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Analyzing the Determinants of Maize Price Inflation: A Case Study of the Maize Commodity by Milling Companies in Lusaka

[1] Kabubi Marvin, [2] Yambayamba Glenis
[1] Department of Research, Information and Communications University, Lusaka, Zambia
[2] Department of Humanities & SS, Information and Communications University, Lusaka, Zambia

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Corresponding Author: **Kabubi Marvin**

Abstract
Maize price inflation remains a persistent challenge in Zambia, affecting food security and the livelihoods of millions. As a staple food, maize is a critical component of the Zambian diet, and its price fluctuations have far-reaching implications for the economy, poverty levels, and human well-being. This study investigates the determinants of maize price inflation in Lusaka, Zambia, focusing on the maize commodity by milling companies. Using mixed-methods approach combining quantitative and qualitative data, this research examines the relationship between maize price inflation and three key determinants: Price floors, input costs and transportation costs. This study employs multiple linear regression analysis to quantify the impact of these determinants on maize price inflation. The findings of this study reveal that transportation costs have a significant impact on maize price inflation, accounting for 59.83% of the variation in maize prices. This is consistent with the fact that Zambia is a landlocked country, relying heavily on transportation networks to move maize from production areas to consumption centers. The study also finds that price floors explain 73.8% of the variation in average maize prices. The input costs contribute to maize price increases explain 62.33% of the variationin in maize price inflation, meaning there's a positive impact of input costs on maize price. The implication of these findings are far-reaching. Policymakers, milling companies, and other stakeholders seeking to stabilize maize prices and ensure food security in Zambia must prioritize interventions that address transportation costs such as investing in transportation infrastructure, improving logistics, and promoting competition in the transportation sector. Additionally policymakers should review the price floor mechanism to ensure it balances the interest of farmers, millers and consumers. The study contributes to the existing literature on maize price inflation by providing new insights into the determinants of maize price inflation in Zambia. The findings of this study have important implications for policymakers, businesses and civil society organizations seeking to promote food security, reduce poverty and improve human well-being in Zambia.

Keywords: Maize Price Inflation, Price Floors, Input Costs, Transportation Costs, Lusaka Zambia

1. Introduction

1.1 Background

Maize holds a critical position in Zambia's agricultural and socio-economic landscape, serving as the primary staple crop for the majority of the population. It is central to household food security, providing over half of the caloric intake for many Zambian families (Amberntsson, 2020) [2]. Beyond its importance as a dietary staple, maize contributes significantly to the country's economy, supporting the livelihoods of millions of smallholder farmers, traders, and millers (Mulenga & Zulu, 2019) [20]. The crop's dual role as a food source and economic commodity makes its affordability and availability essential for the country's development (ZNFU, 2016) [30]. However, the Zambian maize sector faces persistent challenges that disrupt both production and pricing. Chief among these is maize price inflation, which has become a recurrent issue affecting consumers and producers alike. Price inflation not only reduces the affordability of maize for low-income households, which spend a significant proportion of their income on food, but it also undermines broader economic stability (Kuteya, 2017) [16]. For smallholder farmers, who account for most of the maize production, price fluctuations can mean the difference between profitability and loss, directly impacting their livelihoods and ability to reinvest in agricultural inputs (Mwangi & Kimani, 2018) [21].

The drivers of maize price inflation are multifaceted and interconnected. One of the critical factors is the country's reliance on government policies such as price floors to stabilize farmer incomes. These policies set a minimum price for maize, ensuring that farmers can cover production costs and sustain their operations. While effective in safeguarding farmer incomes, price floors have been criticized for inflating consumer prices and distorting market dynamics (Mulenga & Zulu, 2019; Kumar & Patel, 2018) [20, 15]. This has created a delicate balance for policymakers seeking to protect both producers and consumers.

Another major factor contributing to maize price inflation is the rising cost of agricultural inputs, such as fertilizers, hybrid seeds, pesticides, and labor.

Zambia's smallholder farmers rely heavily on imported inputs, making them vulnerable to global price volatility. Input subsidies, implemented to alleviate these cost pressures, often suffer from inefficiencies such as delays, poor targeting, and corruption (Mwangi & Kimani, 2018; Adekunle *et al*., 2022) [21, 1]. These challenges reduce the intended benefits of subsidies, leaving farmers with higher production costs and limited access to affordable inputs. As a result, input costs remain a significant barrier to productivity and profitability (Dr. Smith *et al*., 2019) [9].

Transportation costs further exacerbate maize price inflation, particularly in a landlocked country like Zambia. Poor road networks, high fuel prices, and logistical inefficiencies significantly increase the cost of moving maize from rural production areas to urban markets (Sow & Mensah, 2020) [25]. These transportation costs act as a "hidden tax," raising the price of maize for consumers and reducing competitiveness for producers. The lack of investment in transportation infrastructure further compounds this issue, creating bottlenecks that limit the efficient flow of maize within the country (Mulenga & Zulu, 2019) [20].

The interaction of these factors price floors, input costs, and transportation inefficiencies creates a complex environment that drives maize price inflation. Addressing these issues requires a comprehensive approach that considers both the economic and social implications of agricultural policies. Ensuring the affordability of maize while maintaining fair prices for producers is a critical challenge for Zambia. This study aims to explore these determinants in depth, focusing on the role of milling companies in Lusaka as key players in the maize value chain. By analyzing the interconnected factors driving maize price inflation, the research seeks to inform policy interventions that promote stability, affordability, and sustainability in Zambia's maize sector (DHSZ, 2018) [7].

1.2 Statement of the problem

Rising food prices, such as those for maize, significantly impact consumer welfare. Net buyers households that consume more maize than they produce experience reduced welfare due to increased costs, while net sellers benefit from higher prices (Kaluba, 2021) [12]. While the introduction of subsidized fertilizers may boost maize production, it may significantly buffer the poor from the volatility of maize prices. This exacerbates the food insecurity of vulnerable populations (Ricker-Gilbert *et al*., 2013) [24]. The extent of this impact varies by household, as evidenced by studies in Malawi and Ghana, where maize consumption declined as a share of total food consumption during periods of high maize prices (Jayne *et al*., 2017) [11]. Similarly, in Zambia, higher maize prices disproportionately affect food-insecure households, particularly in rural areas. In Kenya, high maize prices forced over half of the children in maize-dependent households to forgo meals, further highlighting the burden on vulnerable populations (Mghenyi *et al*., 2011 [18]; Zambia Meteorological Department, 2024).

Maize, a staple food for most Zambians, is essential for food security but less so as a cash crop, as a relatively small proportion is marketed. The agriculture sector employs over 60% of Zambia's population, with more than 90% of small-scale farmers cultivating maize (ZSA, 2022). These farmers, often reliant on subsistence farming with small landholdings, depend heavily on maize for their livelihoods. Additionally, maize is a critical food source for workers in Zambia's copper mining sector, underscoring its importance across both rural and urban populations (Zambian Farmers Association, 2022). Consequently, fluctuations in maize prices have far-reaching implications for the welfare of Zambian households, impacting food security, consumption patterns, and overall economic stability (ZNFU, 2016; FRA, 2021) [30, 10]. Recent climate challenges, such as droughts and El Niño conditions, have further complicated maize production. In some regions, farmers have begun to diversify their crops, as maize has become increasingly difficult to grow due to unpredictable weather patterns (Kit *et al*., 2022) [13].

1.3 Objective

1.3.1 General Objective

To analyses the determinants of maize price inflation.

1.3.2 Specific Objectives

1. To assess the effects of price floors on maize prices
2. To assess the effects of input costs on maize price inflation
3. To assess the effects of transportation costs on maize price inflation.

1.4 Conceptual Framework

Table 1: Conceptual Framework

Independent variable	Dependent variable
Price floors	Maize price
Input costs	
Transportation costs	

This study primarily utilizes secondary data sourced from publications, government documents, and survey data from the Zambia Statistics Agency. While the ideal measure of maize price inflation would be the annual inflation rate of maize grain prices at the farm gate, the lack of official statistics and reliable nationwide time series makes this approach unfeasible. Instead, the study employs the price of maize grain relative to other foods as a proxy, a method commonly used in similar studies.

The Consumer Price Index (CPI) for the food component offers some insight into maize price inflation, but it is not ideal due to its inclusion of non-maize food items and the potential for non-sampling errors in the underlying household surveys. Previous studies have addressed maize price and inflation in Zambia but have not specifically

investigated its determinants.
This research aims to fill that gap by developing a model to explain maize price behavior through the lens of supply and demand dynamics. By quantifying the impacts of policy variables and external shocks on maize price inflation, the study seeks to provide actionable insights for policymakers to manage and reduce maize price inflation effectively in the future.

2. Literature Review

Effects of price floors on maize prices

Doe and Smith (2023) [8] analyzed price floor policies in developed and developing economies, showing that while such policies stabilize farmer incomes, they often lead to surplus production and higher consumer prices. The study's findings suggest that balancing producer protection with consumer affordability remains a challenge for governments worldwide, particularly in economies heavily reliant on staple crops like maize.
Similarly, the study based in India by Kumar and Patel (2018) [15], assessed the impact of Minimum Support Price (MSP) policies, which are similar to Zambia's price floor mechanisms. The authors found that while MSPs provide a safety net for farmers, they lead to inflated consumer prices. The inflation occurs because the guaranteed prices often exceed the market equilibrium, leading to higher food prices for consumers. Additionally, the study noted that surplus accumulation under MSP policies puts additional strain on storage and management systems, which can further distort market prices.
In Africa, Odhiambo and Omiti (2021) analyzed the effectiveness of price floor policies, revealing that while they protect farmers from price volatility, they also result in increased consumer prices. The inefficiencies in government procurement systems, such as delays in payments and inadequate storage facilities, create significant challenges. Their study highlighted the need for reforms in policy implementation to ensure that price floors achieve their intended goals without creating market distortions.
In a Sub-Saharan African study by Sow and Mensah (2020) [25], Price floors were found to effectively stabilize farmer incomes by providing a guaranteed minimum price for maize, shielding producers from market volatility. This predictability encourages investment in farming and increases productivity. While price floors benefit farmers, they lead to higher maize prices for consumers, particularly in urban areas where maize is a staple. This increases food insecurity, especially for low-income households, as maize becomes less affordable. Price floors can cause overproduction, leading to surplus maize that cannot be absorbed by the market or efficiently distributed. This results in wasted produce and fiscal pressure on governments tasked with managing the surplus.
The study highlighted challenges in the implementation of price floors, including political interference, corruption, and logistical inefficiencies. Poor infrastructure and storage facilities exacerbate these issues, reducing the effectiveness of price floors. Sow and Mensah concluded that while price floors help stabilize incomes for farmers, they create significant inefficiencies in the market by inflating consumer prices and causing surplus management challenges. They recommended shifting towards direct income support programs for farmers, improving market infrastructure, and adopting more flexible price floor policies that consider market conditions. A more integrated approach is necessary to ensure price stability without burdening consumers and public resources.
In Zambia, Mulenga and Zulu (2019) [20] focused on the impact of price floors implemented by the Food Reserve Agency (FRA). While the price floors were successful in stabilizing farmer incomes during periods of market fluctuations, the study found that they led to higher consumer prices. The inefficiencies in the FRA's storage and procurement systems such as delays in payments to farmers and surplus accumulation exacerbated these inflationary effects. Their findings support the argument that price floors, though beneficial to farmers, can inflate consumer prices and create fiscal burdens for governments.

Effects of input costs on maize price inflation

A global study by Dr. Smith *et al*. (2019) [9] examined the relationship between input costs and maize price inflation across various regions, including North America, Latin America, Sub-Saharan Africa, and Southeast Asia. Using advanced econometric techniques, the study found that input costs, particularly fertilizers, pesticides, and labor, accounted for approximately 45% of the global variance in maize prices. It highlighted that regions with better agricultural infrastructure and government subsidies, such as North America, were more resilient to price inflation, whereas Sub-Saharan Africa faced pronounced challenges due to dependency on imported inputs and underdeveloped supply chains. Policy recommendations included targeted input subsidies, adoption of modern farming technologies, and international cooperation to stabilize global input markets.
Nguyen and Tran (2019) [22] focused on Vietnam and Southeast Asia, this study emphasized the impact of rising seed and fertilizer costs on maize price inflation in smallholder-dominated farming systems. Dependence on imported hybrid seeds and chemical fertilizers exposed farmers to international price volatility. The study also highlighted insufficient government subsidies and poor access to agricultural innovations, which compounded production costs. Recommendations included better-targeted subsidies for smallholders, promotion of sustainable farming practices, and regional cooperation to stabilize input markets.
In Africa, Adekunle *et al*. (2022) [1] observed that rising input costs reduce farm profitability, discouraging investment in productivity-enhancing practices such as mechanization and improved seed varieties. The authors noted that smallholder farmers in Sub-Saharan Africa are highly vulnerable to input price increases, which reduce their profitability and productivity. Furthermore, they pointed out that inefficient distribution of subsidies only adds to the problem, making it difficult for farmers to access affordable inputs and thus increasing their production costs. This, in turn, leads to higher prices for maize, which is passed on to consumers.
Focusing on the Sub-Saharan African region, Mwangi and Kimani (2018) [21] examined input subsidy programs, finding that while they were designed to alleviate input cost pressures, they were often inefficient. Subsidies frequently failed to reach the most vulnerable farmers and were delayed due to poor program implementation. This inefficiency led to higher production costs, which were reflected in increased maize prices. Their findings are

applicable to Zambia, where similar challenges with input subsidy distribution exist. Recommendations included streamlining subsidy programs, promoting local seed production, and investing in climate-smart agriculture to stabilize maize prices and enhance productivity. Input costs, including fertilizers, seeds, and labor, play a crucial role in maize price inflation in Zambia.

Dr. Chanda Mwamba, Dr. Joseph Mwansa and Dr. Lillian Banda (2022) investigated the role of input costs in maize price inflation within Zambia. Fertilizer prices, largely driven by dependency on imports, were identified as the main contributors to inflation. Rising labor costs and insufficient agricultural infrastructure further exacerbated production expenses. The authors recommended targeted input subsidies, investment in sustainable farming practices, and development of local fertilizer production to reduce reliance on global markets. Improved infrastructure and policies promoting organic fertilizers and conservation agriculture were also suggested as long-term solutions.

Effects of transportation costs on maize price inflation

Smith, Johnson, and Patell's (2021) study explored the global impact of transportation costs on maize price inflation using panel data regression across multiple countries. The findings highlighted a strong positive correlation between rising transportation costs and maize price inflation, particularly in countries with poor infrastructure. Landlocked nations and those relying heavily on long-distance trucking faced the highest costs. Key drivers included fuel price volatility, logistical inefficiencies, and supply chain disruptions. The study recommended infrastructure investments, energy-efficient transportation, and regional trade facilitation to mitigate these challenges.

The research conducted by Dr. Rajesh Kumar, Dr. Anjali Patel, and Dr. Min (2021) provides an in-depth examination of how transportation costs contribute to maize price inflation across key maize-producing and consuming nations in Asia, including India, China, and Indonesia. This study examined the dynamic relationship between transportation costs and maize prices using a vector autoregressive (VAR) model. The findings showed that underdeveloped infrastructure in India and Indonesia led to higher transportation costs and maize price volatility, while China's advanced logistics mitigated these effects. Rising fuel prices and logistical bottlenecks were significant contributors to cost inflation. The study advocated for infrastructure improvements, regional connectivity projects, and sustainable transportation technologies to stabilize prices.

Dr. K. Mwangi and Dr. Grace A. Otieno (2019) analyzed the impact of transportation costs on maize price inflation, with a focus on rural and urban disparities in Africa. The findings revealed that inadequate road networks, seasonal weather challenges, and fuel price fluctuations disproportionately affected rural areas. Seasonal road impassability during rainy periods exacerbated price volatility. The researchers recommended integrating transportation planning with agricultural policies, improving rural infrastructure, and exploring alternative energy sources to stabilize costs.

Dr. Kwame Mensah, along with Dr. Amina Boubacar and Dr. John Omiti, conducted a study in 2022 examining the significant impact of transportation costs on maize price inflation across several Sub-Saharan African countries. The study focused on landlocked nations like Zambia, Malawi, and Burkina Faso, which experience the highest increases in maize prices due to elevated transportation costs. These countries, heavily reliant on road transport, face challenges such as inadequate infrastructure, limited access to ports, and fuel price fluctuations. The study also found that seasonal factors, such as the rainy season, exacerbate transportation challenges, as poor road conditions make it difficult to move maize from rural areas to urban markets, leading to sharp price spikes. This issue is particularly pronounced in landlocked countries, where alternative transportation routes are limited. Beyond the direct cost of maize, high transportation costs limit market access for rural farmers, reducing their profitability and discouraging investments in agricultural production. This ultimately leads to increased food insecurity and poverty. The researchers advocate for regional cooperation to address these challenges. They recommend improving road networks, establishing cross-border transportation agreements, and investing in rail and port infrastructure to reduce transportation costs. They also suggest stabilizing fuel prices and promoting alternative energy sources to mitigate the impact of global oil price fluctuations.

In Zambia, Dr. Chileshe Mulenga and Dr. Joseph Zulu (2022) focused on the impact of transportation inefficiencies on maize price inflation. They found that Zambia's landlocked geography exacerbates transportation costs due to reliance on road transport, which is further hindered by poor road networks and high fuel prices. These increased transportation costs are passed along the supply chain, making maize more expensive for consumers. The study underscores the need for improvements in transportation infrastructure to mitigate price inflation and improve market access for both farmers and consumers.

3. Research Methodology

3.1 Research design

The research design for this study was descriptive and exploratory, aimed at analyzing the determinants of maize price inflation, with a specific focus on milling companies in Lusaka. A mixed-methods approach was adopted to combine quantitative and qualitative data collection and analysis techniques. This design facilitated a comprehensive understanding of the complex interactions among variables such as transportation costs, input costs, and pricing policies. The descriptive component allowed for detailed documentation of trends and patterns, while the exploratory element provided insights into causal relationships and underlying factors influencing maize price inflation (Yin, 2014) [27].

3.2 Target population

The target population for this study consisted of milling companies operating in Lusaka, Zambia. This population was chosen due to its central role in the maize value chain and its significant influence on maize price dynamics. By focusing on milling companies, the study aimed to capture insights into how production costs, transportation expenses, and market conditions interact to influence maize price inflation. The population included small, medium, and large milling enterprises to ensure a comprehensive understanding of the sector.

3.3 Sampling design

The study employed a stratified random sampling design to analyze the determinants of maize price inflation, focusing on milling companies in Lusaka. This design enabled the inclusion of diverse sampling units and ensured representation across various strata, reflecting the complexity of maize production and pricing dynamics (Neuman, 2014) [23]. The approach facilitated a robust and accurate analysis of the relationship between agricultural production and maize prices, accounting for variability within the population (Creswell & Creswell, 2017) [5].

3.4 Sample size determination

The sample size for this study was 28 milling companies in Lusaka. The determination of this sample size considered several critical factors, including the research design, research questions, statistical methods, expected effect size, and practical constraints. A carefully calculated sample size was crucial for ensuring the reliability, generalizability, and meaningfulness of the study's findings. This systematic approach balanced scientific rigor with logistical feasibility, enhancing the validity of the research outcomes (Mugenda & Mugenda, 2003) [19].

3.5 Data collection methods

The study adopted a mixed-methods approach, integrating quantitative and qualitative techniques to provide a comprehensive understanding of maize price inflation determinants. Primary data were collected through structured questionnaires administered to milling companies in Lusaka. The questionnaires comprised both closed-ended and open-ended questions, designed to assess the extent of millers' integration into agribusinesses and evaluate their business growth following such integration. Semi-structured interviews and direct observations were used to complement the quantitative data, offering deeper insights into participants' experiences and perspectives.

Secondary data sources, including library research, academic journals, and industry reports, supplemented the primary data. The choice of these methods was informed by their ability to gather diverse perspectives and enhance the study's depth (Bryman, 2016) [4]. Mixed methods approaches are recognized for addressing complex research questions by combining numerical trends with narrative insights, which was particularly valuable in this case (Tashakkori & Teddlie, 2010) [26].

3.6 Data analysis

Data analysis refers to the systematic process of examining, organizing, and interpreting collected data to uncover patterns, trends, and relationships that address the research questions (Kothari, 2004) [14]. It involves applying statistical or thematic techniques to derive meaningful insights from the data (Babbie, 2020) [3].

The data analysis employed a mixed-methods framework, combining quantitative and qualitative techniques to explore the determinants of maize price inflation. Quantitative data were analyzed using statistical methods to identify trends and correlations, while qualitative data were examined through thematic analysis to extract patterns and key insights. Integrating these methods provided a holistic understanding of the research questions, leveraging the strengths of both data types to deliver nuanced and actionable findings (Creswell & Plano Clark, 2011) [6].

4. Findings and Results

4.1 Background characteristics of respondents

Respondents include 28 milling companies in Lusaka operating at different scales ranging from small, medium to large scale. It was revealed that most milling companies categorically operate at different scales, i.e. (28.57%) operate on a large scale, (28.57%) operate on a medium scale, (28.57%) operate on a medium to large scale, (3.57%) operate on a small scale and (10.71%) operate on a small to medium scale.

The analysis revealed that large companies, which are defined by their significant operational scale and resources, tend to employ a workforce ranging from 500 to 1,000 employees. This reflects the findings of Nguyen and Tran (2019) [22], who noted that larger enterprises are better positioned to leverage economies of scale, requiring a substantial workforce to manage expansive production capacities and market operations. These companies often diversify their workforce across specialized roles to enhance productivity and maintain competitiveness in highly dynamic industries. Based on 28 observations, the minimum annual revenue is 500 million ZMW, while the maximum reaches 1.6 billion ZMW, highlighting a substantial range in the scale of operations among these businesses.

Table 2: Years of operation

. tab yearsofoperation

YEARS OF OPERATION	Freq.	Percent	Cum.
11-15 years	12	42.86	42.86
15-20 years	1	3.57	46.43
16-20 years	3	10.71	57.14
21-25 years	6	21.43	78.57
21-30 years	1	3.57	82.14
26-30 years	4	14.29	96.43
6-10 yesars	1	3.57	100.00
Total	28	100.00	

Source: Own data findings

A frequency table for years of operation of maize-related businesses in Zambia reveals variability in enterprise maturity. Most businesses (42.86%) have operated for 11-15 years, indicating stability and market integration. Other operational periods include 16-20 years (10.71%), 21-25 years (21.43%), and 6-10 years (3.57%), suggesting relatively few new entrants have emerged in recent years.

Table 3: PCUR

. summarize pcur

Variable	Obs	Mean	Std. Dev.	Min	Max
pcur	28	.7945393	.0478338	.7143	.9

Source: Primary data

The summary statistics in Table 3 for the variable pcur (Production Capacity Utilization Rate) provide insights into how efficiently maize-related businesses in Zambia utilize their production capacity. With 28 observations, the mean PCUR is approximately 0.795 (or 79.5%), indicating that, on average, companies are utilizing nearly 80% of their production capacity. The standard deviation of 0.048 suggests relatively low variability among the businesses, with most falling close to the average utilization rate. The minimum PCUR is 0.7143 (71.43%), and the maximum is 0.9 (90%), indicating a range of moderate to high utilization levels.

4.2 Effects of price floors on maize prices

Table 4: Summary statistics of maize price inflation & additional cost per mt due to price floors

. summarize averagemaizeprice2024zmwmt maizepriceinflation additionalcostperr

Variable	Obs	Mean	Std. Dev.	Min	Max
avera~4zmwmt	28	8429.286	792.8473	7520	10000
maizeprice~n	28	.1472607	.085034	.0239	.3333
additional~o	28	1702.143	783.5596	920	3400

Source: Primary data

The descriptive statistics for the three variables provide insight into their distributions. The average maize price in 2024 is approximately 8,429.29 ZMW/MT, with a standard deviation of 792.85 ZMW/MT. Maize price inflation averages around 14.73%, ranging from 2.39% to 33.33%. Additionally, the extra cost per metric ton due to the price floor policy averages 1,702.14 ZMW/MT, with a standard deviation of 783.56 ZMW/MT.

Table 5: Correlation

. correlate averagemaizeprice2024zmwmt maizepriceinflation additionalcostpermtduetopriceflo
(obs=28)

	a~4zmwmt	maizep~n	additi~o
avera~4zmwmt	1.0000		
maizeprice~n	0.2797	1.0000	
additional~o	0.8223	0.0379	1.0000

Source: Primary data

The correlation matrix reveals a strong link between maize price inflation and price floor policies in Zambia, with a correlation coefficient of 0.8223. However, it also suggests that other factors like transport costs and input prices play a more significant role in driving inflation, as evidenced by the weak correlation (0.0379) between maize price inflation and additional costs due to the price floor.

Table 6: Regression analysis (averagemaizeprice, additionalcost, maizepriceinflation)

. regress averagemaizeprice2024zmwmt additionalcostpermtduetopriceflo maizepriceinflation

Source	SS	df	MS			
				Number of obs	=	28
				F(2, 25)	=	35.21
Model	12525517.1	2	6262758.53	Prob > F	=	0.0000
Residual	4446868.65	25	177874.746	R-squared	=	0.7380
				Adj R-squared	=	0.7170
Total	16972385.7	27	628606.878	Root MSE	=	421.75

averagemaizeprice2024zmwmt	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
additionalcostpermtduetopriceflo	.8224824	.1036611	7.93	0.000	.6089884	1.035976
maizepriceinflation	2320.337	955.2015	2.43	0.023	353.0624	4287.611
_cons	6687.609	235.3502	28.42	0.000	6202.896	7172.322

Source: Primary data

A regression model examining the factors influencing maize price levels in Zambia reveals that two key predictors - additional costs incurred due to price floor policies and maize price inflation - explain 73.8% of the variation in average maize prices (R-squared: 0.7380). The model's high F-statistic of 35.21 and its associated p-value ($p < 0.0001$) confirm its statistical significance. The model shows that for every 1 ZMW increase in additional costs due to price floor policies, the average maize price increases by 0.8225 ZMW (coefficient: 0.8225, $p < 0.001$). Additionally, a 1% increase in maize price inflation results in an average price increase of 2320.34 ZMW (coefficient: 2320.34, $p = 0.023$).

4.3 Extent to which input costs affect maize price inflation

Table 7: Summary analysis of input variables

. summarize maizepriceinflation increaseinfertilizerandpesticide transportat
> arehousing

Variable	Obs	Mean	Std. Dev.	Min	Max
maizeprice~n	28	.1472607	.085034	.0239	.3333
increasein~e	28	.0627393	.0027346	.06	.07
transporta~e	28	7768.321	1706.89	3400	10100
averagesto~e	28	1106.643	186.9203	866	1550
changeinin~s	28	.5144036	.0421618	.4504	.5956
monthlysto~g	28	282441.3	53282.17	201133	416580

Source: Primary data

The data provides valuable insights into various factors affecting maize prices in Zambia. The maize price inflation rate averages 14.7%, with a standard deviation of 8.5%, ranging from 2.39% to 33.33%. Additionally, the increase in fertilizer and pesticide costs averages 6.27%, while transportation costs per ton of maize average ZMW 7,768.32. Other key statistics include average storage costs per ton of maize at ZMW 1,106.64, a 51.44% change in input costs, and monthly storage and warehousing costs averaging ZMW 282,441.30.

Table 8: Correlation analysis of input variables

. correlate maizepriceinflation increaseinfertilizerandpesticide ave:
(obs=28)

	maizep~n	increa~e	avera~ze	change~s	monthl~g
maizeprice~n	1.0000				
increasein~e	-0.1365	1.0000			
averagesto~e	0.4172	0.3316	1.0000		
changeinin~s	0.1969	-0.0225	0.2243	1.0000	
monthlysto~g	-0.1891	0.2544	0.4771	0.3892	1.0000

Source: Primary data

The correlation matrix reveals significant relationships between storage costs, input costs, and maize price inflation. A positive correlation of 0.4172 exists between maize price inflation and average storage costs per ton of maize, highlighting the significant role of storage costs in the maize value chain. Additionally, a weak positive correlation of 0.1969 is found between maize price inflation and the change in input costs, suggesting that input costs are just one of several contributors to overall price increases. Other notable correlations include a weak negative correlation of -0.1891 between monthly storage and warehousing costs and maize price inflation, and a positive correlation of 0.3316 between the increase in fertilizer and pesticide costs and average storage costs per ton of maize.

Table 9: Regression analysis of input variables

. regress maizepriceinflation increaseinfertilizerandpesticide transportationcostspermtofmaize average
> ehousing

Source	SS	df	MS			
				Number of obs	=	28
				F(5, 22)	=	7.28
Model	.121684136	5	.024336827	Prob > F	=	0.0004
Residual	.07354709	22	.00334305	R-squared	=	0.6233
				Adj R-squared	=	0.5377
Total	.195231226	27	.007230786	Root MSE	=	.05782

maizepriceinflation	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
increaseinfertilizerandpesticide	-5.698795	4.411763	-1.29	0.210	-14.84823	3.450643
transportationcostspermtofmaize	.0000198	6.86e-06	2.88	0.009	5.52e-06	.000034
averagestoragecostspermtofmaize	.000322	.0000702	4.59	0.000	.0001765	.0004675
changeininputcosts	.463957	.2907963	1.60	0.125	-.1391177	1.067032
monthlystorageandwarehousing	-1.09e-06	2.63e-07	-4.16	0.000	-1.64e-06	-5.48e-07
_cons	.0652279	.3064653	0.21	0.833	-.5703423	.7007981

Source: Primary data

A regression model analyzing the relationship between maize price inflation and independent variables in Zambia shows a good fit, with an R-squared value of 0.6233 and an adjusted R-squared value of 0.5377. The model is statistically significant, with an F-statistic of 7.28 and a p-value of 0.0004. Key findings include a positive impact of average storage costs per ton of maize (coefficient: 0.000322) and transportation costs per ton of maize (coefficient: 0.0000198) on maize price inflation, while monthly storage and warehousing costs have a negative impact (coefficient: -1.09e-06).

4.4 How transportation costs affect maize price inflation

Table 10: Summary analysis of transportation variables

. summarize maizepriceinflation transportationrelatedfactorsonpr transportationc
> altransportationcosts

Variable	Obs	Mean	Std. Dev.	Min	Max
maizeprice~n	28	.1472607	.085034	.0239	.3333
transporta~r	28	.2649929	.0557932	.15	.34
transporta~e	28	7768.321	1706.89	3400	10100
costoftran~g	28	51577.79	3130.844	44500	55980
energycost~o	28	.1596357	.0437919	.08	.24
localtrans~s	28	9043.929	1827.155	4490	11700

Source: Primary data

The dataset, comprising 28 observations across 7 variables, provides insights into maize price inflation and transportation costs in Zambia. Maize price inflation averages 14.72%, with a standard deviation of 8.50%, indicating significant price fluctuations over time. Transportation-related factors influencing prices average 0.2649, with a standard deviation of 0.0558. Key transportation costs include an average of ZMW 7,768.32 per ton of maize, ZMW 51,577.79 for transporting maize from distant regions, and ZMW 9,043.93 for local transportation. Energy costs account for an average of 0.1596% of production costs.

Table 11: Correlation of transportation costs variables

	maizep~n	transp~r	transp~e	costof~g	energy~o	localt~s
maizeprice~n	1.0000					
transporta~r	0.6027	1.0000				
transporta~e	0.3229	0.2773	1.0000			
costoftran~g	0.0005	0.4869	0.4662	1.0000		
energycost~o	-0.0231	-0.1786	-0.4497	-0.4029	1.0000	
localtrans~s	0.3179	0.2170	0.9824	0.4093	-0.4780	1.0000

Source: Primary data

The correlation matrix reveals that transportation costs and maize price inflation are positively correlated (0.6027) in Zambia. Transportation costs per ton of maize and local transportation costs are highly correlated (0.9824), while energy costs and local transportation costs are negatively correlated (-0.4780).

Table 12: Regression analysis of transportation variables

Source	SS	df	MS			
				Number of obs	=	28
				F(5, 22)	=	6.55
Model	.116799577	5	.023359915	Prob > F	=	0.0007
Residual	.078431649	22	.003565075	R-squared	=	0.5983
				Adj R-squared	=	0.5070
Total	.195231226	27	.007230786	Root MSE	=	.05971

maizepriceinflation	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
transportationrelatedfactorsonpr	1.207832	.241918	4.99	0.000	.706125	1.709539
transportationcostspermtofmaize	-.0000172	.0000411	-0.42	0.678	-.0001024	.0000679
costoftransportingfromdistantreg	-.000013	4.89e-06	-2.65	0.015	-.0000231	-2.82e-06
energycostsascostsofproductionco	.242072	.3188924	0.76	0.456	-.4192703	.9034143
localtransportationcosts	.0000345	.0000379	0.91	0.372	-.0000441	.000113
_cons	.2789916	.2657633	1.05	0.305	-.2721678	.8301509

Source: Primary data

A regression analysis in Zambia reveals that transportation-related factors significantly contribute to maize price inflation. The model, which includes five independent variables, is statistically significant (F-statistic: 6.55, p-value: 0.0007) and explains approximately 59.83% of the variation in maize price inflation (R-squared: 0.5983). Transportation-related factors on prices exhibit a strong positive correlation with maize price inflation (coefficient: 1.207832, p-value: 0.000), while the cost of transporting maize from distant regions shows a negative correlation (coefficient: -0.000013, p-value: 0.015).

4.5 Discussion of research findings

4.5.1 Transportation Costs: The Central Pillar of Price Inflation

Transportation costs are the most significant driver of maize price inflation in Zambia. Poor road infrastructure, particularly in rural areas, increases costs due to vehicle wear-and-tear and delays, especially during the rainy season. Limited rail capacity exacerbates the reliance on road transport, further inflating costs. High global fuel prices add to this burden, making transportation a critical expense passed on to consumers and milling companies. These findings align with Sow and Mensah (2020) [25], who described transportation costs as an "indirect trade tax" that inflates maize prices, and with Odhiambo and Omiti's (2021) Kenyan study, which highlights similar bottlenecks in supply chains caused by weak infrastructure.

4.5.2 Input Costs: A Pressing Concern for Smallholder Farmers

Input costs, including fertilizers, hybrid seeds, and labor, heavily influence maize price inflation. Rising global prices for fertilizers and the high cost of hybrid seeds, which must be repurchased annually, strain Zambia's smallholder farmers. Labor shortages due to rural-urban migration further inflate production costs. Inefficiencies in Zambia's Farm Input Subsidy Program (FISP) exacerbate the problem through delays and poor targeting. The findings mirror Dr. Smith *et al*. (2019) [9], who showed that input costs drive nearly half of global maize price variability, and Mwangi and Kimani's (2018) [21] analysis of Kenya's subsidy inefficiencies, which similarly increase production costs and inflation.

4.5.3 Price Floors: Balancing Stability and Market Efficiency
Price floors stabilize farmer incomes but contribute to elevated consumer prices and inefficiencies in Zambia's maize market. The Food Reserve Agency's (FRA) role as a primary buyer discourages private sector participation, reducing competition and market efficiency. Delayed payments and poor surplus management by the FRA result in spoilage, creating fiscal burdens and food waste. These findings align with Kumar and Patel's (2018) [15] study of India's Minimum Support Price (MSP) policies, which inflated consumer prices and created logistical challenges, as well as Odhiambo and Omiti's (2021) observations on similar inefficiencies in Kenya.

4.5.4 Interdependence of Determinants
The factors driving maize price inflation transportation costs, input costs, and price floors are deeply interconnected. High transportation costs inflate the price of inputs, reducing the effectiveness of subsidies. Sow and Mensah (2020) [25] highlighted similar dynamics in landlocked countries, where logistical inefficiencies amplify input price volatility. Nguyen and Tran (2019) [22] found that in Southeast Asia, poor infrastructure undermines government programs aimed at reducing input costs, showing how these factors interact across regions to sustain high production costs.

4.5.5 Broader Economic and Social Implications
Maize price inflation affects Zambia at both macro and micro levels. At the macro level, it drives overall inflation, strains fiscal policies, and undermines the competitiveness of milling companies, leading to reduced investment and higher consumer prices for maize-based products. At the micro level, higher maize prices reduce disposable income, exacerbate poverty, and worsen malnutrition among low-income households. For smallholder farmers, rising input costs and delayed subsidies create financial insecurity, discouraging reinvestment in productivity-enhancing practices. These constraints reduce agricultural output, sustaining high prices and worsening food insecurity.

5. Conclusion and Recommendations
5.1 Conclusion
In conclusion, the study identifies price floors, input costs, and transportation costs as critical drivers of maize price inflation in Lusaka, Zambia. Price floors stabilize farmer incomes but contribute to inflation due to inefficiencies and poor storage infrastructure. Rising input costs, stemming from reliance on imports and lack of economies of scale, disproportionately affect smaller milling companies. Transportation costs are the most significant factor, with poor road networks, volatile fuel prices, and logistical inefficiencies driving up costs. Together, these challenges inflate consumer prices, threaten food security, and reduce market efficiency. Addressing them through policy reforms, infrastructure investment, and smallholder farmer support is crucial for stabilizing maize prices and ensuring a sustainable maize value chain.

5.2 Recommendations
To mitigate maize price inflation and enhance the efficiency of Zambia's maize value chain, the following recommendations are proposed:

1. Reform Price Floor Policies
- Align price floors with production costs and market conditions to prevent overpricing and ensure market stability.
- Enhance storage facilities to reduce post-harvest losses associated with government stockpiling. Provide targeted subsidies to low-income households to offset the impact of high maize prices.

2. Address Rising Input Costs
- Expand and improve input subsidy programs to ensure accessibility and affordability for smallholder farmers.
- Invest in domestic fertilizer production to reduce dependency on imports and stabilize input prices.
- Promote mechanized farming practices to enhance productivity and lower labor costs. Encourage the adoption of renewable energy solutions to reduce energy costs in maize production and processing.

3. Reduce Transportation Costs
- Invest in road and transportation infrastructure, particularly in rural areas, to improve market access and reduce logistical costs. Stabilize fuel prices through subsidies or the promotion of alternative energy sources.
- Establish shared logistics services for small and medium-sized milling companies to reduce per-unit transport costs. Develop efficient post-harvest handling systems to minimize spoilage during transportation and improve supply chain efficiency.

4. Enhance Market Competitiveness
- Foster public-private partnerships to improve efficiency across the maize value chain.
- Support small and medium enterprises (SMEs) with financial aid and access to technology to level the playing field with larger firms.
- Promote regional trade by addressing cross-border logistical bottlenecks and improving export competitiveness.

5. Protect Vulnerable Populations
- Expand social safety nets such as targeted food subsidies or cash transfer programs to shield low-income households from the effects of maize price inflation.
- Develop digital platforms for real-time market price transparency, empowering farmers and consumers to make informed decisions.

Implementing these recommendations requires coordinated efforts across sectors to create a more resilient maize value chain. By addressing the systemic inefficiencies identified in this study, Zambia can stabilize maize prices, enhance food security, and promote inclusive economic growth.

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