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The Effect of Agricultural Commercialization on Household Food Security among Smallholder Farmers in Zhombe North Rural District of Zimbabwe

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ABSTRACT

Background: Achievement of food security has become one of the major challenges of most developing countries, including Zimbabwe. This study was designed to investigate the effect of agricultural commercialization on household food security. **Methods**: This study used cross-sectional data for the 2017/18 farming season collected from 165 smallholder farmer households in Zhombe north rural district in Zimbabwe. Instrumental variable regression model was applied for data analysis over the effect of agricultural commercialization. Agricultural commercialization was measured using the crop output market participation share (COMPS). **Results**: The results revealed that COMPS, household head age, household head gender, and income per capita had a significant positive influence on household food security. **Conclusions**: The results indicate that agricultural commercialization and socio-economic characteristics have a role to play in defining the household's food security. Therefore, the findings recommend policies that would promote agricultural commercialization, which improve household food security in turn. The study recommends policymakers to promote agricultural commercialization, since it positively contributed towards household food security. In addition, young-headed, female-headed, and low-income earning households that were identified as the food insecure households.

Keywords: *Commercialization; Food security; Instrumental variable regression.*

Introduction

The effect of agricultural commercialization on household food security was widely investigated in smallholder farmers. However, the findings were controversial; some showed positive effects, whilst the others reported negative effects. Since limited information exists on this issue in Zimbabwe, this study was conducted. Some researchers in Zimbabwe indicated a positive relationship between agricultural commercialization and agricultural productivity, but little is known on the effects of agricultural commercialization on household food security. In Zimbabwe, agriculture plays a significant role in economic stability and growth, contributing to 18% of the gross domestic product (GDP) (Alexander, 2013). However, the country is described as food-deficit with a very

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fragile food security situation (Zimbabwe ICDS 2017), so that 70% of Zimbabwean rural households depend primarily on agriculture for their livelihoods. Economists and politicians acknowledge that agriculture is a driver for growth in Africa with the potential to end poverty and hunger (Timmer, 2005). Agricultural commercialization is one of the strategies used to raise farm incomes and to achieve overall economic development (Carletto *et al.*, 2017, Radchenko and Corral, 2018). This paper added on the currently existing knowledge and provided empirical evidence on the effect of agricultural commercialization on household food security. To measure agricultural commercialization, this study used the crop output market participation share (COMPS).

This study measured household food security using a modified food consumption score (MFCS), which builds upon the Food Consumption Score (FCS) mainly focussing on the household food security access component as one of the important aspects of the household food security equation. Food access is defined as the ability of a household to acquire food from its production, purchase from the market or food hand-outs (Maxwell *et al.*, 2014). The FCS is a food security indicator with composite characteristics that capture the intensity, quality, diversity, and nutritional importance of various food groups consumed in a household [7]. The FCS was calculated using the data obtained from household consumption in seven days. The score uses the frequency when a household consumed food from the identified eight food groups assigning each food group a score and computing the overall FCS, as primarily used by the world food programme (World Food Programme, 2015). The food groups include staples/tubers, pulses, vegetables, fruit, meat/fish, milk, sugar, and oils.

Food insecurity continues to be a challenge, especially in smallholder farmers whose livelihoods depend on rain-fed agriculture. Researchers pointed out the causes of food insecurity as poverty, natural disasters, climate change, etc. The situation calls for increasing collaborative interventions with short-term, mid-term, and long-term scopes by specialists, governments, and development partners. According to Food Agriculture Organization (FAO), food security is defined as a situation whereby "all people at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active healthy life" (Food Agriculture Organization, 1996). Food security has four components including availability, access, utilization, and stability. Food availability and access are very important in the household food security equation (Maxwell *et al.*, 2014). The food insecure population increased from 804 million people in 2016 to 821 million in 2017 (World Health Organization, 2018). Global leaders committed themselves to achieve sustainable development goals (SDGs) that include SDG 2 targeted at ending world hunger.

The debate over the effects of agricultural commercialization is focused on food security, although it is known that farming households' incomes increase through agricultural commercialization (Radchenko and Corral, 2018). Agricultural commercialization has the potential to increase access to improved inputs and marketed food; hence, reducing the food insecurity problems (Radchenko and Corral, 2018). Some studies indicated the perverse effects of agricultural commercialization particularly on the poorest farmers (Carletto *et al.*, 2017). One of the most recent studies conducted in Vietnam using panel data indicated that the effects of agricultural commercialization on household food security was heterogeneous and depended on the agricultural commercialization indicator and the region (Linderhof *et al.*, 2019). These researchers found that the impact of agricultural commercialization on the household food security was more positive in the Southern regions of Vietnam compared to the Northern regions.

A commercialised farming household is the one that produces significant amounts of crops for sale and makes use of improved inputs in its production. The researcher defined a

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commercialised household as the one that sells its farm products, whilst a non-commercialised household was regarded as the one that does not sell its farm products. Given that agricultural commercialization levels vary from 0% to 100%, this study used the intensity of COMPS.

Different households use different ways to handle the problem of food insecurity and this depends on factors such as demographic characteristics of the households and other community variables. Many factors in a household interact to determine the household food security, sometimes households can have more income, but how the income is used depends on the desire to buy nutritious food (Carletto *et al.*, 2017). The economic security of a household is also an important factor as it determines the availability of income and safety nets of a household to afford food (Hendriks, 2015). An Ethiopian study revealed that household size negatively influenced household food security and food insecurity was greater in larger households. The same study showed that households with higher asset indices tended to cope better compared to the poor households in shocks such as drought.

A study in Ethiopia highlighted that food security was a function of entitlements and these entitlements determined the ability of a household to get adequate food (Iram and Butt, 2004). Moreover, technology, land size, and land quality were found to be positively and significantly affecting food security. Food available to a household depends on the family tastes and preferences, demographic characteristics, and food prices. A farming household is both a producer and a consumer of its products. It also can sell its surplus and buy other food products from the market at the same time; so, their economic behaviour can be modelled. Female-headed households tend to be less food secure due to the limited resources such as land and farming labour capacity.

The potential of households to expand small grain utilization is very important in determining the food security. Households located in low rainfall areas need to exploit the production of crops that do well in their areas, so that they can meet their food requirements. One of the most reviewed reasons why households fail to substitute maize with small grains is that the home processing for small grains is intensive as compared to maize. The household's economic access and reception of salary in cash (not receiving foods or goods as a payment) in drought years are among the important factors in improving household food security.

A study in Zambia indicated that income, education, younger age, and gender of the household head (male-headed) were in favour of household food security. The study applied a logit model and measured household food security using meal frequencies (Bulawayo *et al.*, 2019). Household income was considered as an indicator of the households' economic status, which was found to improve the households' access to food. Education increased the human capital of households and increased chances of the household head engagement in wage-earning employment that would increase the ability of households to buy food. An increase in family size increased the household's social and productive capital that enhanced household food security (Bulawayo *et al.*, 2019). On the contrary, an increase in the household size compromised the household's ability to get enough food due to large food demands to meet the household needs (Kalid *et al.*, 2016). Most studies indicated that male-headed households were more food secure compared to the female-headed households. This was believed to be associated with the discriminatory cultural, political, physical, and social situations for women with regard to the ownership and control of productive economic resources especially in Sub-Saharan African and other developing countries (Bulawayo *et al.*, 2019). This implied that female-headed households were more vulnerable to food insecurity. Multiple linear regression analysis was done in Tanzania to find out the determinants of household food security. It indicated that a household's income and number of owned cattle positively contributed to

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food security, while the household size affected household food security negatively.

Materials and Methods

Study area: In Zhombe north rural district, the main livelihood source was formal employment on Empress mine, which changed after the dismantling of the mining company in the late 1970s. The people had to find other ways of survival and started farming. The crops they grow in the area included maize, cotton, sorghum, groundnuts, millet, etc. Most farmers have been growing the crops for sale and consumption. The area is part of the Midlands province, which is currently one of the food insecure regions of Zimbabwe as revealed by the Famine and Early warning Systems network (FEWS NET, 2017). This study is aimed to reveal the effect of agricultural commercialization by smallholder farmers on improving the household food security. Agricultural commercialization will be among other factors such as gender, household size, land size, etc.

Zhombe north rural district is located 155 kilometres North West of the Midlands provincial capital of Gweru taking, approximately a three-hour bus ride from Gweru. The area is 70km southwest of Kadoma town and 104km northwest of Kwekwe town. This area is part of the Midlands province under the Zibagwe rural district council forming part of the rural Kwekwe. **Figure 1** depicts the Zhombe rural map, which is also known as Kwekwe Rural

Design and sampling: This study used the 2017/2018 season cross-sectional data in Zhombe north rural district collected from the ward numbers 6, 7, and 8. The survey captured qualitative and quantitative data on household socio-economic characteristics, farming activities, as well as food security aspect of the households. The two-stage sampling procedure was used to collect data. In the first stage, purposive sampling was applied to select Zhombe north rural district in the Midlands province based on agricultural commercialization practice and the food insecurity challenge. In the second stage, households were randomly selected from the three wards in Zhombe north rural district. A sampling frame of smallholder farmers in the study area was obtained from the extension workers allocated to work in the area and a sampling size of 165 households was estimated for all wards. The formula used to get the sample size was (Yamane, 1967):

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

where n, *e* and N are the sample size, margin of error and population size, respectively. The research targeted the Midlands province, which is one of the areas experiencing a crisis in food security in Zimbabwe (FEWS NET, 2017). The study focussed on rain-fed smallholder farmer households in the Zhombe north rural district with the household as the unit of analysis. The inclusion of the crops in the study was limited to the rain-fed food and non-food crops. The food crops were limited to cereal and legume crops, which included maize, sorghum, groundnuts, round nuts, and cowpeas. The field-grown cash crop in the study area is cotton. The reason for choosing the rain-fed cropping farmers was that the largest proportion of people experiencing food insecurity in the world are the rural smallholder farmers who depend on rain-fed agriculture. So, it would be important to investigate ways through which food security for these households can be enhanced (World Health Organization, 2018).

Data analysis Many methods have been applied in modeling factors of household food security, which include the logistic, ordered probit, Tobit, and linear regression models. However, choosing the model depended on how food security was measured and many ways could be used to measure the household food security (Maxwell *et al.*, 2014). The literature review indicated that the most widely applied model was the logistic regression model (Agidew and Singh, 2018). The multiple linear regression model or the ordinary least squares regression model is one of the methods that can be applied if the dependent variable is continuous and normally distributed. If the dependent value is normally distributed and an

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endogenous variable, the instrumental variable regression method can be used. A variable is endogenous when it is correlated with the error term. The instrumental variable regression model is used to cut the correlations between the error term and independent variables.

To investigate the effect of agricultural commercialization on household food security, the modified food consumption score (MFCS) was used as a proxy to household food security. The instrumental variable regression method was applied because COMPS was suspected to cause an endogeneity problem when included in the Ordinary Least Squares (OLS) model. This is because the level of commercialization can be influenced by other factors included in the model; hence, there will be simultaneous causation in the model variables. Selection of the model depended on satisfying the endogenous variable test as well as the weak instruments test for the instrumental variable regression.

The MFCS makes use of the average FCS for three different seasonal times experienced by smallholder farmers categorised as the early farming period (EFP), mid farming period (MFP), and the post-harvesting period (PHP). The average FCS computed from the three-period estimates is the modified food consumption score (MFCS). The MFCS is important in this study because with agricultural commercialization, a household is assumed to consume higher quantities of food and improved diet quality with diverse nutrient types.

The FCS was computed by estimating the frequency of household consumption of food from the eight food groups with different weights shown in Table 1 in seven days (World Food Programme, 2015).

The factors affecting household food security were identified in the reviewed literature of previous studies. The list of variables used is shown in **Table 2**.

Instrumental variable regression was used to model the effect of COMPS on household food security after selecting an appropriate instrument. Instrumental variable regression model is defined as:

$$Y_{i1} = \alpha Y_{i2} + \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \beta_k X_{ki} + \mu_i \quad (1)$$

Where, Y_2 is an endogenous variable, when it is correlated with μ_i. The instrumental variable regression model was specified as:

$$MFCS = \alpha COMPS + \beta_0 + \beta_1 Age + \beta_2 Gender + \beta_3 Education\ level - \beta_4 Household\ size + \beta_5 Food\ or\ cash\ assistance + \beta_6 Off\ farm\ employment + \beta_7 Agricultural\ training - \beta_8 Distance\ from\ market + \beta_9 Livestock\ units + \beta_{10} Income\ per\ capita + \mu_i \quad (2)$$

The explanatory variables were identified following the empirical evidence on the factors affecting household food security. The studies indicated that household socio-economic factors, income, asset-related endowments, and other climate-related factors influence household food security (Bulawayo *et al.*, 2019).

Results

The explanatory variables for household food security included the COMPS, which could possibly be influenced by some of the explanatory variables in a regression model causing an endogeneity problem of simultaneous causation. Due to this fact, the key determinants of household food security were measured using the instrumental variable regression model. The instrumental variable regression model was used so that the effect of the endogenous variable COMPS on household food security could be measured. The results from the IV regression model are summarised in **Table 3.**

The model was significant at the 1% level as shown by the model specification chi-square test ($P < 0.01$). The R-squared value for the model was 0.24 implying that 24% of the data explained household food security. The IV regression model was not over identified revealed by the over identification test that was not significant ($P > 0.1$); hence, rejecting the null hypothesis stating model over identification. The Pflueger robust weak instrument test is the one used to test the

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relevance and validity of an instrument to include in the model (Pflueger and Wang, 2015). The test was used to examine the validity and relevance of the chosen COMPS instrument.

The result of the weak instrument test indicated that the selected instrument for the crop output market participation share variable was valid. The values for Tau at 10% level of significance for both the limited information maximum likelihood test (LIML) (F statistic = 8.55) and the two-stage least squares (TSLS) test (F statistic = 12.154) for the robust weak instruments were all lower than the effective F-statistic (F statistic = 17.292), rejecting the null stating that the instruments are weak. The instrument used in the model was the farming implements index. This variable was a proper instrument because it could meet the validity and relevance properties of a suitable instrument. Farming implements index was correlated with the crop input market participation share (relevance property), but did not directly determine the household food security (validness property). The results show that the effective factors on the household food security were the crop output market participation share, household head age, household head gender, and income per capita.

Table 1. Food groups weights in food consumption score

Food group	Weight
Main staples	2
Pulses	3
Vegetables	1
Fruit	1
Meat/Fish	4
Milk	4
Sugar	0.5
Oil	0.5

(World Food Programme, 2008)

Table 2. List of variables expected to influence household food security

Description of variables	Measurement	Expected r/ship
Household head age	Number of years	+
Household size	Number of people	-
Crop output market participation share	Proportion of field crop sales over the total value of field crops produced on a farm	+
Distance from market	Kilometres	-
Livestock units	Livestock units computed using standard livestock unit values for different types of livestock	+
Household head gender	1=Male, 0=Female	+
Education	1=Education level above primary, 0=Otherwise	+
Off farm employment	1=Regular employment outside farming, 0=Otherwise	+
Agricultural training	1=Received training on farming, 0=Otherwise	+
Income per capita	RTGS	+
Food/cash assistance	1=Yes, 0=No	+

Table 3. IV regression model results for the effect of agricultural commercialization on household food security (n=165)

Variables	Coefficient	Z-statistical
Crop output market participation share	12.717**	2.38
Household head age	0.199***	2.78
Household head gender	6.32***	3.09
Education	1.001	0.41
Household size	0.467	1.31
Access to food or cash assistance	1.02	0.38
Off farm employment	2.37	1.04
Agricultural training	1.73	0.62

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Table 3. IV regression model results for the effect of agricultural commercialization on household food security (n=165)

Variables	Coefficient	Z-statistical
Distance from the market	-0.4	-0.37
Livestock units	0.45	1.29
Income per capita	0.00817***	3.15
Constant	25.46***	5.12
Model significance (Prob>chi^2)	<0.001	
R-squared	0.24	
Overid/Ovtest p-value	0.29	
Montiel-Pflueger robust weak instrument test	Effective F statistic=17.292; Tau=10% TSLS=12.154 Tau=10% LIML=8.55	
Wald/F	Wald chi^2(11) =132.19	

*, ** and *** mean 10, 5 and 1% level of significance, respectively.

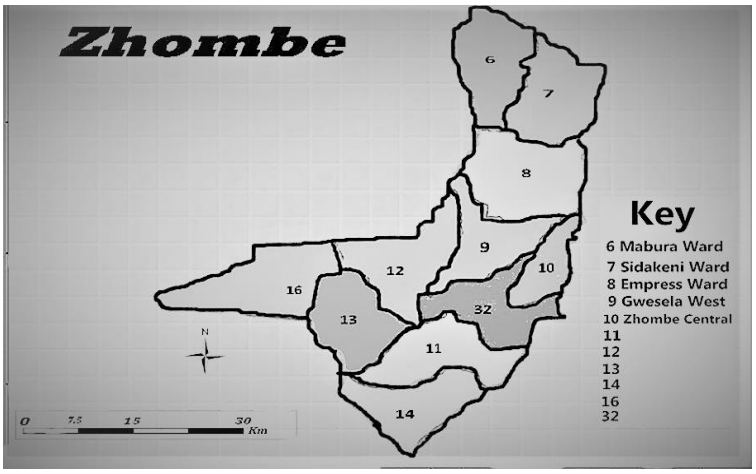

Figure 1. Zhombe North Rural District Map (Wikipedia, 2019)

Discussion

The COMPS positively influenced household food security at the 5% level of significance ($P < 0.05$). Increase of the COMPS value by 1 unit or 100%, holding all other factors constant, resulted in an increase of the household food security by 13 modified food consumption scores. This shows that agricultural commercialization affected the household food security positively through the consumption pathway. This can be attributed to the fact that households who intensively participated in the crop output markets received higher income and used this money for buying food, which in turn improved their food consumption scores. Similar findings were obtained in a Ogutu study, indicating that agricultural commercialization increased food expenditures and better diets (Ogutu *et al.*, 2017).

Household head age positively influenced household food security at a 1% level of significance ($P < 0.01$). An increase in the household head age by one year, holding all other factors constant, would lead to an increase in the household food security by 0.199 modified food consumption scores. This result can be justified by the fact that as household heads grow older, they accumulate more assets that can enhance food security coping strategies, which buffer their food consumption. Younger household heads compared to the older household heads, may have higher demands for cash to pay school fees for children and purchase assets that can fail to improve the food security of households and place these households at the vulnerable positions. This result concurred with the findings

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in other previous studies (Feleke, 2019). However, other scholars revealed an opposite finding, indicating that household head age influenced household food security negatively (Bulawayo *et al.*, 2019).

Household head gender had a positive influence on household food security at a 1% level of significance ($P < 0.01$). The change of household head gender from female to male would averagely increase the household food security by 6.32 modified food consumption scores. The study shows that male-headed households are more food secure compared to female-headed households. The survey statistics showed that 80% of the female-headed households were widowed. Many females lose their families' possessions when their husbands die followed by sharing the deceased person's assets, which is a common practice in the African culture; this may place the female-headed households in vulnerable situations. The findings were similar to the previous studies showing the negative influence of gender on household food security (Bulawayo *et al.*, 2019).

The income per capita positively influenced household food security at a 1% level of significance. An increase in income by 1 Zimbabwean dollar lead to an increase in household food security by 0.0082 modified food consumption scores. This implies that higher income per capita per household increases the food security of a household indicated by higher modified food consumption scores. The result depends on the willingness of a household to spend the income on quality diet. Other studies revealed a positive influence of income on household food security (Bulawayo *et al.*, 2019).

Conclusions

COMPS, household head age, household head gender, and income per capita had a significant positive influence on household food security. These results indicate that agricultural commercialization and socio-economic characteristics have a role to play in defining the household's food security. Therefore, the findings recommend policies that would promote agricultural commercialization, which improve household food security in turn.

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Conflict of interest

The researcher declares no conflict of interest in this study.

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