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The nexus between agricultural exports and food security in Zimbabwe

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Abstract

Purpose: This study aimed to evaluate the relationship between agricultural exports and food security in Zimbabwe from 1990 to 2023.

Research Methodology: A time-series analysis was conducted using the Ordinary Least Squares (OLS) method and autoregressive distributed lag (ARDL) bounds testing approach to examine both short-run and long-run dynamics. Diagnostic tests, such as ADF, multicollinearity, heteroskedasticity, and serial correlation, were performed to ensure robustness.

Results: The findings revealed that agricultural exports had a positive and statistically significant effect on food security. A 1% increase in agricultural exports leads to a 0.007% increase in food security. Other variables, such as rainfall, capital expenditure, and consumption expenditure, positively influenced food security, whereas rural and urban population growth negatively impacted it.

Conclusions: Agricultural exports play a critical role in enhancing food security in Zimbabwe by generating foreign currency and promoting investment in the agricultural sector. However, demographic pressures and climate-related risks remain significant challenges.

Limitations: The study is limited by data availability, as annual data may overlook short-term changes. Additionally, some potentially influential variables were excluded because of data constraints.

Contribution: This study contributes empirical evidence to policy debates on balancing export-oriented agriculture with domestic food needs. It offers actionable insights for government ministries and institutions involved in agricultural planning, advocating greater support for capital investment, infrastructure, and farmer education to ensure sustainable food security outcomes.

Keywords: *Agricultural Exports, FAO, Food Security, GDP, RBZ*

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1. Introduction

Food security is a critical global concern, particularly in developing countries such as Zimbabwe, where access to sufficient, safe, and nutritious food in some parts of the country remains a challenge. Zimbabwe's agricultural sector plays a crucial role in ensuring food security for its population, and the export of agricultural products has implications for the country's food security. Agricultural exports refer to the sale of agricultural commodities and processed products to other countries. While these exports can generate significant economic benefits and foreign exchange earnings for Zimbabwe, it is essential to assess their impact on domestic food security. Akter (2022) pointed out that there is limited understanding of how effective food protectionism is as a tool for stabilizing food prices, as well as its welfare impacts on various actors within the local economies of food-exporting countries. The impact of climate change-induced shocks, such as Cyclones Idai and Kenneth and the worst drought experienced in the past three decades in the Southern African Development Community (SADC) region,

has put Zimbabwe's food security situation in a precarious position. The region has close to 44.8 million people estimated to be food insecure as of July 2020, representing a 67% increase from 2017 (26.9 million people) and a 10% increase from 2019 (41.2 million people) (Alliance, 2020). As of July 2020, approximately 7.7 million people in Zimbabwe were estimated to be food insecure, representing a 40% increase from 2019 (5.5 million people) (AUDA-NEPAD, 2015). Maize production dropped in 2019 to 770 000 tonnes from 2.155 million tons in 2017. The Zimbabwe National Agricultural Policy Framework adopts agro-ecology as the anchor for resilient and sustainable agriculture.

Zimbabwe is a landlocked country with a population of approximately 14 million and a total land area of 39,600 million hectares (Akter, 2022). Eighty-five percent of the country is agricultural land, and the remainder is occupied by national parks, forests, and urban settlements (Ngwenya et al., 2022). The country has a dual agrarian structure comprising large-scale commercial farming and smallholder farming (including small-scale commercial farmers, communal area farmers, and resettlement area farmers). Over one-third of the population lives in urban areas, while the rest resides in rural areas and engages in small-scale and commercial agricultural activities. The country experiences a subtropical climate with a rainy season between November and March. Agriculture is at the heart of the Zimbabwean economy and is critical for food self-sufficiency. The Food and Agriculture Organization (FAO, 2011) argues that the agricultural sector generates 18.5 per cent of GDP and, at best, 40 per cent of total export earnings through the export of tobacco, cotton, and horticultural produce, among others; employs 66 per cent of the country's labor force (the majority being women); and accounts for about 60 per cent of all raw materials for industry. The main agricultural products are maize, cotton, tobacco, wheat, coffee, sugarcane, peanuts, millet, soybeans, sheep, pigs, and goats.

The International Fund for Agricultural Development describes national food security as the capacity of a nation to procure a stable and sustainable basket of adequate food. Zimbabwe should strive to promote agricultural exports while prioritizing domestic food production, crop diversification, and investment in storage and processing infrastructure. The impact of agricultural exports on food security in Zimbabwe is complex and multifaceted, going beyond poverty reduction. It contributes to the improvement of farmers' income growth and generates a surplus for export. Hence, this study examines the impact of agricultural exports on food security in Zimbabwe using a time series data approach for the period of 1990-2023. Since 2000, food production in Zimbabwe, once known as the breadbasket of Southern Africa, has remained below subsistence levels (CZI, n.d.). Owing to the forward and backward links that exist between agriculture and other economic sectors, the poor performance of the agricultural sector has an impact on the entire economy. Output has been restricted due to several unfavorable factors, including structural ones.

Low output could be a result of underfunding the agricultural industry, particularly in research and development, and a lack of public-private partnership investment in the rural and agricultural commodity sector, which is a prerequisite and important catalyst for agricultural development and food production in Zimbabwe. Foreign direct investment has also been limited to date, as less than three per cent in 2022 was invested in agriculture and food industries worldwide (Chopera et al., 2024). These include power outages, lack of credit facilities, high fuel prices and shortages that made agricultural production expensive and delayed timeous land preparation, shortages of foreign currency to meet farmers' requirements of inputs, persistent droughts due to climate change, and deteriorating land quality (through soil erosion, acidification, and nutrient depletion). Gwanongodza (2020) argues that agricultural seasons have been negatively impacted by intrapersonal dry spells and constant rain caused by climate change. Agricultural production has also decreased due to failing irrigation systems and the government's price controls, which have a disincentive effect. This has led to widespread shortages of goods and services, low export revenues, high unemployment rates, and declining living standards.

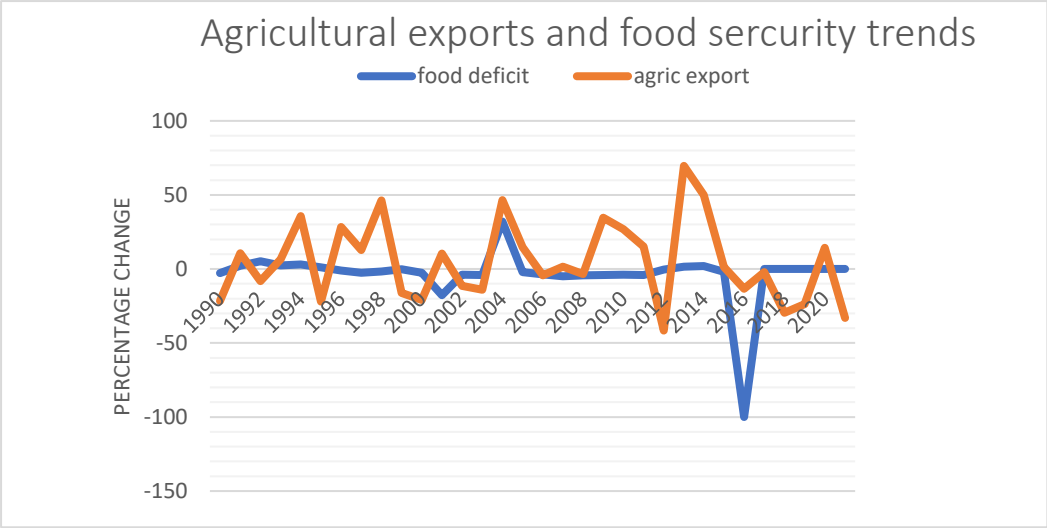
J. S. Smith (2019) postulates that low and lower-middle-income countries remain challenged with low value-added and manufacturing exports. Delays in processing payments to farmers who would have delivered their crops to the Grain Marketing Board (GMB) and limited coordination on the procurement and distribution of key inputs, such as seeds, fertilizers, and chemicals, are some of the challenges faced in the agricultural sector. Decreased production in the sector has also been affected by land reform

programs. The majority of productive farmland remained in the hands of white people after the country gained independence in 1980. During the 1990s, the government attempted to change ownership by taking land and redistributing it without paying compensation, resulting in grain exports and production falling as hundreds of farms were taken over. In Zimbabwe, most farmers face the biggest challenges in accessing the support services they need to increase their productivity. Zimbabwe now depends on food imports and aid to supplement domestic production, making it a more vulnerable nation regarding food security.

The nation's the 1990s Economic Structural Adjustment Program (ESAP) contributed to the decline of investment in the agriculture industry. It made stabilization funds and marketing boards less effective for both agricultural commodities and food staples without viable alternatives being put in place. In late 1997 and 1998, many of the government's fiscal targets were not met, and continuing budget deficits may have contributed to the slowdown in growth. According to Madimu (2020), economic growth declined because the goals of structural adjustment were not met, which also led to higher unemployment, food insecurity, increased poverty, and restricted access to social services. The mandate of the government and the policy makers is to focus on boosting the productive capacity of the economy by reforming the tax code to prioritize economic growth and opportunity (Chika, Oshiogwemoh, & Promise, 2022). Thus, lowering taxes for farmers can stimulate investment in food production and processing, enhancing both local food supply and export capacity.

Open-minded trade recognizes trade, not aid, and the slogan designates a craving to purchase or acquire products from developing countries rather than charitable aid (Ahmad & Dahalan, 2020). In recent years, donor funding for Zimbabwe's agriculture has decreased. For instance, official development assistance for agriculture was cut by multilateral institutions from US$3.4 billion to US$500 million between 1980 and 2019, a decrease of 85% (T. T. A. Smith & Gregory, 2023). The cessation of donor support, negative international press, and Zimbabwe's isolation from the rest of the world all contributed to the already dire situation. The situation in Zimbabwe is also explained by years of systemic failures in development strategies at the national and multilateral levels. At the multilateral level, for instance, long-standing agricultural export subsidies and domestic support programs in developed countries impact agricultural development in developing nations, such as Zimbabwe (Chopera et al., 2024). Indirect export subsidies through export credits, state trading enterprises, and food aid are also permitted under the World Trade Organization's agriculture agreement. This has caused production in developing nations to be compromised for both exports and home markets, with the current result being the retarded farmers' capacities to generate the supply response that the current food crisis calls for. Tawodzera and Crush (2016) revealed that mergers and strategic alliances in the agro-food sector have contributed to the higher prices for agricultural inputs, as well as to the fact that Zimbabwean farmers receive a relatively small fraction of retail prices for their products, thus, profit incentives that would have enhanced food production in Zimbabwe have been dampened.

Matandare (2017) mentioned that monopolistic tendencies in food production and the genetic engineering of seeds are also major culprits that have led to food insecurity in Zimbabwe. Zimbabwe is also experiencing the worst economic crisis in its history, characterized by food shortages and high inflation. The exponential growth in headline inflation is attributed to price increases in both food and non-food categories in the country's consumer-price-index basket. Johnson (2023) added that the economic downturn has seen over three million Zimbabweans now living in the diaspora, one-third of the population malnourished and 2.5 million people receiving food aid. This has further reduced the saleable assets of smallholder farmers, leaving them vulnerable and food insecure. The main objective of this study was to examine the effects of agricultural exports on food security. To achieve this objective, this study evaluates the impact of agricultural exports on food security in Zimbabwe from 1990 to 2023.



Source: FAO and World Bank (2023)
Figure 1. Agricultural exports and food security in Zimbabwe (1990-2023)

Figure 1 shows the trends in agricultural exports and food security from to 1990-2023. For the period 1990-1999 there was a sharp decline in both agricultural exports and food security due to drought, which affected the country during this period. This was also attributed to the implementation of the Economic Structural Adjustment Program (ESAP) in 1990, which caused a shift in food security policies. These businesses were followed by low capital outlay, high mobility, and poor knowledge of food security issues. The policy also caused an increase in basic food prices, which led to food security problems. The general population was left worse off because they could not access food. In 2002, there was a sharp decline in agricultural exports and food security caused by a decrease in agricultural production due to poor agricultural seasons that prevailed during the period and the fast-track land reform policy. A sharp decline in food security and agriculture exports also recorded a tremendous decline in 2008. This is because Zimbabwe experienced hyperinflation in 2008.

Hyperinflation eroded purchasing power, leaving most individuals worse off. Zimbabwe's agricultural produce, as an agrarian economy, fetched lower prices on the global market, and the situation was worsened by the global melt town. During 2018-2019 the agriculture sector was hit hard by drought, which resulted in large-scale crop failure and a sharp decrease in agricultural exports and food security. In 2019, According to Manyanga, Murendo, Pedzisa, Mutyasira, and Ndou (2023), the country's vulnerability assessment committee estimated 5.5 million Zimbabweans in rural and 2.2 million Zimbabweans in urban to be food insecure during the peak of 2019-2023, leaving people in need of food assistance. However, during some periods under study, there were some noticeable improvements in agricultural exports and food security, for instance the Period 2003-2007. This can be attributed to factors such as incentives that have been unveiled, for example, credits and technology, irrigation developments and input support, and the command agriculture provision of tillage services.

Matandare (2017) and Mukoka (2020) assert that the agriculture sector contributes 60% of raw materials to the other sectors for production and 70% of the total population employed in the sector. Agriculture plays a vital role in reducing poverty and contributes to development in developing countries, including Zimbabwe. Agricultural exports contribute significantly to the economy's generation of foreign currency, which may be channeled to other important sectors. However, due to the harsh economic conditions in Zimbabwe, agricultural output is declining, as depicted in Figure 1. The agricultural sector has encountered constraints such as limited market access, drought, corruption, and limited access to finance, leading the country to resort to imports, especially maize from Zambia. The economic performance of the region has declined over the years under investigation, leading to an increase in expenditure on food imports and falling export earnings. Despite the government's efforts to increase agricultural productivity through Presidential Input Schemes, Pfumvudza, dam construction, and the country's involvement in international trade, the country continues to suffer from food insecurity. Thus,

studying the impact of agricultural exports on food security is critical in Zimbabwe. Achieving a balance between agricultural exports and domestic food production, along with the diversification of agricultural systems, is crucial for ensuring long-term food security. This research is significant as it aids relevant institutions, such as the Ministry of Lands, Agriculture, Fisheries, Water and Rural Development and Ministry of Finance and Investment Promotion, in allocating funds and finding suitable measures to deal with the negative trends in the sector.
The article has an introduction that shows the background of the study, research gap, study objectives, and significance of the study. This is followed by a literature review that summarizes related studies in the area of interest. The methodology section consists of the econometric model and a description of the variables. The next section presents the results, interpretation, and discussion. The last section presents the conclusions and policy proposals.

2. Literature review

2.1 Theoretical Foundations

Several theories have been proposed to explain the relationship between food security and agricultural exports, and some have been advanced to explain variations in food security. For the purpose of this work, only the theories of Malthus and Heckscher-Ohlin are succinctly discussed. Malthus (1986) propounded the Malthusian theory and his interests were on the gap between the growth of population in exponential terms and the slower growth of food supply in arithmetic terms which result in food shortages. He proposed that food security problems are a threat that a country will endure. Furthermore, after 1961, world cereal yields and agricultural output continued to drop (Harris & Kennedy, 1999). According to the FAO, food output per capita decreased in 51 developing nations, including Zimbabwe, and increased in 43 developed countries between 1979 and 1987 (Sadik, 1991). The neo-Malthusian theory analyzes food security from the perspective of food production. Malthus (1986) addressed the issue of food shortage and proposed the theory that the world's rising population will outstrip the planet's ability to feed it. He claims that population control is more powerful than the earth's ability to provide man with food.

Building upon various theoretical models of agricultural exports and food security in the economic literature, this study aims to determine how agricultural exports and various explanatory factors affect food security in Zimbabwe. The model is based on the Heckscher-Ohlin Theorem. The Heckscher-Ohlin theorem (H-O theory) is a tenet of classical trade theory that suggests that international trade liberalization leads to economic growth. According to the hypothesis, countries with a lot of capital will export capital-intensive products, and countries with a lot of labor will export labor-intensive goods. The H-O theory also recognizes the economic implications of inefficiency in production. Therefore, a country that has a relatively cheap cost of capital to labor but chooses to engage in labor-intensive activities would be inefficient in productivity. Therefore, the liberalization of agricultural foreign trade is an essential factor in promoting food security in Zimbabwe. The relevance of the theory hinges on the fact that each country is endowed with one form of resource or the other, as postulated. Furthermore, the theory emphasizes that the basis of trade is the difference in natural resources. This postulation is adequately relevant to the selected countries because they are endowed with different resources. From the aforementioned different natural resource endowments in Zimbabwe, there is a basis for trade, as explained by the H-O theory of international trade. The evidence of trade indicates a tendency for food security among the selected countries based on different natural resources.

Various studies have examined the relationship between agricultural exports and food security. Adenegan et al. (2004) studied the effects of agricultural exports on Nigeria's food security. Employing multiple regression analysis, their results proved that export earnings do not have a considerable effect on food insecurity in Nigeria, whereas other variables, such as food imports, real per capita income, total domestic output of food, and time, have a positive relationship between food security and agriculture exports. Tiongco and Francisco (2011) looked at the Philippines' food security problem and the potential approaches to achieve food security. The findings on food security show that the Philippines is far from becoming self-sufficient. Using the same econometric technique, Osabohien, Matthew, Gershon, Ogunbiyi, and Nwosu (2019) examined the effect of agricultural exports on food security in West Africa. According to their research, agricultural exports have a major impact on

economic development. The researchers affirmed that agricultural exports should be supported by extending the agricultural production base.

Abdelhedi and Zouari (2020) researched the impact of agriculture on food security in North Africa. Their findings, using a fixed effects model, demonstrated that agricultural value-added has a positive association and a considerable impact on food security. Runganga and Mhaka (2021) studied the causality between agricultural exports and economic growth in Zimbabwe. The regression results show that agricultural raw exports have a negative relationship with economic growth, whereas agricultural and non-agricultural exports have a positive relationship with GDP. The Granger causality test shows the direction of causation for the variables. Agricultural raw exports and agriculture exports do not Granger-cause GDP growth, but non-agricultural exports cause GDP growth.

3. Methodology

This study adopted an ex-post facto research design to examine the impact of agricultural exports on food security in Zimbabwe from 1990 to 2023. The data used in this study were secondary in nature and were sourced from the World Bank, FAO, and the Zimbabwe Statistical Agency. The data were collected on an annual basis. The current study treats food security as a dependent variable, and food security together with other variables act as explanatory variables; thus, they act as control variables capable of influencing food security.

This study adopts the model employed by Adenegan et al. (2004), who studied the influence of agricultural exports on food security in Nigeria. They expressed their model as follows.

$$\mathrm{FSI} = \beta_0 + \beta_1 \mathrm{AGRIEX} + \beta_2 \mathrm{YPC} + \beta_3 \mathrm{FEP} + \beta_4 \mathrm{TDF} + \beta_5\, \mathrm{INF} + \beta_6 \mathrm{DRGT} + \beta_7\ \mathrm{CONE} + \beta_8 \mathrm{CAPE} + \varepsilon_t$$

Due to the unavailability of data, several variables in the adopted model, such as real per capita income, food export profits, total domestic food output, and inflation, were removed. Hence, to fit the current investigation, the author modified the aforementioned equation as follows:

$$\mathrm{FSI} = \beta_0 + \beta_1 \mathrm{AGRIEX} + \beta_2 \mathrm{RNF} + \beta_3 \mathrm{RUR} + \beta_4 \mathrm{URB} + \beta_5\, \mathrm{FIMPO} + \beta_6 \mathrm{DRGT} + \beta_7\ \mathrm{CONE} + \beta_8 \mathrm{CAPE} + \varepsilon_t$$

FSI, AGRITEX, RNF, RUR, URB, FIMPO, DRGT, CONE, CAPE, and ε_t represent food security, agriculture exports, rainfall, rural population growth, urban population growth, food imports, drought, government expenditure, capital expenditure, respectively; ε is a random error term; and t is the time trend, which is normally included in standard time-series specifications to account for the omitted variables in the model. Agricultural exports, government expenditure, rural population, rainfall, and capital expenditure were expected to have a positive relationship with food security. On the other hand, drought and urban population would deter the growth of the economy; hence, a negative relationship is expected between agricultural exports, drought, urban population, and food security.

Diagnostic checks

The study conducted an OLS diagnostic test to satisfy the model prerequisites. Kondo and Mutsvangwa (2025) argues that, before assessing the chosen model, it is fundamental that one need to carry out diagnostic tests. Brooks (2019) and Triadji, Busnetty, and Sihombing (2024) contend that prior to assessing the outcomes, one ought to conduct diagnostic tests to guarantee the availability of data that satisfy the assumptions of the chosen parameter estimation procedure, for example, the Gauss Markov assumptions while utilizing OLS. If such assumptions are not satisfied, the researcher must settle on another assessment methodology that does not have extreme preconditions. To obtain relevant and suitable findings, tests such as unit root test, co-integration, auto correlation, heteroskedasticity to placate the independently and identically distributed residuals assumption, model specification and multicollinearity, amongst others are conducted. The statistical test for the measurement of the parameter estimate includes the co-efficient of determination R^2, Durbin-Watson (DW), F-ratio and the t-test. The significance level at which the hypothesis was accepted was 5% (0.05).

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4. Result and discussions

To acquire reliable outcomes, all diagnostic tests reported in this section must adhere to all the assumptions of the model propounded by Diebold (2017), Gujarati and Porter (2012), and Lin (2008), as communicated in the above section.

Table 1. Descriptive Statistics

	FSI	AGRIEX	CAPE	CONE	DRGT	FIMPO	RNF	RUR	URB
Mean	-1.285	10.65	14.47	16.78	0.26	12.88	637	45.23	28.78
Median	-1.68	0.369	15.57	17.29	0	13.16	649	45.53	28.45
Maximum	121.07	241.7	24.58	27.49	1	23.69	876	49.60	35.33
Minimum	-14.17	9.31	2	2.047	0	2.235	430	40.52	23.22
Std. Dev.	1.78	43.35	6.57	5.68	0.44	5.814	123	2.84	3.64
Skewness	3.10	5.12	-0.588	-0.95	1.11	-0.05	0.11	-0.129	0.20
Kurtosis	5.19	1.57	1.834	1.30	1.22	1.924	24.15	1.712	1.81
Jarque-Bera	2.61	29.54	2.29	6.11	7.1	1.42	0.52	2.22	2.01
Probability	0.2706	0	0.318	0.04	0.03	0.49	0.77	0.32	0.364
Observations	31	31	31	31	31	31	31	31	31

Source: Computer analysis using EViews 10

To understand the nature of the data collected, this study uses descriptive statistics for all variables under study, as presented in Table 1. Rainfall revealed very high volatility with 123 standard deviations from a very high mean of 637. A relative analysis postulates that rainfall plays a crucial role in affecting productivity, which then leads to low food security. A positive skewness of 0.11 means that during the time under study, there was good rainfall, which increased food security. A higher-than-normal kurtosis of 24.15 confirms that time series data with rainfall as a variable is more leptokurtic in nature.

Food security revealed high volatility (sensitivity) to exogenous effects, as shown by 43 standard deviations from the mean. It also indicates very wide range with maximum return of 121 % and minimum return of -14%. A positive skewness of 3 indicates that more food security exists during the period under study. Hence, agriculture should be invested in to secure more food for the household. A kurtosis of 5 implies an excessive peakedness and leptokurtic nature. The data for agricultural exports and other variables were different from food security and rainfall in terms of skewness and kurtosis. Kurtosis ranges from 1.6 to 1, indicating a mesokurtic nature, while food security and rainfall are leptokurtic in nature. The Jarque-Bera test suggests that all variables, except capital expenditure and drought, are normally distributed, as the p-values are significant at the 5% level of significance.

The Augmented Dickey-Fuller (ADF) test was used to check for the presence of unit roots. This is to ensure that the variables are devoid of stationary weakness that might impede the result of the analysis. Table 2 summarizes the ADF, and it can be inferred from the results that all the variables were integrated of order zero I (0) and one 1(1).

Table 2. ADF test results

Variable	ADF Test statistic	Test critical value at 5%	Order of integration
FSI	-5.510839**	-1.952910	I (1)
AGRIEX	-5.357790*	-1.952473	I (0)
CAPE	-6.363381**	-1.952910	I (1)
DRGT	-3.630677**	-1.952473	I (1)
RNF	-4.273374**	-3.574244	I (1)
FIMPO	-4.283766*	-3.568379	I (0)
URB	- 3.037190*	-2.967767	I (0)
CONE	-6.253667**	-1.952910	I (1)
RUR	-4.531361*	-1.952910	I (0)

Source: Computer analysis using EViews 10

The variables in Table 2 are stationary at I (0) and I (1), demonstrating a mean-reverting series. This is proven by the absolute values of the ADF statistics, which are greater than 0.05. Gujarati and Porter (2012) pointed out that variables are said to be stationary whenever the absolute values of the ADF statistics are greater than the critical values. The absence of I (2) variables in the model compelled the researchers to test for a long-run relationship between the variables. When variables are stationary at different orders, it is important to use the ARDL bound test to ascertain the long-run relationship between the variables (Nkoro & Uko, 2016). The ARDL approach allows for different lag lengths for each variable in the model, making it more flexible in handling dynamic relationships than the fixed lag structure in the (Engle & Granger, 1987). Another advantage is that ARDL is often preferred for small sample sizes, as it provides reliable estimates and inferences even with a limited number of observations. In contrast, the Engle and Granger (1987) method is less efficient for small samples. Thus, according to Yeboah (2020), the Engle-Granger test is considered more robust in most cases. The researcher used the ARDL bound test approach proposed by (Pesaran, Shin, & Smith, 2001).

Table 3. ARDL Cointegration test results.

Test Statistics	**Values**	**K**
F-Statistics	14.08041	3
	Critical bounds Values	
Significance	**Lower Bound**	**Upper Bound**
5%	3.62	4.16

The ARDL bound test results in Table 3 show positive results. K addresses the quantity of autonomous variables in the model (number of regressors). Using a 5% significance level, the F-statistics is higher than the lower and upper bound values, which allows us to infer that there is a long-run relationship between the variables under study.

4.1 Other diagnostic test

The p-values of the Ramsey Reset statistic for the model are significant at the 5% level of significance, showing that the models are correctly specified. Kondo and Mutsvangwa (2025) highlighted that, in classical linear regression, a model should be devoid of the heteroskedasticity problem. From the heteroskedasticity test, the p-value of the Chq statistics is greater than F t F-statistic at the 5% level of significance, which shows that the disturbances are independently distributed. The presence of autocorrelation in the model was detected using the LM test for serial correlation. The p-values of the Breusch-Godfrey serial correlation test are significant at 5%, which indicates that the variables are free from autocorrelation. Multicollinearity was not found between the independent variables. The maximum correlation (0.57) between the independent variables was observed for the rural population and capital expenditure.

4.2 Findings

OLS regression was used to estimate the relationship between food security and agricultural exports, with other explanatory variables in Zimbabwe. In the estimation process, the dependent variables were not lagged to ensure that the model possessed a high degree of goodness of fit. The coefficient of Adjusted R-squared, F-statistic and Durbin Watson statistic were statistical tools used to make inferences from the regression results.

Table 4. Presentation of regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AGRIEX	0.007729	0.003082	2.5081	0.02
CONE	0.083523	0.033433	2.498196	0.0204
CAPE	0.092726	0.034488	2.688688	0.0134
DRGT	0.938136	0.363178	2.583128	0.017
FIMPO	0.0604	0.029464	2.049957	0.0525
RNF	0.003165	0.001241	2.550469	0.0182
RUR	-7.831981	1.164321	-6.726651	0
URB	-5.768284	0.897346	-6.428162	0
C	513.1858	78.71316	6.519695	0
R-squared	0.886976	Mean dependent var		-1.284774
Adjusted R-squared	0.845876	S.D. dependent var		1.789019
S.E. of regression	0.702343	Akaike info criterion		2.368912
Sum squared resid	10.8523	Schwarz criterion		2.785231
Log likelihood	-27.71814	Hannan-Quinn criter.		2.504622
F-statistic	21.58113	Durbin-Watson stat		1.751849
Prob(F-statistic)	0.0000	0	0	0

Source: Computer analysis using EViews 10

The Adjusted R-squared reveals that 84.6% of changes in food security were attributed to the joint variations in all explanatory variables. This model is statistically significant, as highlighted by the F-statistic of 21.58113, which indicates that changes in food security were significant within the period studied. The Durbin Watson statistic of 1.75 is not quite bad; however, the serial correlation LM reveals no autocorrelation in the model. The regression results presented in Table 5 show that agricultural exports have a positive and statistically significant relationship with food security. The variable yielded a positive coefficient of 0.007, which means that a 1% increase in agricultural exports leads to a 0.007 percent rise in food security when all other factors are held constant. The underlying assumption is that agricultural exports can generate revenue and foreign exchange earnings, which can be invested in improving agricultural infrastructure, increasing productivity and enhancing food production capacity. The economic growth resulting from agricultural exports can create investment opportunities in rural areas, including agricultural research, technology, and market development. This can lead to increased agricultural productivity and income, ultimately benefiting food security in the region. This result is in line with the findings of Adenegan et al. (2004), where a 1 % increase in agricultural exports resulted in 0.78% increase in food security. They are also supported by Matandare (2017), who discovered that agricultural exports positively influence food availability in South Africa.

Rainfall was statistically significant with a variable coefficient of 0.003165. Rainfall is the primary source of water for agricultural crops. Sufficient and well-distributed rainfall ensures adequate soil moisture, which is essential for seed germination, plant growth, and the development of crops. Sustained and timely rainfall supports optimal crop productivity, leading to higher yields and increased food production. Satisfactory rainfall patterns are particularly important during critical stages of crop growth, such as flowering and grain-filling. Sufficient rainfall expands the possibilities of agricultural diversification. It enables farmers to grow a variety of crops, including staple crops, cash crops, and vegetables, depending on local agro-climatic conditions. Diversification enhances dietary diversity,

improves nutrition, and reduces the vulnerability of food systems to climate-related risks and market fluctuations. The results support Ciccone and Ismailov (2022); however, they contradict the findings of Kinda and Badolo (2019), who found that rainfall volatility negatively impacts the food supply.

Population expansion plays a significant role in explaining food security. It has a negative t-statistic and a negative coefficient of -7.831981. This means that a 1% rise in rural population growth will be followed by a 7.83 percent reduction in food security. This is because many rural areas have limited access to resources such as land, water, capital, and technology, which can hinder agricultural productivity. Smallholder farmers, who constitute a significant portion of the rural population, often face challenges related to inadequate infrastructure, low-quality inputs, and limited access to markets. These constraints can result in low agricultural yields, reduced food production, and, ultimately, food insecurity. These results are similar to those of Mbow et al. (2019), who pointed out that rural regions have a low per capita income, putting a strain on water and soil resources, improper methods of resource utilization, increased inequality among rural families, and decreased soil fertility, thereby compromising food security. Urban population growth has a significant coefficient of -5.768284, indicating that every additional unit of urban population growth results in a 5.768 percent reduction in food security. This is because as the urban population grows, the demand for food increases significantly. Urban areas require a constant food supply to meet the needs of their inhabitants. The rising demand can put pressure on agricultural systems to produce more food, which may lead to unsustainable agricultural practices, the overexploitation of natural resources, and increased environmental degradation. These results are in line with the work of Cole, Augustin, Robertson, and Manners (2018), who argued that food insecurity in emerging countries is a result of large-scale migration from rural to urban regions.

Drought was positively and statistically significant in explaining food security. Drought is a prolonged period of abnormally low rainfall that can lead to water scarcity, reduced crop yields, livestock losses, and overall food production challenges. However, the positive coefficient results contradict our expected results. This also contradicts the results of Kuwayama, Thompson, Bernknopf, Zaitchik, and Vail (2019), who argued that a prolonged period of drought results in high food insecurity. Their results also indicated that drought has an adverse impact on food security, possibly because Zimbabwe is an agro-based economy that heavily relies on agricultural output. Drought leads to reduced crop production, resulting in an increase in food prices and a reduction in food security. The positive sign can be explained by the role the government plays in ensuring food security. The ensuing surveillance and identification of vulnerable groups enhance access to food from the government or donor agencies.

Consumption expenditure was statistically significant with a positive coefficient of 0.083, implying that a 1% increase in consumption expenditure results in a 0.092 increase in food security. Sufficient consumption expenditure enables individuals to purchase an adequate and diverse range of food items that meet their nutritional requirements. Higher consumption expenditure generally indicates greater purchasing power, which can enhance access to nutritious food and contribute to improved food security. These results agree with Ahmed and Medabesh (2020), who found that the household share of food expenditure (as a proxy for income) is an indicator of household food security. Capital expenditure plays an important role in stimulating food security in Zimbabwe's agricultural sector. A 1% increase in capital expenditure contributes to a 0.092% increase in food security. Capital expenditure enables investment in agricultural inputs, machinery, irrigation systems, and other technologies that can enhance agricultural productivity. By providing farmers with access to improved tools and resources, capital expenditure can increase crop yields, improve post-harvest handling, and optimize production processes. Higher agricultural productivity contributes to increased food production and availability, which are crucial for achieving food security. This is in accordance with a study by Didi, Budi, and Nuhfil (2016) and Restiatun, Bustami, and Andika (2024). They found a positive impact of capital expenditure on the growth of agricultural produce and food security. Chand and Kumar (2004) analyzed the impact of capital expenditure on agricultural productivity and food security in Nigeria and found a positive relationship between capital expenditure and agricultural productivity and food security in Nigeria.

5. Conclusion

Achieving food security has been a difficult task for many countries, particularly developing countries such as Zimbabwe. More agricultural exports lead to the accumulation of foreign currency, which can be used to develop basic infrastructure and provide farmers with inputs that will result in high food security in the economy. The findings of this study empirically show that agricultural exports in Zimbabwe significantly affect food security. Although there is no prescribed amount of agricultural exports that guarantees food security, government authorities should always strive to maintain high agricultural output through policies. Based on the findings of this study, the following recommendations are proposed:

The government should promote cash crops for exports, such as tobacco and cotton production, as this will increase the availability of foreign currency and improve food security through entitlement. The government should set up a plant to process and package tobacco and cotton to add value and increase their competitiveness in international markets. This will increase competitiveness in the international market, thereby increasing earnings from exports, which, in turn, will help the importation of other basic food products that are not being produced efficiently in the country and can improve food security. The government of Zimbabwe should ensure that the private sector, such as banks, has adequate loans and foreign currency to support farmers, as this will contribute to an increase in food security in the economy. Private firms tend to be efficient in terms of resource allocation. Therefore, allowing the private sector to help individuals in need of assistance will speed up the processes involved in the agriculture sector. Private firms should, therefore, have enough money to support farmers with cheap loans, especially farmers in the meat industry, as they require huge capital. This will also enhance the country's food security.

Given the pivotal role of agriculture in Zimbabwe's economy and the challenges rural farmers face in accessing agricultural education, the government should implement an Agricultural Empowerment Initiative. This initiative should aim to provide comprehensive agricultural training to rural farmers, equipping them with the necessary knowledge and skills to cultivate high-value export crops effectively (Chiwaridzo et al., 2024). Many rural farmers in Zimbabwe are actively engaged in farming but lack the expertise to maximize their agricultural potential. Limited access to educational resources and financial constraints further impede their ability to adopt modern farming practices and cultivate high-value crops with high market value. By offering free agricultural training, the government can address these gaps and empower farmers to enhance their productivity and their income.

The government should allocate resources for agricultural research to improve crop varieties, farming techniques, and livestock breeds that are better suited to export markets. This will support the development of climate-resilient crops to mitigate the impact of weather variability on agricultural production, thereby increasing crop yields and agricultural exports. The government should upgrade rural roads to facilitate the transportation of agricultural products from farms to markets and ports for export purposes. Thus, the government should invest in storage facilities and cold chain infrastructure to reduce post-harvest losses for products such as vegetables, fruits, and meat to maintain the quality of perishable goods, thereby increasing exports, which will then food security. The government should transform the tobacco marketing system from auction sales to a dual system involving contract growing/marketing and auctions operating side by side. This can allow an increase in production through inputs and technical advice from contractors. This should unlock some potential by facilitating the timely provision of cropping inputs to growers, which then transforms into high food security in the economy.

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