Factors Influencing Maize Sales Among Smallholder Farmers in Zambia

Jimaima, Mulala and Muzeya, Hamwende and Lwisha, Charity Mutale and Chizyuka, Henry and Chisata, Chitambo Muyunda

The University of Zambia, The University of Zambia, The University of Zambia, University of Lusaka, The University of Zambia

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Abstract

Maize is both Zambia’s staple food crop and a key cash crop for smallholder farmers, yet the commercialization of maize production remains constrained by structural, economic, and institutional barriers. This study investigates the determinants of maize sales among smallholder farmers using nationally representative data from the 2015 Rural Agricultural Livelihoods Survey (RALS), covering over 8,800 agricultural households. A multiple linear regression model was employed to assess the influence of socioeconomic, farm-level, institutional, and market-related factors on maize sales. Results indicate that maize commercialization is primarily shaped by economic and production-oriented variables rather than socio-demographic characteristics. Specifically, higher maize prices, larger cultivated areas, the use of hired labor, coupled with higher transport costs significantly increase maize sales, while reliance on unreliable price information exerts a strong negative effect. Conversely, factors such as gender, age, education, and distance to market were statistically insignificant, suggesting that structural constraints affect all farmers equally. These findings highlight the need for systemic interventions that reduce transaction costs through improved infrastructure, strengthen access to timely and reliable market information, and enhance production capacity via land access, input provision, and labor support. By addressing these universal barriers, policymakers and development partners can facilitate the transition of Zambia’s smallholder farmers from subsistence to market-oriented production, thereby improving rural incomes, food security, and national agricultural commercialization.

Introduction

Agriculture forms the backbone of Zambia’s economy, particularly in rural areas where it sustains over 70% of the population through employment, food supply, and income generation (Phiri, J et al.,2020; Santpoort, R. 2020). Within this sector, maize is not only the country’s staple food crop but also a major cash crop cultivated primarily by smallholder farmers. It plays a crucial role in household food security, national economic stability, and rural development. Despite this centrality, the marketing of maize remains a persistent challenge for smallholder farmers, many

of whom struggle to convert production into meaningful income (Santpoort, R. 2020). This disconnect between production and commercialization underscores the need to understand the factors that influence maize sales in Zambia, as such insights are vital for improving farmer welfare, reducing rural poverty, and promoting sustainable agricultural commercialization.

Maize production is widespread across all ten provinces of Zambia, with significant concentrations in Central, Eastern, and Southern provinces. Smallholder farmers defined as those cultivating less than five hectares of land contribute the bulk of national maize output, which accounts for nearly 60% of Zambia's total cereal production (Silva, J. V et al., 2023; Malesu, L. M et al.,2024). The crop is integral to government-led food security programs such as the Farmer Input Support Programme (FISP), which supplies subsidized inputs to enhance production (Alawode, A. 2025). While these initiatives have increased maize output, the capacity of smallholder farmers to sell their produce profitably remains constrained by several socioeconomic, infrastructural, financial, and policy-related factors.

A primary challenge is limited market access. Many smallholder farmers live in remote rural areas characterized by poor road networks, inadequate transport services, and high logistical costs. This isolation makes it difficult for farmers to reach high-demand urban markets where maize fetches better prices. While the Food Reserve Agency (FRA) operates satellite depots across all districts and remains a major buyer of maize, its presence in rural areas is often inadequate. As a result, farmers still face the same challenges limited access to competitive markets and the burden of selling their produce to local traders or middlemen at significantly lower prices. Moreover, FRA's pricing structures, which are usually lower than prevailing urban market rates, further reduce farmers' profit margins. The situation is further worsened by the lack of access to reliable and timely price information, which limits farmers' bargaining power and increases their vulnerability to exploitation. Farmers who lack radios, mobile phones, or access to digital platforms remain at an even greater disadvantage in negotiating fair terms of trade (Chapoto, A et al., 2019; Burke, W. J et al.,2020).

Institutional and policy-related factors further complicate maize marketing. Government interventions, particularly through the Food Reserve Agency (FRA), are designed to stabilize maize

prices and provide a guaranteed market for smallholder farmers. However, challenges such as delayed payments, fixed pricing structures, and occasional market distortions have been reported. These outcomes sometimes reduce farmer confidence in formal maize purchase programs and limit their willingness to sell through official channels. Moreover, unpredictable government interventions such as sudden export bans or policy shifts create uncertainty in the market, discouraging private-sector investment and undermining efforts to build sustainable maize marketing systems (Ariga, J et al., 2019; Jayne, T. S et al.,2019).

Transaction costs also play a critical role in influencing maize sales. Expenses related to transportation, storage, handling, and negotiation often consume a substantial portion of farmers' potential earnings (Silwimba, N. P et al., 2025). For example, inadequate storage facilities force farmers to sell immediately after harvest, when prices are usually at their lowest, thereby limiting their ability to take advantage of seasonal price fluctuations. Similarly, high transportation costs discourage participation in formal markets, resulting in lower overall market engagement and reduced income from maize sales (Hlatshwayo, S. I et al.,2021; Changalima, I. A et al., 2022).

Beyond infrastructure and policy, access to finance is another critical factor shaping maize sales. Smallholder farmers often face liquidity constraints due to limited access to affordable credit and financial services (Santpoort, R. 2020). As a result, many are compelled to engage in "distress sales" of maize immediately after harvest to meet urgent household needs such as school fees, healthcare, and loan repayments. This practice forces them to sell at low prices rather than waiting for more favourable market conditions. The absence of effective rural credit systems and affordable financial products prevents farmers from making strategic marketing decisions.

Climate variability also indirectly influences maize sales. Recurrent droughts, erratic rainfall, and pest outbreaks (such as the fall armyworm) reduce both the quantity and quality of maize harvests, thereby affecting the surplus available for sale. In years of poor harvest, smallholders often retain most of their maize for household consumption, leaving little for the market (Njavwa Mwila, T. 2021; Adunola, M. P et al., 2021). Conversely, bumper harvests without corresponding market demand may lead to gluts, driving prices down and further diminishing farmers' incomes.

Social and organizational factors also play a role. Farmers who belong to cooperatives or producer associations often enjoy better access to inputs, information, and markets compared to those who operate individually. Collective marketing enables farmers to pool resources, reduce transaction costs, and strengthen their bargaining power. However, weak farmer organizations, limited trust, and lack of coordination remain barriers to fully leveraging such opportunities in Zambia.

Another dimension relates to regional and international trade. Zambia is a key maize producer in Southern Africa, and cross-border trade has the potential to improve market opportunities for smallholder farmers (Nshimbi, C. C. 2020). However, inconsistent government export policies, coupled with weak border infrastructure and trade restrictions, often limit farmers' ability to benefit from regional markets in countries such as the Democratic Republic of Congo, Zimbabwe, and Malawi.

Previous studies on maize marketing such as (Luiz, J. M.,2019; Aggarwal, S et al., 2024) emphasize issues of transaction costs, information gaps, and limited market access. However, gaps remain in understanding how these factors interact and the extent to which each contributes to influencing maize sales. Most existing research tends to isolate single variables without considering the combined effects of socioeconomic, infrastructural, institutional, climatic, and organizational constraints. Therefore, there is insufficient evidence to guide comprehensive policy formulation that effectively addresses the challenges faced by smallholder farmers.

This study seeks to fill that gap by assessing both the nature and the magnitude of factors that influence maize sales among smallholder farmers in Zambia. By identifying and quantifying these determinants, the research will generate insights that are valuable for policymakers, farmer organizations, and development partners. These findings can inform strategies aimed at reducing transaction costs, improving access to profitable markets, strengthening information systems, increasing financial inclusion, and aligning policy interventions with farmer needs. Ultimately, such measures have the potential to enhance farmer incomes, improve household food security, and foster sustainable rural development.

In summary, maize is a cornerstone of Zambia's agricultural economy, but its effective commercialization is hampered by numerous constraints that extend beyond infrastructure and policy. Socioeconomic realities, climate risks, financial exclusion, and weak organizational structures also shape maize sales outcomes. This research examines the determinants of maize sales among smallholder farmers and assesses their relative importance. By doing so, it contributes to evidence-based solutions that can strengthen agricultural marketing systems, improve rural livelihoods, and support the broader goals of national economic growth and food security.

Methodology

Data Source

This study utilized **secondary data** from the **2015 Rural Agricultural Livelihoods Survey (RALS)**, a nationally representative household survey jointly conducted by the Indaba Agricultural Policy Research Institute (IAPRI), the Central Statistical Office (CSO), and the Ministry of Agriculture. The survey employed a stratified two-stage sampling design to ensure representation across provinces and rural households. RALS 2015 covered approximately 8,800 agricultural households across Zambia, collecting detailed information on household demographics, income sources, agricultural production, input use, and market participation.

For this study, the sample was restricted to **smallholder farming households** (defined as those cultivating less than 5 hectares) who reported maize production in the 2014/2015 agricultural season. Non-maize producing households were excluded from the analysis.

Data Preparation

The raw RALS dataset was cleaned and prepared for analysis as follows:

1. **Data screening:** Missing values, outliers, and inconsistent responses (e.g., negative values for production or sales) were identified and handled appropriately. Outliers in maize sales were minorized at the 1st and 99th percentiles to reduce their influence.

2. **Variable selection:** Variables relevant to maize sales were extracted, including household demographics (age, gender, education of household head), farm-level characteristics (farm size, labour, input use), institutional variables (market access, participation in cooperatives, access to extension services), and economic factors (maize price received, transportation cost).

3. **Variable transformation:** Continuous variables such as farm size and household labour were standardized where appropriate. Dummy variables were created for categorical factors (e.g., gender, cooperative membership, extension access).

Analytical Techniques

1. **Descriptive Statistics**

    - Frequencies, percentages, were computed to summarize the demographic and socio-economic characteristics of the sampled households.

2. **Regression Analysis**

    To determine the factors influencing maize sales, a **multiple linear regression model** was estimated. The dependent variable was the value of maize sales (in Zambian Kwacha). The model is specified as:

$$y_i = \beta_0 + \beta_{1i}X_{1i} + \beta_{2i}X_{2i} + \cdots + \beta_{ni}X_{ni} + \varepsilon_i$$

Where:

a. y_i = maize sales of household (measured in Kwacha)

b. β_0 = intercept

c. β_i = coefficients of explanatory variables

d. X_i= independent variables for household

e. ε_i = error term

The independent variables included:

f. **Maize price received (Kwacha/kg)**

g. **Transport cost (Kwacha/km or total expenditure on transport)**

h. **Farm size (hectares under maize production)**

i. **Household labor (family + hired labor, in person-days)**

j. **Gender of household head (male = 1, female = 0)**

k. **Education of household head (years of schooling)**

l. **Access to extension services (1 = yes, 0 = no)**

m. **Cooperative membership (1 = yes, 0 = no)**

n. **Distance to nearest market (km)**

o. **Household size (number of members)**

Both continuous and categorical variables were included in the model to capture socioeconomic, institutional, and farm-level influences on maize sales.

3. **Statistical Testing**

    a. Statistical significance of explanatory variables was assessed at the **5% significance level ($p < 0.05$)**.

Ethical Considerations

Since the study used secondary data (RALS 2015), no direct contact with human subjects occurred. However, data were used strictly for academic purposes, maintaining confidentiality as per the guidelines of the original survey administrators.

Results and findings

The study reveals a dynamic and somewhat unexpected demographic profile among Zambian smallholder maize farmers. Counter to traditional perceptions of African agriculture, the sector shows strong involvement from both genders, with female-headed households constituting a

slight majority at 50.17% of the sample. This underscores the pivotal role women play in national maize production and highlights the necessity for gender-sensitive policies that address their specific challenges (Adam, R. I et al., 2020; Tambo, J. A et al., 2021). Furthermore, the sector is characterized by a notably young workforce, with 60% of farmers falling within the 0-25 age bracket, suggesting that maize farming remains a viable livelihood for Zambian youth. However, educational attainment is generally low, with a majority (59.36%) having only primary education and 17.02% having no formal schooling at all. This educational landscape presents a unique challenge for disseminating new agricultural techniques and market information, necessitating tailored, non-literacy-based extension services as found by Ninh, L. K. (2021).

The analysis identified that the decision to sell maize is predominantly driven by economic and farm-level factors, rather than socio-demographic characteristics, similar to Martey, E et al. (2020). As expected, classic market incentives play a crucial role; higher maize prices provide a strong motivation for farmers to bring their surplus to market. Production capacity is equally critical, with both larger field sizes and the use of hired labour significantly increasing the volume of maize sales. This indicates that the ability to generate a harvest that exceeds subsistence needs is the fundamental prerequisite for commercial engagement. A more complex and intriguing finding is the positive relationship between transport costs and sales. This suggests that the high cost of accessing markets creates a powerful economic pressure, often compelling farmers to sell specifically to offset the expense of transportation, which may lead to sub-optimal selling decisions (Ncube, D. 2020).

A critical finding with major policy implications is the significant negative impact of unreliable price information on maize sales. Farmers who lacked access to accurate, timely market data sold significantly less, demonstrating how information asymmetry cripples their bargaining power and exposes them to exploitation by better-informed buyers. This underscores that knowledge is a form of capital as important as land or labour, similar to Hajjar, R et al. (2020). Conversely, several factors often assumed to influence agricultural market participation were found to be statistically insignificant. These include gender, age, marital status, education level, and physical distance to the market (Agholor, A. I., 2023).

This collective insignificance powerfully indicates that the barriers to market entry such as production constraints, high transaction costs, and poor information are universal constraints that affect all farmers equally, regardless of their personal circumstances.

In conclusion, the path to commercializing Zambia's smallholder maize sector lies not in broad demographic targeting, but in implementing systemic interventions that address these universal constraints. The findings advocate for integrated policy approach focused on three pillars: first, enhancing production capacity through secure land tenure and access to productivity-boosting inputs and labour-saving technologies; second, reducing market transaction costs, primarily by improving rural infrastructure and transport systems to make market access less prohibitive; and finally, democratizing market intelligence by investing in robust, accessible information dissemination systems, such as mobile technology and community radio, to level the informational playing field (Kaiser, N et al., 2022; Liao, R et al., 2025; Nachiappan, B et al., 2025). By empowering farmers with the means to produce a surplus, the ability to get it to market affordably, and the knowledge to sell it profitably, policymakers can unlock the vast potential of this young, diverse, and enterprising smallholder community.

Factors Influencing Maize Sales

A multiple regression analysis was employed to isolate the specific factors driving market participation, revealing five key variables that exerted a statistically significant influence on the volume of maize sales among smallholder farmers. These findings paint a clear picture of a decision-making process dominated by practical economic and production constraints rather than socio-demographic characteristics.

First, the analysis identified two powerful market incentive factors. **Transport costs** demonstrated a positive relationship with sales volume. This counterintuitive finding, similar to Mamonov, V et al. (2019) suggests that the high cost of accessing markets creates a significant economic pressure, compelling farmers to sell larger quantities to generate the necessary cash to offset these expenses, even if it means selling at a sub-optimal time or price. Conversely, and as expected, the **price of maize** itself was a positive and significant driver. Higher market prices act as a direct motivator, incentivizing farmers to allocate a greater portion of their harvest to the

market to maximize income, thereby reinforcing the fundamental law of supply in response to price signals as Santpoort, R. (2020) found in their study.

On the production side, two critical capacity factors emerged. The **unit area of the field** was a major positive determinant, underscoring that the ability to generate a marketable surplus is the fundamental prerequisite for commercial sales. Larger plots enable farmers to achieve economies of scale and move beyond subsistence production (Giller, K. E et al., 2021). Complementing this, the **use of hired labour** also had a positive effect. Access to additional labour, particularly during peak periods like planting and harvesting, enhances productivity, improves the timeliness of operations, and ultimately increases the total harvestable surplus available for sale.

Finally, the analysis highlighted the critical role of information. A strong negative effect was found for farmers who relied on **unreliable sources for commodity price information**. This result underscores the severe disadvantage caused by information asymmetry. Without accurate and timely market intelligence, farmers are unable to negotiate effectively, often leading to sales at lower prices or a reluctance to engage with distant, potentially more lucrative markets due to perceived risk (Hoayek, A et al., 2023). This depresses both the volume and value of their sales.

Notably, a range of **socio-demographic variables including gender, age, marital status, education level, and distance to the market were found to be statistically insignificant**. This collective null finding is profoundly important. It indicates that the barriers to market participation are universal constraints that affect all farmers equally, regardless of their individual characteristics. The struggle to overcome high transport costs, limited production capacity, and poor market information is a shared experience across the smallholder community.

In summary, the results compellingly argue that the path to enhancing commercial maize sales lies not in demographic targeting, but in systemic interventions designed to lower transaction costs (e.g., improving rural infrastructure, facilitating collective transport), boosting production capacity (e.g., improving access to land and credit for inputs), and democratizing access to accurate, real-time market information.

Multiple regression analysis identified five significant factors influencing maize sales:

Variable	Coefficient	P-value	Effect
Transport cost	0.7205	0.000	Positive; higher transport costs associated with higher sales
Price of maize	0.0892	0.000	Positive; higher maize prices encourage sales
Unit area of field	0.1847	0.035	Positive; larger cultivated area increases sales
Household source of commodity price info	-0.0448	0.007	Negative; unreliable price information reduces sales
Hired labor	0.6503	0.038	Positive; more labor increases production and sales

Source: Authors' analysis

Other factors, including gender, age, marital status, education, and distance to market, were not statistically significant.

Discussion

The empirical findings of this study clearly demonstrate that the commercial behaviour of smallholder maize farmers in Zambia is predominantly governed by a set of economic and production-oriented factors, while socio-demographic characteristics play a remarkably negligible role. This distinction is critical for designing effective agricultural and market development policies.

A central, and somewhat counterintuitive, finding is the significant positive influence of **transport costs** on sales volume. This suggests that the financial burden of market access is so substantial

that it acts as a powerful motivator rather than a simple barrier. Farmers are compelled to sell a sufficient quantity of maize not just for profit, but specifically to generate the cash required to justify and cover the high cost of transportation itself (Bates, R. H. 2019). This behaviour points to a scenario of **distress sales** or sub-optimal market participation driven by logistical inefficiencies, underscoring an urgent need for investments in rural infrastructure and logistics, such as road networks, vehicle access, and localized aggregation points, to reduce this coercive pressure on farmers.

Conversely, the positive correlation between **maize prices** and sales volume confirms a fundamental market principle: price signals are a potent incentive. When farmers are confident they will receive a favourable return, they are more likely to allocate a greater share of their harvest to the market. This finding directly highlights the critical importance of **transparent and reliable market information systems**. When farmers have access to accurate, timely data on prevailing prices in different markets, they are empowered to make strategic decisions about when and where to sell, thereby maximizing their income and engaging more confidently with the market economy (Gardner, T. A et al., 2019).

On the production front, the analysis confirms that **scale is a fundamental prerequisite** for commercial engagement. The positive relationship between the **size of cultivated area** and sales volume is straightforward: larger plots enable farmers to generate a harvest that exceeds their household's subsistence needs, creating a marketable surplus. This is further amplified by the positive effect of **hired labour**, which indicates a transition from purely subsistence farming towards a more commercial orientation. Access to additional labour allows for more timely and efficient farming operations, directly increasing yields and the volume of produce available for sale.

The negative impact of **unreliable price information** powerfully reinforces the argument for better market systems. Households relying on hearsay, outdated data, or sources with vested interests are at a severe disadvantage. This information asymmetry cripples their bargaining power, increases their perceived risk, and often leads to missed opportunities or sales at unfavourable prices, ultimately depressing their market participation.

The most striking overarching conclusion, however, is the consistent **statistical insignificance of socio-demographic variables** such as gender, age, marital status, and education (Adisa, O. 2019; Rahman, M. M et al., 2020). This indicates that the constraints of high transport costs, limited production capacity, and poor market information are universal challenges that affect all farmers equally. Therefore, interventions that successfully address these systemic barriers such as facilitating access to land and capital, improving rural infrastructure, and deploying digital market information services will benefit the entire smallholder community, enabling a more prosperous and market-integrated agricultural sector (Radeny, M. A et al., 2020).

Conclusion

In conclusion, this study underscores that the pathway to enhancing commercial maize sales among smallholder farmers lies in addressing critical economic and structural constraints, rather than focusing on socio-demographic characteristics. The analysis reveals that factors such as age, gender, and educational attainment have a negligible influence on market participation. Instead, the decisive drivers are unequivocally economic and operational: the prevailing market price of maize, the cost of transport, the scale of cultivation (farm size), the utilization of hired labour, and, crucially, access to reliable and timely market information.

These findings provide a clear mandate for policymakers and development practitioners. To effectively boost smallholder productivity and market integration, interventions must be strategically targeted. This includes improving Market Linkages and Infrastructure by reducing the prohibitive transaction costs associated with transport by investing in rural infrastructure and facilitating collective marketing. Democratizing Market Intelligence through establishing robust and accessible systems for disseminating accurate, real-time price information to eliminate the disadvantages of information asymmetry. Enhancing Production Capacity by supporting farmers in increasing their surplus through improved access to resources like land, credit for inputs, and labour-saving technologies.

By implementing such a holistic approach that tackles these fundamental barriers, stakeholders can empower smallholder farmers to transition from subsistence-oriented practices to more

profitable, market-driven agriculture, thereby strengthening both rural livelihoods and national food security.

Recommendations

Based on the study's findings that maize sales are constrained by economic and structural factors rather than socio-demographics, the following evidence-based recommendations are proposed to enhance market participation among smallholder farmers:

1. Implement Systemic Solutions to Reduce Transaction Costs: Instead of merely educating farmers on the benefits of selling, policy should directly address the key barrier of **transport costs**. Recommendations include:

- **Investing in Rural Road Infrastructure** to lower the cost of getting goods to market.
- **Promoting Farmer Collective Action** through cooperatives or groups to enable collective bargaining for better transport rates and to aggregate produce for more efficient, larger-volume sales.
- **Supporting the Establishment of Local Aggregation Points** or warehouse receipt systems, allowing farmers to sell larger quantities locally without each individual incurring high transport costs.

2. Institutionalize Access to Real-Time Market Intelligence: The negative impact of unreliable information requires a systemic solution. Rather than just "ensuring access," we recommend:

- **Formalizing and Scaling Digital Information Platforms** that deliver real-time maize prices via SMS (e.g., Vodafone Farmers' Club) or voice messages to overcome literacy barriers.
- **Integrating Price Information into Popular Agricultural Radio Programs** to ensure wide dissemination.
- **Training Extension Officers** to act as verified sources of market information, not just agronomic advice.

3. Facilitate Land Access and Sustainable intensification: While expanding cultivated area is beneficial, it is often not feasible due to land scarcity. A more sustainable recommendation is to:

- **Promote Programs that Enhance Productivity *per Unit of Land*** through access to improved seeds, fertilizer, and sustainable farming practices. This allows farmers to generate a surplus without necessarily expanding their land area.
- **Support Secure Land Tenure Programs**, as secure land rights encourage farmers to invest in productivity-enhancing technologies that lead to a marketable surplus.

4. Formalize and Support Rural Labor Markets: To address the need for hired labour, interventions should:

- **Support the Development of Hired Labor Networks** or databases to connect farmers with available workers.
- **Explore and Promote Mechanization Hire Services** (e.g., tractor services) as a labour-saving technology that can achieve similar goals of timeliness and increased production capacity, especially for land preparation and harvesting.

5. Target Research on Information Channel Efficacy: The final recommendation is crucial. Further research should be specifically directed to:

- **Conduct Rigorous Impact Evaluations** comparing the effectiveness of different price information channels (e.g., SMS vs. radio vs. extension agents) on actual sales revenue and farmer profitability, not just on knowledge.
- **Identify and Analyse the Specific Sources of "Unreliable Information"** to better understand and counter the misinformation ecosystems that currently disadvantage farmers.

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