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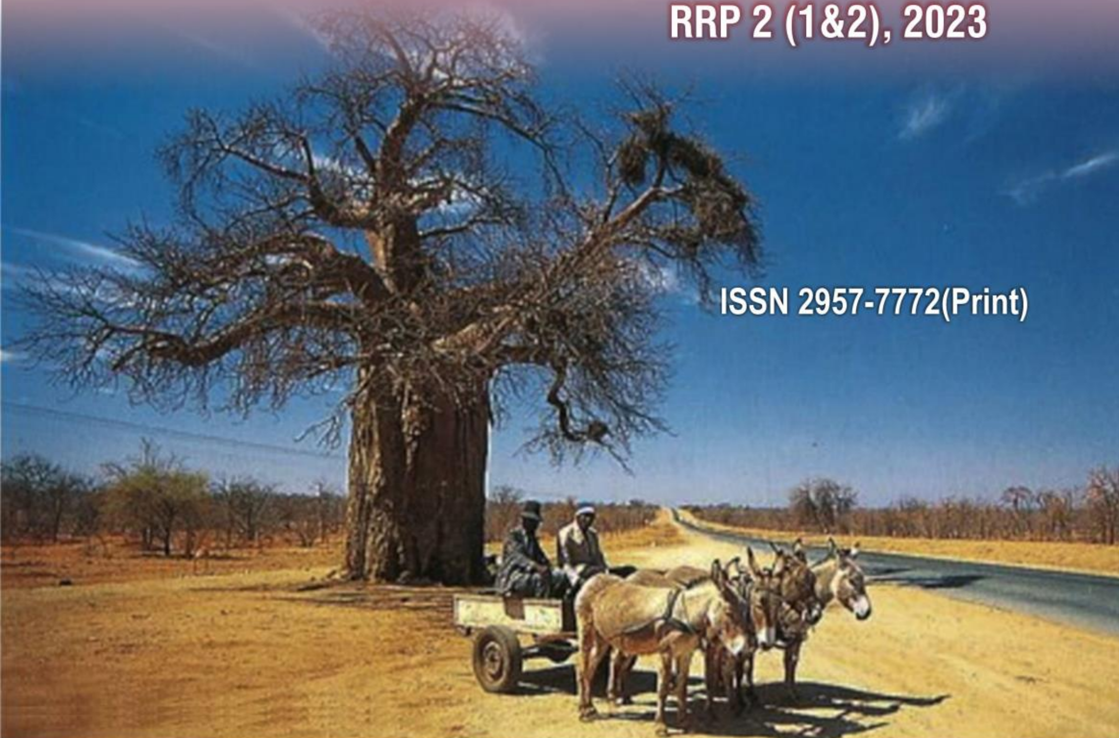
REVIEW OF *Rural Resilience Praxis*

RRP 2 (1&2), 2023



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About the Journal

JOURNAL PURPOSE

The purpose of the *Review of Rural Resilience Praxis is* to provide a forum for disaster risk mitigation, adaptation, and preparedness.

CONTRIBUTION AND READERSHIP

Sociologists, demographers, psychologists, development experts, planners, social workers, social engineers, economists, among others whose focus is that of rural resilience.

JOURNAL SPECIFICATIONS

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SCOPE AND FOCUS

As much as the urban territory is increasing by each day, the rural economy, especially in many developing countries, still retains a great proportion of the extractive and accommodation industry. Retaining some space as rural remains critical given the sectors role in providing ecosystem services to both wildlife and humanity. In this light, rural resilience as practice beckons for critical studies especially in the face of the ever-threatening extreme weather events and climate change that then impact on the livelihoods and lifestyles of the rural communities. Review of Rural Resilience Praxis (RRRP) comes in as a platform for critical engagement by scholars, practitioners, and leaders as they seek to debate and proffer solutions of the rural sector as well as trying to champion the philosophy of the right to be rural. The issue of conviviality between the different constituencies of the sectors, compiled with the competing challenges of improving rural spaces while also making the conservation, and preservation debates matter is the hallmark of this platform of criticality. The journal is produced bi-annually.

Guidelines for Authors for the Review of Rural Resilience Praxis

Articles must be original contributions, not previously published and should not be under consideration for publishing elsewhere.

Manuscript Submission: Articles submitted to the *Review of Rural Resilience Praxis*are reviewed using the double-blind peer review system. The author's name(s) must not be included in the main text or running heads and footers.

A total number of words: 5000-7000 words and set in 12-point font size width with 1.5 line spacing.
Language: British/UK English
Title: must capture the gist and scope of the article
Names of authors: beginning with the first name and ending with the surname
Affiliation of authors: must be footnoted, showing the department and institution or organisation.
Abstract: must be 200 words
Keywords: must be five or six containing words that are not in the title
Body: Where the authors are more than three, use *et al.,*
Italicise *et al., ibid.,* words that are not English, not names of people or organisations, etc. When you use several authors confirming the same point, state the point and bracket them in one bracket and in ascending order of dates and alphabetically separated by semi-colon e.g. (Falkenmark, 1989, 1990; Reddy, 2002; Dagdeviren and Robertson, 2011; Jacobsen *et al.,* 2012).

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The Impact of the Russia-Ukraine Conflict on Farmer Input Supply in Small-ccale Maize Production in Mashonaland East Province Zimbabwe

FADZAI MUTASA[1], ARCHEFORD MUNYAVHI[2] AND INNOCENT CHIRISA[3]

Abstract

The conflict between Russia and Ukraine created economic impacts felt across the whole world and has high potential to derail the economic outlook for Zimbabwe among many other countries that heavily depend on imports. Starting in early 2022, fertiliser prices rose almost 30% due to the Russian invasion of Ukraine. In this study, the effect of the Russia-Ukraine conflict on the cost of maize inputs, maize productivity and profitability of maize production was evaluated in Chikomba District, located within Mashonaland East Province for the 2021-2022 and 2022-2023 maize growing seasons. Simple random sampling was used to obtain a sample size of 385 participants derived from the conversion of a standard deviation of 0.5 at a 95% confidence level into a z-score. Questionnaires were used to obtain primary data from the participants. Benefit cost ratio (BCR) and gross margin budget analysis were used to evaluate the profitability of maize production. Out of the five explanatory variables that had a significant impact on maize productivity, AN use had the most significant effect in both seasons, 2021/22 and 2022/23, with (B=0.575, p=0.025) and (B=0544, p=0.025), respectively. Given that the Russia-Ukraine conflict period was characterised by exorbitant AN price increases that reduced affordability by many smallholder farmers across Zimbabwe, it therefore, means that the conflict has had a negative impact on maize productivity by farmers. This is due to the use of a lower fertiliser rate in response to the 57% and 71% price hike in basal and top-dressing fertiliser, respectively, lowering the yield/productivity of maize, meaning that there will be less maize to sell for covering costs and making a profit. The reduction in input levels lowered both the cost of production and the potential yield that could be produced for the market. There is need for further study aimed at

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developing solutions that enhance the farmers' resilience to the effects of conflict on input prices, productivity and profitability of maize production.

Key words: *productivity, profitability, smallholder farmer*

INTRODUCTION

Maize is Zimbabwe's staple crop with approximately 2.1 million metric tonnes (t) required for the nation to be food secure. Unfavourable macroeconomic conditions and recurrent droughts have made it difficult for Zimbabwe to meet this target, compelling the government to import maize from neighbouring countries (Dugbazah *et al.*, 2022). Maize production, productivity and profitability are crucial for food insecurity alleviation both at household and national level. In the recent past, a lot of factors have negatively affected maize productivity and profitability. Notable changes in the agrarian sector, macroeconomic challenges and climate variability are some of the problems that are blamed for the poor performance of the Zimbabwean agricultural sector, specifically maize (Bhasera, 2015). Maize ranks first in terms of the number of producers, area grown and total cereal production in Zimbabwe. Maize is the staple food crop of the nation and is also an important cash crop. About 64%of Grain Marketing Board (GMB) maize sales is used for human consumption, 22%as livestock and poultry feed and 14% for industrial purposes (Dugbazar *et al.*, 2022). For a standard maize producer, the cost of inputs is broken down as follows; seed (6.58%), fertiliser and lime (55.04%), herbicides (9.17%), insecticides (0.18%), labour (5.26%), tractor hires (14.91%) and harvesting with combine (11.05%) (SEEDCO, 2018). Maize production and its profitability in Zimbabwe is dependent largely on the cost and availability of fertiliser (55.04%), regardless of the sub sector (Mail, 2022). The conflict between Russia and Ukraine created economic impacts felt across the whole world and has high potential to derail the economic outlook for Zimbabwe aand many other countries that depend heavily on imports (*ibid.*). Starting in early 2022, fertiliser prices rose almost 30% due to the Russian invasion of Ukraine (Nduva *et al.*, 2022).

In January this year, fertilisers constituted 11, 8%or US$74.57 million of the country's import bill of US$632 million (*ibid.*). Russia is the second largest producer of ammonia after China, while Ukraine is ranked 18th based on production statistics for 2020 and the war is going to contract supply of ammonia and hence cause a spike in its prices. On the other hand, Zimbabwe is a net importer of ammonia, especially since the closure of the electrolysis plant at Sable Chemicals in Kwekwe (Paul, 2022). Other fertiliser dealers in

Zimbabwe import finished fertilisers from different parts of the world and the conflict has disrupted the commodity's value chains (*ibid.*).

Russia, which is contending with Western sanctions due to its invasion of Ukraine, produces large quantities of key chemicals used in the production of fertilisers. It also supplies much of the natural gas used to produce ammonia, a major component of nitrogen fertilisers (*ibid.*). As a result, the price of fertiliser went up by 55% in the last round of price increases, piling pressure on local farmers and food producers who are battling huge increases in operational costs (*ibid.*). Fertiliser sold in formal shops was costing between ZWL$25 000 and ZWL28 600 a 50-kg bag as of the 2022 agricultural season, while others demanding US dollars were charging between US$68 and US$78 a bag. Hikes in the price of fertiliser meant that production costs world increase against normally depressed producer prices. Grower viability is heavily compromised. Productivity will also be compromised as farmers may try to stretch the little as they must cover wide areas. Additionally, the cost of chemicals has gone up by 20%, diesel 35%, and labour up by 45% in US dollar terms, apart from the 55% increase in the price of fertiliser (*ibid.*).

LITERATURE REVIEW

Conflicts have two main effects on the cost of producing goods and services. First, shocks brought on by armed conflict disrupt markets and restrict trade (Arias *et al.*, 2019). Armed conflicts, terrorist attacks, looting, or general damage destroys public and private capital, assets and resources, reducing the productive potential of businesses and people (*ibid.*). Attacks on the civilian population result in kidnappings, murders and other forms of mortal injury that degrade or destroy human capital. Conflicts directly affect market efficiency as well (*ibid.*). Prices rise and network sizes decrease due to a decline in the supply of commodities and greater transaction costs.

THE EFFECTS OF THE RUSSIA-UKRAINE CONFLICT ON THE PROFITABILITY OF MAIZE PRODUCTION

Farmers and agricultural officials have struggled with the instability of smallholder farmers' income in emerging nations because of variable farm prices over the years (Emmanuel, 2020). The Russia-Ukraine conflict, directly affecting African countries, particularly the farmers who depend on agricultural inputs from these nations, poses a serious threat to the global economy at a time when farmers are still struggling to recover from the socio-economic effects of the Covid-19 pandemic (Agroforestry, 2022). Even outside of the continent where the war is being fought, numerous countries have been impacted by Russia's war on Ukraine. (*ibid.*).

The cost of goods has altered. Food costs are being driven up by the conflict, making agricultural supplies scarce for farmers. Compared to the cost before the conflict, goods and services are now very expensive (*ibid.*). Russia is one of the largest producers of fuel oil in the world; but, since the war, there has been a decline in fuel oil imports, leading to an increase in the cost of gasoline in the nation. As a result, farmers now pay more for transportation which lowers their earnings (*ibid.*). Few smallholder farmers can afford the rising costs of items because of the knock-on effects (*ibid.*). In January this year, fertilisers constituted 11.8%or US$74.57 million of the country's import bill of US$632 million (Mail, 2022). Russia is the second largest producer of ammonia after China, while Ukraine is ranked 18th based on production statistics for 2020 and the war is going to contract supply of ammonia and hence cause a spike in its prices. On the other hand, Zimbabwe is a net importer of ammonia, especially since the closure of the electrolysis plant at Sable Chemicals in Kwekwe (Paul, 2022). Other fertiliser dealers in Zimbabwe import finished fertilisers from different parts of the world and the conflict has disrupted the commodity's value chains (*ibid.*).

HOW CONFLICT AFFECTS LAND USE: A CASE AGRICULTURAL ACTIVITY IN AREAS SEIZED BY THE ISLAMIC STATE (IS)

Socio-economic shocks, technogenic catastrophes and armed conflicts often have drastic impacts on local and regional food security through disruption of agricultural production and food trade, reduced investments, and deterioration of land and infrastructure (Eklund *et al.*, 2017). The study noted that there were differences in the effects to land use between IS controlled areas and non-IS areas. It was discovered that signs of land abandonment in the IS zones were 7% of what had been cropland during the reference period (2000-2013) had changed to fallow/bare soil in 2015 (*ibid.*). This is only slightly more than land abandonment outside the IS zones, in that only 5% of the cropland was converted to fallow/bare soil (*ibid.*). A special report from Reuters stated that many farmers in the IS zones of Iraq had not planted any seeds for the 2015 season due to land access problems, fertiliser and fuel shortages, and uncertainty of getting their crop bought by the new 'government' (Fick, 2015). Non-IS zones saw a much larger relative change, where 52% of the high intensity cropland changed from having two to only one harvest. This indicates that farmers in both Iraq and Syria were having problems maintaining high intensity agriculture, but that farmers inside the IS zones were maintaining high-intensity agriculture to a wider extent. The results of the study showed that 63% of the high-intensity agriculture was maintained in IS areas (compared to 40% in non-IS areas). This may be because the IS has forced landowners to keep cultivating the land to control food production (*ibid.*). This is similar to a move taken by the government of Iraqi during a period of international trade sanctions in the 1990s, when it forced farmers to increase the cropland extent to compensate for the government's inability to import food and fertiliser (*ibid.*).

RUSSIA-UKRAINE WAR: GLOBAL IMPACT ON LOGISTICS

The Russia-Ukraine conflict has affected the global logistics market at every level (Blogs, 2022). The effects of the COVID-19 pandemic on warehouse capacity and container availability had just started fading when the Russia-Ukraine war started impacting the industry. The war impeded the flow of goods, fuelled cost increases and product shortages, and created catastrophic food shortages around the globe. Russia has been destroying Ukraine's agricultural infrastructure, thereby disrupting the entire supply chain (iibid.). The Black Sea and Azov Sea had been blocked by Russia, and the Ukrainian grain shipments were hijacked in the early months of the attack. However, in July, Russia and Ukraine signed a United Nations (UN) deal to allow Ukrainian grain exports from three Black Sea ports to ease shortages. Despite the deal, Russia attacked Odesa's seaport with cruise missiles hours after signing the deal. The uncertainty has had a snowball effect on supply chains across the globe (*ibid.*).

FOOD SUPPLY SHORTAGE AND RISE IN PRICES

In Europe, natural gas prices rose by around 120-130% in the six months since the start of the war, while coal prices rose by 95-97% during the same period. The prices of soybean, corn and crude oil – of which Russia is the leading producer – have been increasing ever since the attack (*ibid)*. The cost of fertilisers, mainly for crops and animal feed, was already high due to increased demand during the pandemic. Similarly, the household stockpiling of several products led to a shortage and the recently created shipment crisis deepened it. Russia and Ukraine are major suppliers of fertiliser and the land destruction and commercial constraints due to the war have brought a major export concern for fertilisers and, in turn, food and grains (*bid.*).

RISE IN OIL AND GAS PRICES

The surging oil and gas prices, coupled with the geopolitical risks arising from the conflict, are bound to cripple global supply chains, especially in the energy-intensive logistics sectors. The Black Sea ports, along with several other routes, has become non-operational following the war, cutting off the supply of several products and commodities, including transport equipment, machinery, electronics, metals, chemicals, fertilisers and food products (*ibid.*). The European Union has also been struggling with the availability of these energy sources, and the sharp surge in prices. The EU imports a significant share of energy from Russia. It also depends on Russia for 35% of its natural gas imports, around 20% of crude oil imports and 40% of coal imports. The rise in oil and gas prices has a crippling global effect. Organisations involved in supply chain operations need to take active measures to mitigate risks and soften the blow of rising prices and energy shortages (*ibid.*).

PORT CONGESTION, CONTAINER SHORTAGE, AND SURCHARGES

Several ports shut down due to the war, leading to a rise in ocean shipping costs (*ibid.*). Ships had to be re-routed causing congestion and leading to delays in cargo flows that worsened the global supply chain condition. In addition to this, sanctions and restrictions led to a shift from rail transport to ocean transport, creating more pressure and resulting in deeper container scarcity. This led to steep price increases for many essential goods, like grains, shooting up by around 60% between February and May 2022.

CONTAINER SHORTAGE

Average container prices continue to soar. The conflict has led to a massive increase in one-way pickup rates in India amid container shortages, wreaking major havoc on the peak shipping season. A stream of cancelled orders and delayed shipments have led to port congestion in the U.S (*ibid.*). Cargo is being moved away from the U.S. West Coast and there is an increase in container vessels anchored at Savannah and Houston. Because of U.S. port congestion, ocean carriers are cancelling shipments and sailings, leading to significant productivity issues at the ports. On the East and Gulf Coasts, container delivery volume is high and is pushing the prices up. The increase of containers on the East Coast is benefiting the warehouse sector, leading to fast-increasing warehousing costs. In August 2022, the prices were up by around 8% since January (*ibid.*).

However, the container volume in China is down. Manufacturing orders are being cancelled, resulting in a decrease in container bookings (*ibid.*). Also, several new projects are being launched to help provide some relief in the logistics sector. In July 2022, Fuzhou, the capital of east China’s Fujian Province, launched its 9 900-kilometre China-Europe long freight train named ‘Mindu.’ The train is expected to take 20 days less than the sea route (*ibid.*).

RESEARCH METHODOLOGY

Mashonaland East Province was the site of the research. It measures a total of 32 230 km^2 with a total population of 1.35 million and is one of the largest maize-growing provinces in Zimbabwe (City-facts, 2022). It has a combination of favourable climate, rich soils and the greater part of the province lies in natural region 2A and 2B where intensive farming takes place. The rainfall ranges from 750-1000 mm per annum and the temperature averages 25-30^{0}C (*ibid.*). Livestock and vast and intense crop production make up much of the economy of Mashonaland East Province. This region is used for the cultivation of tobacco and cereal crops like maize, sorghum and finger millet, and legumes like common beans, sweet potatoes, Irish potatoes, round nuts, and groundnuts. Across all tenure systems, maize is the most widely produced cash and cereal crop in the province (*ibid.*).

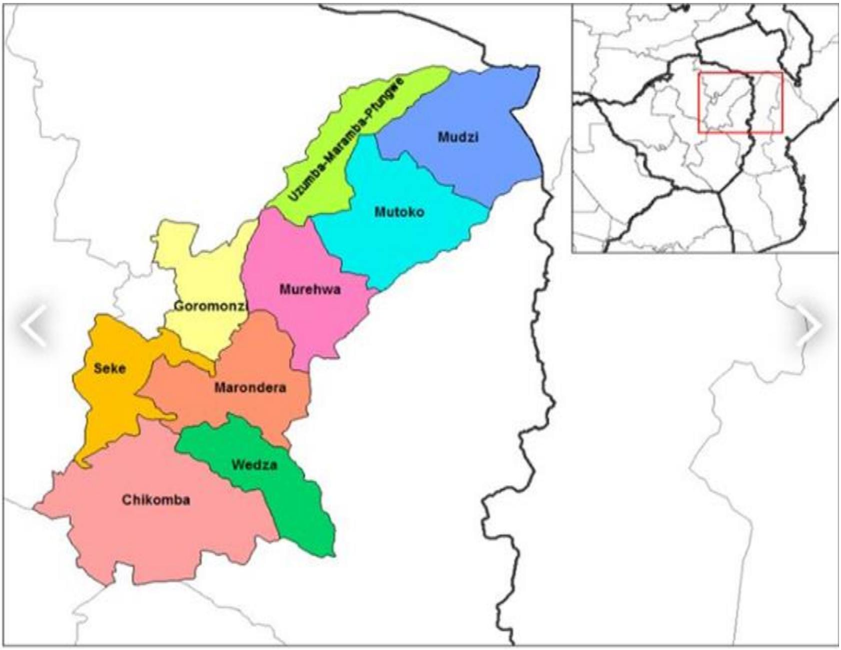

Figure 1: *Mashonaland East Province*

SAMPLING PROCEDURE

From Mashonaland East, 30% of the nine districts were selected and this translates to at least three wards in each district. Simple random sampling was used in this study to choose study respondents. Simple random sampling was done, using the maize farmer record received from the provincial Agritex officer to minimise bias and guarantee that every maize farmer participating in the study had an equal chance of being chosen. A sample size of 385 smallholders was used. Both primary and secondary data were used in this research to meet the study's objectives.

ANALYTICAL TOOLS

The first objective of the study was to determine the effect of the Russia-Ukraine conflict on productivity of maize production in Zimbabwe. Maize productivity in the study is the measure of the total number of 50-kg maize bags produced per hectare by a farmer. To test for maize productivity variance during the Russia-Ukraine conflict period, the research adopted an econometric Cobb Douglas production function shown below from the study by (Dube and Guveya, 2013).

$$Maize = \boldsymbol{\beta_0} + \boldsymbol{\beta_1 X_1} + \boldsymbol{\beta_2 X_2} + \boldsymbol{\beta_3 X_3} + \boldsymbol{\beta_4 X_4} + \boldsymbol{\beta_5 X_5} + \boldsymbol{\beta_6 X_6} + \boldsymbol{\beta_7 X_7} + \boldsymbol{\beta_8 X_8} + \boldsymbol{\beta_9 X_9} + \boldsymbol{\beta_{10} X_{10}} + \boldsymbol{\beta_{11} X_{11}} + \boldsymbol{\beta_{12} X_{12}} + \boldsymbol{\varepsilon}$$

where maize is the total quantity of maize of 50-kg bags from each hectare during the Russia-Ukraine conflict period, RK represents the dummy variable that is Russia-Conflict and X is vector representing farmer characteristics. The vector of characteristics includes gender, age, experience, maize variety, credit access, extension contact, Pesticides Control in 2021/22 season, Cultural Pest Control in 2021/22, Pesticide Control in 2022/23, Pest Cultural Control in 2022/23, Weed Cultural Control 2021/22, Weeds Cultural Control 2022/2023, Compound D Use 2021/22, AN Use 2021/2022, Compound D Use 2022/23, and AN Use 2022/23.

THE EFFECT OF THE RUSSIA-UKRAINE CONFLICT ON THE PROFITABILITY OF MAIZE PRODUCTION.

The last objective of the study was to determine the effect of the Russia-Ukraine conflict on the profitability of maize production in Zimbabwe. Gross margin (GM) analysis, a method for evaluating an enterprise's viability, was used. Like other investment analyses, GM is static and does not account for time value of money. Nonetheless, there are certain benefits to using GM as an analytical tool, such as its capacity to provide sensible alternatives for an organisation's operating structure. Data on variable expenses and revenue was used by GM. GM was obtained by subtracting the Total Variable Costs (TVC) of maize for all the farmers from the Total Revenue (TR) of produce of all the farmers as shown below. Fertiliser, herbicides, salaries and fuel expenditures are examples of variable costs. Total output per hectare was multiplied by price per kilogram to determine Total Revenue (TR). The following equation was used to do GM budget analysis:

GM = TR – TC

where: GM = Gross margin, TR = Total revenue and TVC = Total variable cost

If the GM is positive, it means maize production during the Russia-Ukraine conflict (2021/23 and 2022/23 season) was profitable. The choice rule for the GM analysis is to select a harvesting method whose GM is higher, relative to the other method. The study also used the Return per Dollar Invested (RDI) and break-even price to measure profitability of maize production during the Russia-Ukraine conflict (2021/23 and 2022/23 season). A return per dollar above USD1.5 is usually considered as a basic guideline with regard to the return per dollar as a measure of the financial viability and sustainability of a project (Mahoo, 2011). ROI= Profit/Cost of Investment and break-even price was obtained by calculating (Total fixed costs/Production unit volume) + Variable Cost per unit. Also, a harvesting technique with a significantly better return on investment is thought to be more practical and sustainable. Chagwiza *et al.* (2008) claim that calculating the GM is a crucial stage in budgeting for and planning a farm. GM is not a good indicator of profitability, although Johnsen (2003) found that it is the most acceptable indicator at farm level. One may immediately evaluate the profitability and viability of similar businesses using GM. In this study, the financial viability of tea production using the two harvesting techniques of hand and machine was evaluated using GM analysis. According to Orr (2008), the use of GM clearly identifies the areas that require improvement, and that GM analysis is crucial. To increase profits, one can quickly determine what must be improved.

RESULTS

The first objective of the study sought to determine the effect of the Russia-Ukraine conflict on the productivity of maize production in Zimbabwe. The researcher performed a Classical Multiple Linear Regression Model (CLRM) analysis. The results of the analysis are presented in Table 1 below.

Table 1: *Testing for Independence of Residuals* (Research Data and SPSS Results, 2023)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.852[a]	.810	.58	3.382	2.185

The test for independence of residuals is shown in Table 1, where the researcher computed the Durbin Watson test. A Durbin Watson statistic value of 2.185, which is suggestive that error terms (µ) generated by the Classical Linear Regression Model (CLRM) are free of auto-correlation though there is some form of negative correlation. Nevertheless, in this regard, the researcher adopted the general rule of the thumb by E-views (1997) which stipulates that a Durbin Watson test is considered to have no auto-correlation when it lies between 1.5 and 2.5. This, therefore, means the first assumption has been met.

Table 2: *Model Goodness of Fit - The ANOVA Table* (Research Data and SPSS Results, 2023)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	87.052	13	6.696	14.586	.000[b]
	Residual	983.388	371	11.435		
	Total	1070.440	384			

Table 2 results show that the explanatory variables included in the Classical Linear Regression Model (CLRM) have a collective statistical significance effect (F=14.586, p=0.000) on maize productivity in Zimbabwe. This means that the independent variables are jointly statistically significant in determining maize productivity (Table 2). The R-Square show that 81% of the variation in maize productivity is explained by the model explanatory variables representing the Russia-Ukraine conflict.

Table 3: *Classical Linear Regression Model results on Maize Productivity* **(**Research Data and SPSS Results, 2023)

Model		**Unstandardised Coefficients**		**Standardised Coefficients**	T	Sig.
		B	**Std. Error**	**Beta**		
1	(Constant)	33.663	6.802		4.949	.000
	Gender	.121	.982	.018	.123	.902
	Age	.023	.026	.128	.886	.378
	Maize Varieties	.393	.673	.067	.585	.560
	Experience	.157	.113	.112	1.42	.160
	Credit Access	.491	.135	.182	2.306	.049**
	Extension Contact	.033	.152	.181	.217	.829
	Pesticides Control 2021/22	.352	2.594	.053	.136	.892
	Cultural Pest Control	.327	2.680	.049	.122	.903
	Pesticide Control 2022/23	.241	3.643	.032	2.066	.047**
	Pest Cultural Control 2022/23	1.790	3.710	.234	.482	.631
	Weed Cultural Control 2021-2022	.723	.728	.110	.993	.323
	Weeds Cultural Control 2021/2022	1.064	.966	.130	1.101	.274
	Fertiliser Use Compound D Use 2021/22	.664	.691	.105	.960	.340
	AN Use 2021/2022	.575	.761	.085	2.755	.025**
	Compound D Use 2022/23	.432	.810	.011	2.102	.019**
	AN Use 2022/23	.544	.842	.073	1.646	.025**

Dependent Variable: YIELD (BAGS/Ha) Key, *, ** denotes 1%, 5%, level of significance respectively

Table 3 shows the explanatory variable coefficients together with the p-values used to determine whether an explanatory variable is statistically significant or not. The model results show that four variables; that is, credit access (t=2.306, p=0.049), pesticide use (2022/23) (t=0.066, p=0.047), AN use (2021/22) (t=0.755, p=0.025), Compound D use (2022/23) (t=0.105, p=0.019), and AN use in (2022/23) (t=0.646, p=0.025), were statistically significant in explaining the variation in maize productivity in Zimbabwe during the time of the Russia-Ukraine conflict. From the results of the study shown in Table 3, it can be noted that the beta values are 0.491, 0.241, 0.575, 0.432, and 0.544 for credit access, pesticides control during 2022/23 season, AN use during 2021/22 season, compound D use in 2022/23 season, and AN use in 2022/23, respectively. The 0.491 coefficient for credit access implies that when all other variables are held constant, an increase in access to credit by a unit, leads to an increase in maize productivity per hectare by about 0.491 bags, implying a positive effect of credit on maize productivity.

Secondly, all other explanatory variables being constant, when farmer increases pesticide control as in 2021/22 season, maize productivity per hectare also increase by 0.241 bags per hectare. This also implies that more pesticide should be availed and affordable to all smallholder farmers in the Russia-Ukraine conflict period to increase maize productivity given that farmers who had used pesticide control method had higher maize productivity levels. Additionally, AN use also acted to have a statistically significant effect on maize productivity, with holding all other explanatory variables constant. Increasing AN use by farmers in 2021/22 season by one unit would force maize productivity to increase by 0.575 bags per hectare. This was due to fact that AN use for top-dressing the maize crop was an important parameter for productivity. With an increase in AN used for maize production, farmers could attain higher productivity levels. This also implies that farmers who used more AN for top-dressing had high productivity levels compared to those who used small amounts or none.

The positive coefficient of 0.432 shows that increasing compound D use on maize production led to increase productivity per hectare. This also implies that during the Russia-Ukraine conflict farming season of 2022/23, farmers should have used more compound D to increase maize productivity. It also means farmers who used greater compound D had higher maize productivity levels. Lastly, AN use in 2022/23 season also appeared to have a statistically significant effect on maize productivity (t=0.646, p=0.025). Basing on the coefficient, holding all other explanatory variables constant, increasing AN use by farmers by one unit would force maize productivity to also increase by 0.5544 bags.

RESULTS ON THE IMPACT OF RUSSIA-UKRAINE CONFLICT ON SMALLHOLDER MAIZE PROFITABILITY.

The last objective of the research was hinged o determining the effect of the Russia-Ukraine conflict on the profitability of maize production in Zimbabwe. The researcher used a point-bisection correlation analysis in SPSS v.22. The results of correlation analysis are presented in Table 4 below.

Table 4: *Pearson's Point-Bisection Correlation between Russia-Ukraine and Profitability* (Research Data and SPSS Results, 2023)

		Russia-Ukraine	Profitability
Russia-Ukraine	Pearson Correlation	1	-.16
	Sig. (2-tailed)		.242
	N	385	385
Profitability	Pearson Correlation	-.16	1
	Sig. (2-tailed)	.242	
	N	385	385

**. Correlation is significant at the 0.05 level (2-tailed).

Table 4 shows Correlation analysis of -0.016 between Russia-Ukraine and profitability associated with a (p-value of 0.242). These results show that the relationship between the Russia-Ukraine and profitability was statistically insignificant (r=-0.16, p=0.242). Based on the correlation analysis results, the researcher used GM analysis and sample paired t-test to determine the effect of Russia-Ukraine conflict profitability. GM was obtained by subtracting the total variable costs (seeds, fertilisers, pesticides, labour and marketing) associated with maize production from total revenue for producing maize per hectare for all the farmers included in the study.

Table 5: *Gross Margin per hectare for Smallholder Maize Farmers (N=385)* (Research Data and SPSS Results, 2023)

Farming Season	GM/Ha	Return per $ investment (ROI)	Breakeven price ($/bag)
2021/22	USD$214.00	US$0.47	US$11.00
2022/23	US$107.00	US$0.27	US$13.00
Method	Df	Value	Probability
T-test	383	0.992	0.193

The findings show that maize production during both the 2021/22 and 2022/23 seasons, was profitable with positive average GMs per hectare of $214.00 and $107.00, respectively. However, sample t-test results confirmed that there was an insignificant difference in profits obtained during the 2021/21 and 2022/23 seasons as indicated by the p-value of 0.193 and t-value of 0.992 at 5% level of significance. These results mean that maize production during the 2022/23 season made comparablly lower profits than the 2021/22 season. This was also assessed by Return per Dollar Investment (RDI) as shown in Table 5 above 0.47 and 0.27 for 2021/22 and 2022/23, respectively. The RDI findings confirm a decrease in return per dollar invested, meaning that there is a drastic increase in prices of the variable inputs, while holding other factors at constant during the Russia-Ukraine season. The RDI findings are also supported by the inverse relationship in break-even price per 50kg bag of maize shown in the Table 5 of $11.00 and $13 for 2012/22 and 2022/23 seasons, respectively.

Therefore, these results mean that maize production in Zimbabwe need to adopt an effective pricing system to enable farmers enjoy a better profit position while covering all costs associated with production. This also means increasing prices associated with producing a tonne of maize.

DISCUSSION

The Russia-Ukraine Ukraine onflict has had a noticeable effect on the supply chain of agricultural inputs. Due to the limitations of the researcher to make direct observations of real-time changes and effects in the supply chain dynamics, indirect observations were made and conclusions inferred from the data and results on the change in input costs. From this, it was observed that the cost of basal fertiliser (Compound D), top dressing (AN) and maize seed (25kg), rose by 57%, 71% and 26%, respectively. This is due to the closure of ports in Ukraine and Russian products being sanctioned by the EU from using certain trade routes that resulted in the cancellation of orders and delay in shipments and congestion (Blogs, 2022). Due to the supply chain interruptions, there are now more expensive shipping costs, fewer available containers and less warehouse space (*ibid.*).

The agricultural infrastructure in Ukraine has been destroyed and the entire supply chain disrupted by Russia. Russia had closed the Black Sea and Azov Sea, and in the early months of the assault, grain shipments from Ukraine were commandeered. To alleviate shortages, Russia and Ukraine struck a United Nations (UN) agreement in July to allow Ukrainian grain shipments from three Black Sea ports. Several hours after the agreement was made, Russia launched a cruise missile attack on the port of Odesa. Worldwide supply networks have become more and more strained because of the uncertainty (*ibid.*). The crisis between Russia and Ukraine has had a profound impact on the world logistics sector. When the Russia-Ukraine war began to influence the sector, the impacts of the epidemic on storage capacity and container availability had just begun to fade. The conflict slowed down trade, fuelled price hikes and commodity shortages, and led to disastrous food shortages across the world.

The steep increase in prices of maize inputs is a cumulative result of the disruptions that the Russia-Ukraine conflict has caused. Following the war, the Black Sea ports and several other channels ceased to be active, cutting off the supply of a number of goods and commodities, including transport machinery, electronics, metals, chemicals, fertilisers, and food items (*ibid.*).

The first objective of the study sought to determine the effect of the Russia-Ukraine conflict on the productivity of maize production in Zimbabwe. The yield dropped by 25% despite the increase in cultural weed and pest control by 25% and 15%, respectively. The drop-in yield is due to firstly the reduction in fertiliser use in the field, because the synthetic inorganic fertilisers are specific, have high rates of N, P and K, and are fast acting within a period of seven days depending on the intensity the sun (Kong *et al.*, 2022). The composition by mass of a 50-kg basal fertiliser bag (compound D) is 7% N :14% P: 7% K compared to cow manure with NPK values of 0.73%, 0.48% and 0.55%, respectively (SEEDCO, 2018). The composition by mass of a 50-kg bag of top dressing (AN) is 34.5% N compared to 2.40% N and 1.0% N of rabbit and chicken manure, respectively (*ibid.*). This astronomical difference in macronutrient concentration, coupled with high specificity and rate of reaction results in a drastic reduction in yield/productivity of maize when the fertiliser application rate/Ha is reduced. Animal manure is characterised mostly by a high carbon-nitrogen ratio, because most livestock are grazers, topped off by the fact that there is little use of concentrated animal feed by smallholder farmers due to financial constraints. When the microbes start breaking down the manure with a high carbon-nitrogen ratio, they first absorb the nitrogen available in the manure and use it to synthesise proteins for breaking down the manure and then release the nitrogen after they die. The nutrients may then be released well after the time the crop needed it, resulting in a delayed and retarded crop response to the nutrients, leading to lower yields with manure. Manure is, therefore, ideal for soil amelioration (acidity and structure) and not as a primary source of nutrients (*ibid.*). Table 3 shows the effect of different fertiliser application rates on the yield potential/productivity of maize.

CONCLUSION

The first objective of the research was premised on determining the effect of the Russia-Ukraine conflict on the productivity of maize production in Zimbabwe. The study findings revealed a 25% drop in yield (Table 3) between the 2021-22 and 2022-23 growing seasons This also occurred simultaneously with a 33% drop in basal fertiliser application (compound D), a 25% drop in chemical weed control and a 15% reduction in chemical pest control. However, the use of cultural methods in weed control and pest control, rose by 25% and 15%, respectively as the smallholder farmers resorted to more inexpensive solutions for weed and pest control. Fall army worm (FAW), a persistent pest that attacks several fertilised crops, including pastures, sorghum, pearl millet and corn, is controlled by urine (Zhakata, 2021). Use of female urine, particularly that of a pregnant woman, is excellent for eradicating the FAW. To spray the crops, combine a 500-ml bottle of urine with 16 litres of water. The worms will die shortly after spraying the crop. Women's urine is particularly effective in worm control after it has been fermented for at least 24 hours. The hormonal changes that occur during pregnancy are most likely key for the control of FAW (*ibid.*). For the control of weeds, the smallholder farmers resorted more to traditional methods such as using hand hoes which are slow and not precise in targeting the weeds.

Overall, it is evident from the study findings that the Russia-Ukraine conflict has had a negative effect on maize productivity by farmers in Zimbabwe. Out of the five explanatory variables that had a significant impact on maize productivity, AN use had the most significant effect in both seasons 2021/22 and 2022/23 with B=0.575, p=0.025 and B=0544, p=0.025, respectively. Given that the Russia-Ukraine conflict period was characterised by exorbitant AN price increases which reduced affordability by many smallholder farmers across Zimbabwe, it therefore, means that conflict has had a negative impact on maize productivity by the farmers. These results are consistent with another study by Arias *et al.* (2019).

The last objective of the research was hinged on determining the effect of the Russia-Ukraine conflict on the profitability of maize production in Zimbabwe. A GM results for the 2021-22 season has an ROI that is $0.20 higher than that of the 2022-23 season despite having a higher total production input cost of $456 compared to $395.50 of the 2022-23 season. This can be attributed to the use of a lower fertiliser rate in response to the 57% and 71% price hike in basal and top-dressing fertiliser, respectively, that lowers the yield/productivity of maize, meaning that there will be less maize to sell for covering costs and making a profit. The reduction in input levels lowered both the cost of production and the potential yield that could be produced for the market. This resulted in a higher break-even point for the 2022-23 season of $13/bag of maize against a lower yield, compared to the lower break-even point for the 2021-22 season which was lower by $2 at $11/bag of maize. Maize production during the Russia-Ukraine conflict in the 2022-23 season was, therefore, 15% less profitable than maize production before the Russia-Ukraine conflict. In other words, a smallholder farmer who made a 15% yield loss in the 2021-22 season is on par with a productive smallholder farmer in the 2022-23 season.

REFERENCES

Agroforestry, V. (2022). The Impact of Russia's War on Ukraine – For Farmers in East Africa. Available online: https://viagroforestry.org/news/the-impact-of-ukraine-russia-war-on-farmers/.

Arias, M. A., Ibanez, A. M. and Zambrano, A. (2019). Agricultural Production amidst Conflict: Separating the Effects of Conflicts into Shocks nd Uncertainty. *World Development, 119*, 165-184.

Bhasera, J. (2015). *An Assessment of Smallholder Maize Productivity and Profitability in Zimbabwe*, Arusha, Tanzania: Esami Business School.

Blogs, L. (2022). gep.com. Available online: Available online: https://www.gep.com/blog/mind/russia-ukraine-war-logistics-impact. [Accessed 7 April 2023].

Chagwiza, C. and Fraser, G. (2012). Economic Evaluation of Sweet Sorghum in Biofuel Production as a Multi-Purpose Crop: The Case of Zambia. *Bioenergy for Sustainable Development in Africa*, 53-60.

City-facts (2022). city-facts.com. Available online: https://www.city-facts.com/chikomba. [Accessed 11 December 2022].

Dube, L. and Guveya, E. (2013). Land Tenure Security and Farm Investments amongst Small Scale Commercial Farmers in Zimbabwe. *Journal of Sustainable Development in Africa, 15*(5). 107-121.

Dugbazah, J. *et al.* (2022). Enhancing Maize Production in Zimbabwe by Utilising Climate Smart Technologies. Available online: https://www.nepad.org/blog/enhancing-maize-production-zimbabwe-utilising-climate-smart-technologies#_ftn10. Accessed 24 September 2022.

Eklund, L. *et al.* (2017). How Conflict Affects Land Use: Agricultural Activity in Areas Seized by the Islamic State. *Environmental Research Letters, Volume 12*.

E-VIEWS. (1997). *E-Views Users' Guide Version 3.* Irvine: California, Quantitative Micro Software.

Johnsen, F. H. (2003). Using Gross Margin Analysis in the TRP II SUA Projects. Impact: Lessons Learnt from Farmer-Oriented Research Newsletter. *Sokoine University of Agriculture, 4*(1), 19-21.

Kong, F. *et al.* (2022). Effect of Chemical Fertiliser Application on Maize Production in China over the Past 15 Years: A Meta-Analysis. *Agronomy, 12*(12).

Mago, S. and Costa, H. (2016). Microfinance as a pathway for smallholder farming in Zimbabwe. *Environmental Economics*, Available online: [Accessed 20 September 2022].

Mahoo, P. E. (2011). Market Channels, Pricing Efficiency, Profitability and Price Transmissions. Market Efficiency Analysis of Jatropha Value Chain: Case Study of Monduli and Arumeru Districts Doctoral Dissertation, Sokoine University of Agriculture.

Mail, T. Z. (2022). Zimbabwean agriculture bears brunt of Russia/Ukraine conflict. Available online: https://www.thezimbabwemail.com/farming-environment/zimbabwean-agriculture-bears-brunt-of-russia-ukraine-conflict/. [Accessed 20 September 2022].

Nduva, S. *et al.* (2022). Price and Availability: The Impact of Russia's Invasion of Ukraine on African Fertiliser Markets. Available online: https://developmentgateway.org/blog/price-availability-the-impact-of-russias-invasion-of-ukraine-on-african-fertiliser-markets/. [Accessed 23 September 2022].

Orr, L. M., Stevens, M. M. and Mullen, J. D. (2008). An Evaluation of the Economic, Environmental and Social Impacts of NSW DPI Investments in IPM Research in Invertebrate Rice Pests. Economic Research Report 41. Available online: https://ageconsearch.umn.edu/record/45632

Paul, Z. (2022). Zimbabwe farmers reel from soaring fertiliser prices. Available online: https://www.herald.co.zw/zimbabwe-farmers-reel-from-soaring-fertiliser-prices/. [Accessed 19 September 2022].

SEEDCO (2018). *Farmers Guide: Grain Crops*. 1 ed. Harare: SEEDCO.

Zhakata, V. (2021). Urine effective in controlling army worm. Available online: https://www.manicapost.co.zw/urine-effective-in-controlling-army-worm/. [Accessed 10 April 2023]