technical factors but also marketing factors. As other economic agents, farmers intend to maximize revenue subject to the cost of production. Price as one of the factors of high revenue matters a lot when coming to decision-making on crop production. When a farmer begins the season forecasted the price that his or her produce will fetch in the market. Thus, they decide on the level of output to produce given the expected price.

According to Jongeneel and Ge (2010) to understand and model the decision-making behavior of the producer, the utility maximization framework can be used. They denoted "the utility function for a producer j as $u^j(I, B, R)$:

Where; I = monetary income;

B = non-pecuniary benefits of farm production, modeled as a function of family labor used for on-farm production;

R = Leisure.

According to Key and Roberts (2009:3), an additive utility form is also used as follows:

$$u(I,B,R) = U(I) + B(h) + R(r) \quad \text{... (1)}$$

Where: I = py + mw− xq − vl − F,

Where, y = marketed outputs (vector of marketed outputs in case of multiple outputs)

p = output price (vector of output prices in case of multiple outputs)

w = wage at the labor market

l = amount of land

m = off-farm labor work

r = leisure time

h = family labor used for on-farm production

x = marketed variable input (vector of marketed inputs in case of multiple inputs, including hired labor)

q = input price (vector of input prices in case of multiple inputs)

v = fixed costs per hectare, these are fixed costs related to the use of land

F = fixed costs per farm, examples of the fixed costs are for example maintenance costs of machinery, rent costs for buildings.

In this case, it is an expected price that is taken as a major influencing factor for the level of production that will be decided by the farmer. For the expected variables, Distributed Lag Models are appropriate for the estimation of the relationship between independent and dependent variables. The use of distributed lag models is justified by the fact that the responses of producers or consumers to changes in the economic environment resulting for example, from changes in prices or incomes, are not instantaneous, and are usually distributed over time. Therefore employment of the distributed lag model is crucial for the case whereby producer decision is guided by a forecasted factor, produce price in this case.

Therefore the study is based on the simplest distributed lag model, Koyck lag model developed by L. M. Koyck in 1954. Koyck lag model is one of the distributed lag models which uses one lagged value of y (independent variable) as a determinant of the current value year. It allows the prediction of current values of a dependent variable based on both the current values of an explanatory variable and the lagged (past period) values of this explanatory variable while also including expected variable(s). With a single explanatory variable P, the model is written

$$Y_t = \propto (1 - \lambda) + \beta_0 P_{t+1} + \lambda Y_{t-1} + V_t \quad \text{… (2)}$$

The derivation of Koyck lag model is based on the assumption that;

$$\beta_i = \lambda^i \beta_0, \qquad i = 1, 2, 3$$

Where $0 < \lambda < 1$

Erdal et al. (2009) indicated that "the Koyck lag model developed based on the assumption that lags in the independent variable affect the dependent variable to some extent and the weight of these lags decrease geometrically". One difficulty that is common to all distributed-lag models is the choice of lag length. Koyck model has been one of the distributed lag models, apart from the said difficulty, it is also associated with two disadvantages namely multicollinearity and degree of freedom reduction. Despite the weaknesses of the Koyck model, it has many advantages, its coefficients can be estimated by Ordinary Least Squares (OLS) or Generalized Least Squares (GLS), assuming that x (regressor) is strictly exogenous. Furthermore, interpretation of the βs coefficients is straightforward. Also, the weaknesses of the model can be minimized using different ways, for example, in the case of big sample size; the degree of freedom is not much affected. Altogether, Haile et al. (2013) informed that no literature provides evidence on the superior price expectation model to be used for estimation of agricultural production response. According to Erdal et al. (2009), "Koyck lag model (a reduced model from the distributed lag model) addresses the limitations of other distributed lag models". This makes Koyck model robust among other expectation models''.

The estimated model for this study is as follows:

$$lnmlandsize\ 2018 = \alpha(1-\lambda) + \lambda \text{mlandsize2017} + \beta_1 \text{hhsize} + \beta_2 \text{Agehead} + \beta_3 \text{Edu} + \beta_4 \text{novisits} + \beta_5 \text{mprice} \quad V_t \quad \ldots (3)$$

Where:

lnmland2018 = current size of land planted with maize (2018)
mlandsize2017 = previous year production (represented by the size of land grown with maize -2017)
hhsize = household size
Agehead = age of the head of household
Edu = Number of years head of the household spent in school
novisits = number of visits by extension officers
mprice = expected price
$\beta_1 - \beta_5$ = parameters to be estimated and
V_t = random error term

Notably, it is the size of land planted with maize used to represent quantity of maize produced. This is supported by Coyle (1993) that size of land planted with crops is not influenced by the conditions (e.g., climate change) after planting as output does.

4.0 RESULTS

Among other factors, the paper intended to empirically test the relationship that exists between the expected farm-gate price and the maize produced (or size of land planted maize). Thus, the null hypothesis to be tested reads as: "*there is no relationship between the expected farm-level price and size of land allocated to maize production*". Other factors involved in the analysis are previous year production (size of the previous land allocated to maize production); household size; the households' age; and the heads of the household's education.

The specified model (3) was estimated to measure the relationship between expected farm-level price and the size of land planted with maize in the 2018 production season. As stated earlier, crop price is used as a proxy for transaction costs as it is a victim of transaction costs. Moreover, unobservable transaction costs are difficult to quantify but it is obvious that their total effect is seen in the crop price. Before running the model, checking its fitness and ability of explanatory variables to explain the variations observed in the dependant variable was crucial. The F – test was conducted to check how the model fits the data. The results indicated that the model (3) estimated was statistically significant at a 1 percent level meaning that the model fit the data correctly. Also, part of the variations observed in the dependent variable was significantly explained by the independent variables involved in the model as adjusted R^2 was about 72 percent (Table

2).

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.849[a]	0.721	0.716	0.30656

a. Predictors: (Constant), expected farm gate price in TZS, numbers of years spent in school, number of visits done by extension officers in 2018, the total size of land in acres planted with maize in the 2017/2018 production season, age of head of household, family sizes.

Koyck Lag Model results presented in 3 were statistically significant at 1%, 5%, and 10%. The results indicate that household size and the total of land in acres planted maize in the previous production season (2017) had positive coefficients of 0.043 and 0.216 respectively and were significant at both 1% (p = 0.000). Also, the expected farm gate price (in TZS) had a coefficient of 1.203E-005 and was significant at 10% (p = 0.069). Moreover, the age of the household head and the number of years spent in school had positive coefficients of 0.001 and 0.006 respectively but were not significant at 1%, and 10% (p = 0.322, p = 0.446). Finally, the number of visits done by extension officers in 2018 had a negative coefficient of -0.005 but was also not significant (p = 0.787).

Table 3: Koyck Lag Model Results

Variable	**Coefficient**	**Standard Error**	**t-value**	**Probability**
Constant	-0.581	0.123	-4.705	0.000
Household size	0.043	0.008	5.255	0.000***
Age of household head	0.001	0.001	0.991	
Number of years spent in school	0.006	0.007	0.762	0.322
				0.446
Total of land in acre planted maize in 2017	0.216	0.008	27.571	0.000***
Number of visits done by extension officer in 2018	-0.005	0.018	-0.271	0.787
Expected farm gate price in TZS	1.203E-005	0.000	1.822	0.069**

Key: ***Highly significant at 1% (α = 0.01) and **Significant at 10% (α = 0.10

Dependent variable: Current land grown with maize in the 2018 production season

Source: Field survey data and own computations

5.0 DISCUSSION

The finding of this study shows that the household size contributed positively to the land allocated for maize production at t-value of 5.255. This finding implies that an increase of one unit (i.e. one member of a household) would increase acres planted maize by 5.255%. In other words, a small household size cultivates small areas of land for maize production. The relatively small farm size of the respondents will inevitably lead to subsistence farming which does not encourage commercial farming. This finding makes sense since in the study area household members are the main source of manpower used in agricultural production. The findings tally correctly with among others, the one obtained by Simonyan et al. (2011) which revealed that household size is a positive and significant driver for agricultural production. However, these findings contrast with the agriculture household model which is applied in developing countries where markets of agricultural output are said to be imperfect. The market imperfection causes the farming household to allocate labour into different activities, whereby the allocation decisions can be determined endogenously by the rate of shade wage rather than the rate of market equilibrium (Bongole et al. 2022). Razzano et al. (2020) revealed the existence of agricultural output market imperfection in Tanzania. Based on the agriculture household model and the existence of market imperfection in the study, still households were found allocating their labour to maize production. Barrett (2008) argued that the information asymmetry, market imperfections, and transaction costs could push farming households to produce food for their consumption rather than for market production. Similarly, farmers with market access that guarantees higher prices and superior profits for their products will be encouraged to increase agricultural productivity and production.

Also, the expected farm-level price contributed positively to the size of land allocated to maize production at a t-statistic of 1.822 and is significant (ρ = 0.000). This finding allows the rejection of the null hypothesis; hence, there is a relationship between the expected farm-level price and the size of land allocated to maize production. The finding derived from this study is that farm-level price is an important factor to increase crop production. The finding of this study is similar to that obtained by Mose et al. (2007) that high maize price-related significantly to aggregate maize supply. Similarly, the findings agree with the transaction cost theory as low transaction cost enables a farmer to receive a good price and therefore be motivated to increase production by expanding the land under cultivation. Therefore, low farm gate prices affect smallholder farmers to increase land for maize cultivation as well as inhibit them from pursuing commercial agriculture opportunities.

Moreover, as stated in the methodology section, the previous season's land allocated to crop production is a crucial factor for the next season's land that will be cultivated. Based on the results obtained from the analysis, the size of land grown with maize in the previous season showed a positive sign and it is significant (ρ = 0.000). This implies that if the previous season's land cultivated increased by one acre, the next season’s land that will be planted maize will increase by 0.22%. Either sign was expected depending on the price of maize in the previous season. This is so because if the price was attractive then farmers would expand the land for production and vice versa is true. These findings are consistent with earlier literature (Razzano et al. 2020). Similarly, the findings agree with the cobweb theorem which states that “price fluctuations can lead to fluctuations in supply which cause a cycle of rising and falling prices”.

Although not significant, age and education of the head of household indicated a positive relationship with the size of land allocated to maize production. The result implies that the size of land allocated to maize production increase with the increase of the age and level of education of household head. One unit (year) increase in the age above the mean leads to a 0.001% increase in land grown with the maize. On the other hand, the result revealed that a 1-year increase in schooling leads to an increase in the size of land growing with maize by 0.01%. Contrary to other studies, the findings revealed an insignificant relationship between the age and size of land grown with maize. Among other studies which found a significant relationship is Nyambose and Jumbe (2013). But they showed the possibility of age leading to an increase or decrease in the probability of adopting the technology and therefore increase or decrease in production. For the case of education, Ebojei et al. (2012) obtained the same results in terms of the sign but different in significance level. Results by Ebojei *et al.* indicated that education of the farmer is related to maize production significantly as it is an important determinant for technology adoption as well as extension services.

Results show that number of a visit by extension officers is an insignificant determinant of crop production with a negative sign. The negative coefficient suggests a negative influence of the variable on determining the size of land allocated to maize production. This result implies that a 1 unit increase in the number of visits by extension workers above the average would decrease acres grown with maize by 0.005%. The negative sign is contrary to the expectations of the researchers. Similarly, the finding is contrary to the one obtained by Mose et al. (2007) that shows extension services positively and significantly influenced maize production in Kenya. Similarly, the finding is not in line with that of Abubakar et al. (2019) and Ambali et al. (2021) who highlighted that number of extension visits has a positive impact on farm production and investment decisions. Farmers often rely on the information provided by extension agents to make informed farm production and investment decisions (Ambali et al. 2021). Probably the negative coefficient and insignificant relationship between the number of visits done by extension officers and the size of land allocated for maize production as well as improved maize production is because even if farmers adopted the extension officers' knowledge it was difficult to access the market for the surplus.

6.0 CONCLUSION

The main objective of the study was to empirically quantify the relationship between crop production and farm-level price. The key findings indicated that the expected farm-level price has a significant influence on the land allocated to maize production. These findings allowed the rejection of the null hypothesis stated earlier. Based on these findings, it can be concluded that the output market component (maize price for this study) is crucial for increased crop production. With increased crop production and assured market, farmers will solve or reduce the problem of poverty in different ways; through food secured and earned income for other needs like dietary requirements, paying school fees, etc. Traditionally, interventions for increased crop production have been in technological issues like improved seeds and fertilizers ignoring the output market. Therefore whatever effort that minimises constraints along output marketing channels and hence low transaction costs is important. The low transaction cost will allow traders to offer an attractive price to farmers and therefore increased crop production.

Based on the findings the authors are hereby recommending those interventions aimed at reducing transaction costs and encouraging increased crop production while increasing farmers' participation in competitive markets. Some of the recommended interventions that might reduce transaction costs and therefore attractive farm-level prices are the improvement of rural roads and communication infrastructure together with a reduction in different levies along with both inputs and output market channels.

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8.0 CONFLICT OF INTEREST

The authors declare that this manuscript is a result of their original effort and work and that to the best of their knowledge, they declare that this study has no conflict of interest.

REFERENCES

Abu, B. M., Issahaku, H., Nkegbe, P. K. 2016. Farmgate versus Market Centre Sales: A Multi Crop Approach, *Agricultural and Food Economics*, 4 (21): 1-16.

Abubakar, H. N., Garba, Y. , Gana, A. K. and Jocob I. A. 2019. Factors influencing adoption of rice improved production practices by farmers in adopted villages, Niger state, Nigeria. *Adv Plants Agric Res.*, 9(1): 183 – 189.

Ambali, O.I., Areal, F.J., Georgantzis, N. 2021. Improved Rice Technology Adoption: The Role of Spatially-Dependent Risk Preference. *Agriculture*, 11, 691. doi.org/10.3390/agriculture1108069.

Anh and Bokelmann, 2019. Smallholders' Preferences for Different Contract Farming Models: Empirical Evidence from Sustainable Certified Coffee Production in Vietnam, *Sustainability*, 11(14): 1-26.

Barrett, C. B. (2008). "Poverty traps and resource dynamics in stallholders agrarian systems," in Environment and Natural Resource Use, eds R. Ruijs and R. Dellink (Springer), 17–40.

Benfica, R., Boughton, D., Mouzinho, B., Uaiene, R. 2014. Food Crop Marketing and Agricultural Productivity in a High Price Environment: Evidence and Implications for Mozambique. Research Paper # 76E. Maputo, Mozambique: Directorate of Economics, Ministry of Agriculture.

Bongole, A. J., Hella, J. P. and Bengesi, K. M. K. 2022. Combining Climate Smart Agriculture Practises Pays Off: Evidence on Food Security From Southern Highland Zone of Tanzania. Front. Sustain. *Food Syst.* 6:541798. doi: 10.3389/fsufs.2022.541798.

Boudreau, M., Watson, R.T., Chen, A. J. W., Greiner, M., Sclavos, P. 2007. The Benefits of Transaction Cost Economics: The Beginning of a New Direction. Conference Paper; Proceedings of the Fifteenth European

Conference on Information Systems, ECIS 2007, St. Gallen, Switzerland, 2007, accessed on 13/04/2020, https://www.researchgate.net/publication/221408443
Bryman, A. 2016, *Social Research Methods*, Oxford University Press, New York.
Chongela, J. 2015. Contribution of Agriculture Sector to the Tanzanian Economy, *American Journal of Research Communication* 3 (7): 57-70.
Coase, R. 1937. The Nature of the Firm, *Econometrica*, 4: 386 - 405.
Collinson, C. D., Kleih, U., Burnett, D. G., Ferris, R. S. B., Jagwe, J.N., Muganga, A. K. 2002. *Transaction Cost Analysis. Final report.* Technical Report. Natural Resources Institute, Chatham, UK; accessed on 20/03/2020, https://gala.gre.ac.uk/id/eprint/12186/1/Doc-0545.pdf .
Coyle, B. T. 1993. On Modeling Systems of Crop Acreage Demands, *Journal of Agricultural and Resource Economics*, 18 (1): 57-69.
Cuevas, A. C. 2014. Transaction Costs of Exchange in Agriculture: A Survey, *Asian Journal of Agriculture and Development*, 11 (1): 21 – 38.
Dana, J., Gilbert, C.L. 2008. Managing Agricultural Price Risk in Developing Countries, Discussion Paper No. 19, 2008.
Ebata, A., Cramon-Taubadel, P. V. S. 2015. Transformation of Global Agri-Food Systems:Trends, Driving Forces, and Implications for Developing Countries. Global Food Discussion Papers, Georg-August-University of Göttingen; accessed on 11/022020, https://www.spring-nutrition.org/publications/resource-review/updates/.
Ebojei, C. O., Ayinde, T. B., Akogwu, G. O. 2012. Socio-economic Factors Influencing the Adoption of Hybrid Maize in Giwa Local Government area of Kaduna state, Nigeria, *Journal of Agricultural Science* 7 (1): 23-32.
Erdal, H., Erdal, G., Esengun, K. 2009. An Analysis of Production and Price Relationship for Potato in Turkey: A distributed Lag Model Application. *Bulgaria Journal of Agricultural Science* 15(3): 243 - 250.
German, H. 2008. Risk Management in Commodity Markets: Shipping to Agriculturals andEnergy. A John Wiley and Sons Ltd Publication. The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, England.
Haile, M.G., Kalkuhl, M., & Von Braun, J. (2013). Short-term Global Crop Acreage Response to International Food Prices and Implications of Volatility. ZEF – Discussion Papers on Development Policy No. 175. Bonn, Germany: Center for Development Research Press; accessed on 06/05/ 2020,https://link.springer.com/article/10.1007/s12571-017-0731-x
Jack, B. K. 2013. Constraints on the Adoption of Agricultural Technologies in Developing Countries." Literature review, Agricultural Technology Adoption Initiative, J-PAL (MIT) and CEGA (UC Berkeley).
Jagwe, J. N. 2011. The Impact of transaction costs on the Participation of Smallholder Farmers and Intermediaries in the Banana Markets of Burundi, Democratic Republic of Congo and Rwanda. University of Pretoria, SA.
Jongeneel, R. A., Ge, L. 2010. Farmers' Behavior and the Provision of Public Goods: Towards an analytical framework. Wageningen, Statutory Research Tasks Unit for Nature & the Environment (WOT Natuur & Milieu), WOtwerkdocument 203. 64 p. 6.
Key, N., Sadoulet, E., Janvry, A. 2000. Transaction Costs and Agricultural Household Supply Response, *American Journal of Agricultural Economics,* 5 (82): 245 - 259.
Koyck, L.M. (1954) Distributed Lags and Investment Analysis. North-Holland, Amsterdam.
Kyaw, N. N., Ahn, S., Lee, S. H. 2018. Analysis of the Factors Influencing Market Participation among Smallholder Rice Farmers in Magway Region, Central Dry Zone of Myanmar. *Sustainability* 2018, 10, 4441.
Leyaro, V., Boulay, B., Morrissey, O. 2014. Food Crop Production in Tanzania: Evidence From the 2008/09 National Panel Survey, F-40110-TZA-1: Research Report to IGC Tanzania. The International Growth Centre (IGC), British, UK.
Martins, R. A., Serra, F. R., Leite, A. S., Ferreira, M. P., Li, D. 2010. Transactions Cost Theory Influence in Strategy Research: A Review through a Bibliometric Study in Leading Journals. Rio de Janeiro/RJ-25 a 29 de setembro de 2010.
Mose, L.O., Burger, K., Kuvyenhoven, A. 2007. Aggregate Supply Response to Price Incentives: The Case of Smallholder Maize Production in Kenya, *African Crop Science Conference Proceedings, Nairobi, Kenya*, 8, 1271 – 1275.
Ngaruko, D. D., Bushesha, M., Pallangyo, W. 2014. Trade Impediments and Market Transaction Arrangements for Maize and Rice in Tanzania, *World Journal of Social Science Research*, 1(1): 1 – 20.
Nyambose, W., Jumbe, C. B. L. 2013. Does Conservation Agriculture Enhance Household Food security? Evidence from Smallholder Farmers in Nkhotakota in Malawi, *International Journal of Sustainable Agriculture Research, 5(1)*, 118-128.

Okoye, B.C., Abass, A., Bachwenkizi, B., Asumugha, G., Alenkhe, B., Ranaivoson, R., Randrianarivelo, R., Rabemanantsoa, N., Ralimanana, I. 2016. Effect of Transaction Costs on Market Participation among Smallholder Cassava Farmers in Central Madagascar, *Cogent Economics & Finance* 4 (1): 1 - 20.

Razzano C. C, Mura G, Borrelli N (2020) What potential for small-scale farmers in Tanzania? Evidence from Arumeru in: Borrelli N, Ndakidemi P *Small Farmers for a Food System Transition: Evidence From Kenya and Tanzania*, Ledizioni LediPublishing, Milano – Italy.

Simonyan, J. B., Umoren, B. D., Okoye, B. C. 2011. Gender differentials in Technical Efficiency among Maize farmers in Essien Udim Local Government Area of Akwa-Ibom State, Nigeria, *International Journal of Economics and Management Sciences*, 1(2): 17-23.

Statista (2021. Global data platform. https://www.statista.com/

Tomšík, K., Smutka, L., Lubanda, J. P. E., Rohn, H. 2015. Position of Agriculture in Sub-Saharan GDP Structure and Economic Performance, *Agris on-line Papers in Economics and Informatics, VOL, VII, No. 1*.

URT (2015). Agricultural Sector Development Strategy - II 2015/2016 – 2024/2025. Ministry of Agriculture Food Security and Cooperatives (MAFC), Dar es Salaam, Tanzania.

Williamson, O. E. 1991. Comparative Economic Organization: The Analysis of Discrete Structural Alternatives, *Administrative Science Quarterly*, 36 (2): 269 – 296.