

Assessment of Influential Behaviours Affecting Maize Yield Maximization among Smallholder Farmers in Zambia: A Case Study of Mkushi District

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Abstract

This study assessed the influential behaviors affecting maize yield maximization among smallholder farmers in Mkushi District, Zambia. The primary objectives were to identify these behaviors, evaluate their effects on maize yields, and propose interventions for enhanced productivity. A mixed-methods approach was employed, integrating quantitative surveys and qualitative interviews with a sample of 154 farmers. Key findings revealed that farmer demographics, particularly age and education, significantly influenced yield outcomes. The adoption of modern farming practices, including improved seed varieties and timely planting, along with effective climate change adaptation strategies, were pivotal in boosting maize productivity. However, critical barriers, such as limited access to credit, financial resources, and markets, constrained yield potential. Regression analysis indicated that the adoption of modern farming practices increased yields by 20% ($p < 0.05$), while proper agronomical practices, such as optimal fertilizer use, contributed an additional 15% ($p < 0.05$). Challenges like insufficient resource management and delayed planting were linked to yield reductions of up to 25%. These findings underscore the need for tailored interventions, including training programs on modern agricultural techniques, enhanced credit facilities, and improved market infrastructure. The study emphasizes the importance of integrating behavioral theories, market transition frameworks, and transaction cost perspectives to understand and address these challenges comprehensively. By addressing these multifaceted challenges, the research contributes to Zambia's broader goals of agricultural development, poverty reduction, and sustainable economic growth. Recommendations include developing training programs for smallholder farmers that consider their educational background, age, and experience with modern farming, creating microcredit schemes with flexible repayment plans tailored to smallholder farmers' harvest cycles, and designing interventions in Mkushi District that address specific challenges like soil degradation and pest pressures.

Keywords: Maize Yield, Smallholder Farmers, Agricultural Practices, Climate Change Adaptation, Credit Access.

Introduction

Maize is one of the most important cereal crops in the world, in agricultural economy both as food for human beings, feed for animals and other industrial raw materials. It is one of the world's leading crops cultivated over an area of about 142 million hectares with a

production of 637 million tons of grain. In Nepal, the current area planted under maize was 849,892 ha with an average yield of 2.02 t ha (CBS, 2016). It is estimated that for the next two decades the overall demand of maize will be increased by 4% to 8% per annum resulting from the increased demand for food. Such increase in demand must be met by increasing the maize yield per unit of land (Pangali, 2001). However, over the decades, the agricultural production including maize has either remained stagnant or increased at a very slow rate (FAO, 2019).

The production of maize on a global scale has significantly risen over recent decades due to growing demand, advancements in technology, heightened yields, and expanded cultivation areas (Erenstein, 2022). Therefore, Maize stands out as the primary cereal crop and the most extensively grown staple, exerting a crucial influence on food security across sub-Saharan Africa (SSA). While a few nations have made notable strides in enhancing maize productivity, the average yields in SSA remain considerably lower than the potential achievable with better cultivars and effective crop management practices (Abate et al, 2017). Maize production in many sub-Saharan African countries, where maize is a staple food, often experiences low yields, averaging around 1.5 tons per hectare, which amounts to only 20 percent of the average yields in developed countries (Abate et al, 2017).

Agriculture is one of the most important sectors in the majority of developing countries when it comes to poverty alleviation. This stems from the fact that in most of the developing countries, the majority of the poor are engaged in agriculture and so growth in the sector is often associated with relatively large reduction in poverty (World Bank, 2022). In Zambia, the agricultural sector contributes 13 to 20% of the Gross Domestic Product (GDP) and also accounts for about 70% of the total labor force (CSO, 2022).

Maize is by far the most widely grown crop in Zambia as it is the country's staple and principal food security crop. Constituting about 80% of all farmers, the over 1.1 million smallholder farmers grow most of the maize despite being resource poor (Tembo and Sitko, 2013). These smallholder farmers contribute to more than 80% of the total maize produced annually in Zambia. Apart from being the major source of household food security in Zambia, maize accounts for 41% of the value of farm income including the value of production and sales (Mweemba, 2019).

In Zambia, the legislative and policy environment governing maize production plays a crucial role in shaping the agricultural landscape. The government has implemented various policies aimed at enhancing food security and supporting smallholder farmers, particularly through the Farmer Input Support Programme (FISP), which provides subsidized seeds and fertilizers. However, challenges remain in policy implementation and coherence, often leading to inefficiencies in resource allocation and access. Recent studies highlight the need for a more integrated approach that aligns agricultural policies with market demands and environmental sustainability (Chisanga, et al., 2022). Additionally, regulatory frameworks must be strengthened to ensure that farmers can access necessary resources while

adhering to safety and quality standards, thereby fostering a conducive environment for maize yield maximization.

Effective marketing and distribution systems are vital for smallholder farmers to achieve optimal returns on their maize production. In Zambia, the lack of efficient marketing channels often results in farmers facing significant post-harvest losses and limited access to lucrative markets. Research indicates that enhancing market access through improved infrastructure and cooperative marketing strategies can significantly increase farmers' income and incentivize higher production levels (Mubanga et al., 2023). Furthermore, weather variability poses a considerable risk to maize yields, as unpredictable rainfall patterns can adversely affect crop growth. Coupled with limited access to financing and investment opportunities, these factors create a challenging environment for smallholder farmers. Addressing these issues through targeted incentives, such as access to credit and insurance products, can enhance farmers' resilience and improve their return on investment, ultimately contributing to maize yield maximization in the region.

Over the past several decades, improving productivity in maize production has been one of the major goals of the Zambian government (Xu, et al., 2009). For instance, in its recognition of the need to improve productivity in maize production as well as to assure national food security and increased incomes to various stakeholders, government introduced the Fertilizer Support Programme (FSP) in 2002. In 2009, FSP was renamed and reformed as the Farmer Input Support Programme [FISP] (12. Mlilile, 2022). Under FISP, the number of farmers benefiting from subsidized fertilizer and improved seed was increased even though the actual subsidy package was halved (Jayne et al., 2010). One of the implicit aims of the programme has been that with the majority of resource poor small-scale farmers accessing subsidized inputs, the adoption of improved maize seed and fertilizer would increase and in turn, result in increased productivity. It has been envisaged that improved productivity would sustainably increase production and the incomes of smallholders over time through sales of maize surpluses to the Food Reserve Agency (FRA), and other market players. Besides the benefits in addressing the problem of soil degradation, Conservation Agriculture (CA) practices are being promoted and advocated for by both government and non-governmental organizations (NGOs) because they have also been associated with efficient use of resources and improved productivity (Jayne et al, 2015).

Despite this progress, in most developing countries, maize yields have largely plateaued, with a modest average of 2.08 metric tons per hectare, ranking among the lowest on a global scale (World Bank, 2022). This is because maize production is often constrained by various human, socio-economic, and institutional factors that limit the adoption of improved technologies and practices to maximize the yield. As stated above, (World Bank, 2022) argues that the maize yield is much lower than the potential yield that can be achieved under optimal conditions.

Problem Statement

Despite the Food Reserve Agency (FRA, 2023) emphasizing that increasing maize production yields in Zambia is essential to enhance food security, reducing reliance on food imports, and mitigating the need for cropland expansion, there is a problem of failure to maximize maize yields, which has far-reaching effects on food security, economic development, and poverty reduction in Zambia. Currently, actual maize yields in Zambia range from 1.4 to 3.0 tons per hectare, significantly below the potential yields of 8 to 15 tons per hectare achievable through best agronomic practices (FAO, 2019). This disparity highlights a critical gap that, if not addressed, could hinder Zambia's agricultural development and economic growth. The consequences of these low yields are profound, contributing to food insecurity, increased poverty levels, and the inability to achieve national goals, such as becoming a prosperous middle-income nation by 2030 (Ministry of Agriculture, 2023). Additionally, it is estimated that approximately 60% of smallholder farmers in Zambia are not adopting modern agricultural practices, which significantly contributes to the persistent yield gap. This gap in maize production not only threatens food security but also has an estimated economic impact of over \$1 billion annually on Zambia's GDP, highlighting the urgent need for targeted interventions to enhance agricultural productivity (Ministry of Agriculture, 2023). Empirical evidence indicates that the behaviors of smallholder farmers have had a significant impact on maize yield maximization in Zambia over the past decade (World Bank, 2022). Farmers' decisions regarding crop valuation, reluctance to adopt new technologies, limited market knowledge, and inadequate access to markets are among the challenges that hinder optimal yields. Additionally, issues such as improper planting dates, ineffective crop rotation, insufficient fertilizer application, and inadequate pest and disease management further exacerbate the situation. According to the Food and Agriculture Organization (FAO, 2019), these influential behaviors largely contribute to the failure in maximizing maize yields. Addressing these challenges is crucial for improving productivity and achieving the ideal situation where yields meet their full potential, thereby facilitating poverty eradication and contributing to national development objectives.

Research Objectives

- i. To identify the influential behaviours affecting maize yield maximization among Smallholder farmers in Mkushi District
- ii. To assess effects of the influential behaviours on maize yield maximization among Smallholder farmers in Mkushi District
- iii. To explore interventions that can enhance maize yield maximization among Smallholder farmers in Mkushi District

Research Questions

- i. What are the influential behaviors affecting maize yield maximization among smallholder farmers in Mkushi District?
- ii. Why do these influential behaviors affect maize yield maximization among smallholder farmers in Mkushi District?
- iii. How can interventions be implemented to enhance maize yield maximization among smallholder farmers in Mkushi District?

Literature Review

Influential behaviours affecting maize yield maximization among smallholder farmers

There are various influential behaviours affecting maize yield maximization among smallholder farmers. (Olwande et al, 2009) states that among the most influential behaviours affecting maize yield maximization among smallholder farmers, reluctance to adopt new technologies, inability to determine crop value, poor management of resources and inappropriate agronomical practices greatly affect maize yield maximization.

The effects of the influential behaviours on maize yield maximization among smallholder farmers

A study by Mlilile (2022) on the effects of influential behaviours affecting maize yield maximization in Tanzania established that influential behaviours increase maize yield by 30.43% among smallholder farmers. Moreover, it found that, crop valuing and adoption of new technologies increases maize yield maximization by 22.68% and 22.36% respectively. It is also found that agronomic practices such as weeding, spacing and manure application had positive effect on maize yield, increases maize yield by 28.12%, 25.26% and 37.14% respectively. Unfortunately, smallholder farmer failing to use the influential behaviours appropriately to maximize maize yield experienced decline of maize yield by 53.74% compared to smallholder farmers who did so. The study however, recommended that smallholder farmers ought to be worry of influential behaviour affecting maize yield maximization if they are to be progressive in maize production.

Another study by (Ogada 2015), investigated the Impact of Improved Farm Technologies on Yields: The Case of Improved Maize Varieties and Inorganic Fertilizers in Kenya established that influential behaviours play a significant role in improving maize yield maximization among smallholder farmers. The findings of the study showed that inorganic fertilizers and improved maize varieties significantly improve yields when adopted as a package rather than as individual elements. The impact is greater at the lower end of the yield distribution than at the upper end, and when technical efficiency of the farmers improves. A positive effect of partial adoption is experienced only in the lower quartile of the yield distribution. The policy implication is that adoption of new and complementary agricultural technologies should be promoted as a package, and should target households and areas which are already experiencing low yields to enhance maize yield maximization. Notably (Ogada, 2015), states that improved farm technologies are meant to make

agriculture more rewarding, especially in terms of increased output per unit of factor input or improved quality of output.

Additionally, the study established that that inorganic fertilizers and improved maize varieties improved yields. The magnitude of the effect of these technologies on yield, however, depended on whether a farm household adopted a complete package, and on the household's baseline yield level. Overall, households that adopted the complete package of new technologies (planting fertilizer, improved maize varieties and top dressing fertilizer) positively affected maize yield maximization.

According to a study conducted by Osei (2020) on resource-use efficiency in maize production among smallholder farmers in Ghana, it was found that among the influential behaviours affecting maize yield maximization among smallholder farmers, management of resources can't be ignored if smallholder farmers are to maximize their maize yield. The study by Osei aimed to evaluate the efficiency with which smallholder maize farmers use their input resources such as land, labor, capital, fertilizers, herbicides, pesticides, and improved seed in maize production. The study used the multi-stage sampling technique to collect cross-sectional data from 600 smallholder maize producers from the northern, Brong-Ahafo, eastern, and central regions of Ghana. This study employed the marginal value product (MVP) to marginal factor cost (MFC) ratio (MVP/MFC) of the input resources. The results revealed an increased return to scale, meaning smallholder maize farmers in the pooled sample and the studied regions should enlarge their production scale by about 3.2%, 2.2%, 7.6%, 6.8%, and 2.8%, respectively, to maximize productivity. The results also revealed that resource inputs like fertilizer, herbicides, pesticides, improved seed, and land were underutilized. Therefore, these resources need to be increased if smallholder maize farmers in the pooled sample want to be efficient in their production. Labor and capital were over-utilized and needed to be reduced to increase efficiency in the farmers' maize production.

Interventions that can enhance maize yield maximization among smallholder farmers

There are several interventions that can enhance maize yield maximization among Smallholder farmers. Gray (2021) states that one of the ways to maximize maize yields among smallholder farmers is by planting quality seeds. Agricultural productivity depends on the quality of seeds with which farmers sow their fields. Therefore, to increase maize yield on their farmlands, smallholder farmers are recommended to sow only certified seeds that have passed all the necessary quality parameters. Certified seeds may cost higher than those that do not have certification, but the result will be worth it, because proper quality of seeds is one of the main factors that affect crop yield. Besides that, planting only high-quality seeds represents one of the ecofriendly methods to increase crop yield. If needed, a farmer can check the quality of seeds by referring to a relevant seed company and requesting it to conduct special trials on a given land plot.

Additionally, Meyers (2015) states that, it is important to remember that the quality of seeds is not something that is permanent and undamageable, seed grains need protection from the moment they are planted in the ground. Seed coating is one of the seed treatment techniques used to accomplish this. It is the process of protecting seed grains with outer materials in order to improve their characteristics (weight, size) and/or provide them with some active compounds (micronutrients, microbial inoculants, growth regulators, etc.) called to protect them against plant diseases and boost their growth.

According to Jayne et al (2015), monitoring the growth of crops can be a very good recipe to enhance maize yield maximization among smallholder farmers across continents. From the early stage of development through budding and up to harvesting, it is very important to monitor plant health in order to timely detect any problem that can arise on a given farmland (be it related to pest infestations, plant diseases, weeds, etc.) and that can affect the crop yield. Regular monitoring of land plots, for instance, allows smallholder farmers to easily follow the growth status of plants and carry out crop yield estimation using remote sensing (FAO, 2019). The evolution of plant health status provides key information to decide on possible interventions to the needs of crops that can enhance yield.

To enhance maize yield maximization, smallholder farmers can use smart application of fertilizers and crop protection methods. FAO (2019) notes that although fertilizers are intended to nourish the various types of soil, boost plant growth, and increase yields, their use should be balanced and prudent. Using too much fertilizers can negatively affect the soil quality and, therefore, the agricultural productivity. Within one field, different areas may have different needs for soil fertilization, which is why the best solution here is to use fertilizers selectively, depending on the need for them in different field zones. This accurate approach to field fertilization helps keep the soil in good health, which helps increase the average crop yield per acre. Smallholder farmers aiming to increase crop yields must take care of their plants throughout their development and up the end of the growing season (Mweemba, 2019). Depending on the problem that may arise, farmers use different substances to diminish the impact of weeds, pests or diseases on crop yield. Such substances are usually herbicides, insecticides, desiccants, plant growth regulators, fungicides, adjuvants, etc. In general, there are various crop protection methods that smallholder farmers can use and among the main ones are weed/pest management and plant disease management.

To add to the above on Interventions to Enhance Maize Yield Maximization, the Diffusion of Innovations Theory explores how new ideas and practices spread within a social system. Identifying effective intervention strategies for promoting new agricultural practices among smallholder farmers in Mkushi District could be informed by this theory. Additionally, Meyers (2021) stipulates that Community-Based Participatory Research (CBPR) involves collaborating with community members to identify and address local issues in order to enhance maize yield maximization. Designing interventions in partnership with smallholder farmers and local organizations could increase their effectiveness and sustainability.

Research Gaps

The literature reviewed explains how influential behaviours such as failure to understand crop value, management of resources, adoption of new technologies and agronomical practices affect maize yield maximization. However, there is limited literature showing how the influential behaviours affect maize yield maximization in Zambia as most literature available is on general maize productivity in the country.

Theoretical and Conceptual Framework

Theoretical Framework

The theoretical framework includes three key theories relevant to agriculture: Behavioral Theory, which emphasizes the influence of farmers' attitudes and behaviors on decision-making to enhance crop yields; Market Transition Theory, which highlights the shift from state-controlled economies to market economies, providing smallholder farmers with opportunities for market participation and improved income; and Transaction Costs Theory, which addresses the costs incurred during commodity exchanges that can lead to opportunistic behavior and negatively impact smallholder farmers' profits and crop yields. These theories collectively suggest that understanding and addressing behavioral, market, and transactional factors can significantly enhance agricultural productivity and farmer welfare.

Conceptual Framework

The following conceptual framework was used in the study.

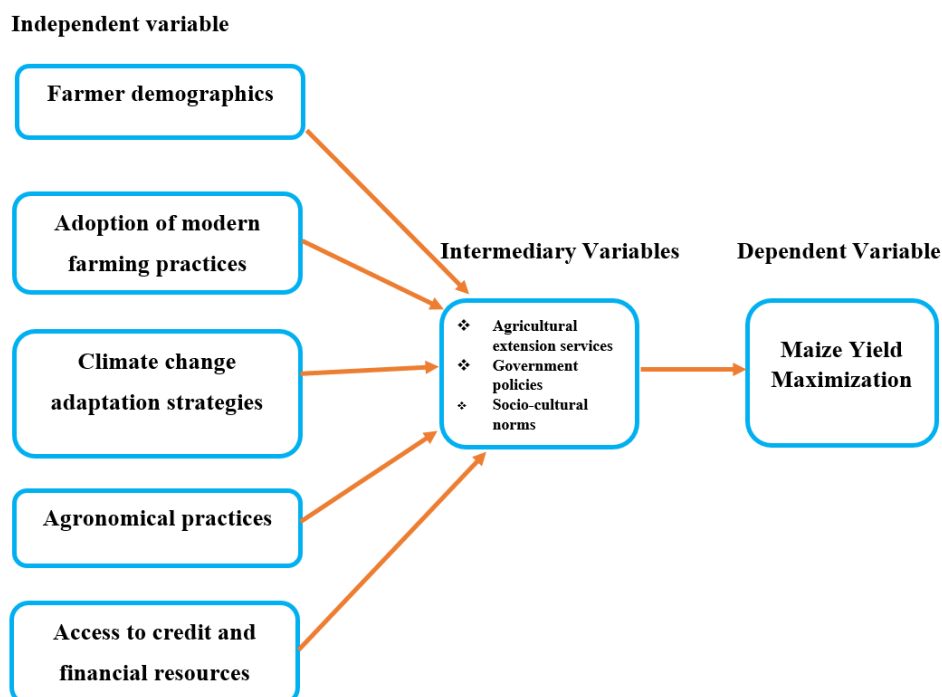


Figure 3.1: Conceptual framework

Research Methodology

This study adopted a pragmatic mixed research approach, allowing for the collection of both quantitative and qualitative data, which provides a comprehensive understanding of smallholder farmers' agronomical practices influencing maize yield maximization in Mkushi district. By integrating different research methods, the researcher was able to triangulate findings, enhancing the validity and reliability of the results. A mixed-method research design was utilized, drawing on both primary and secondary data collection methods. The main tool for data collection was a structured questionnaire, supplemented by interview schedules for qualitative insights. The study employed a simple random sampling technique, resulting in a sample size of 154 respondents from a target population of 250 smallholder farmers and agricultural specialists.

Additionally to the above, Simple random sampling was used to choose the study respondents. Simple random sampling was used because it is easy to implement and understand. Simple random sampling will be done with the help of camp officers found in Mkushi farm block. It ensures that each member of the population has an equal chance of being selected, which helps to reduce bias in the sample. This method is also efficient and cost-effective, as it does not require complicated procedures or resources (Kombo, and Tromp, 2006). Statistical Package of Social Sciences (SPSS) version 27 and Microsoft excel was used to analyse the quantitative data. The results were presented in tables, histograms, and pie charts. Qualitative data was analysed using content analysis to derive meaningful insight, and identify patterns and themes in the qualitative data. This technique allowed for in-depth understanding, contextualization, and flexibility. Qualitative content analysis involved a process designed to condense raw data into categories or themes based on valid inference and interpretation. This process is inductive reasoning, by which themes and categories emerge from the data through the researcher's careful examination and constant comparison. Analyze the coded data to identify recurring themes, patterns, or relationships between different codes or categories. Explore the frequency, prevalence, and co-occurrence of codes to gain insights into the dominant themes and their significance. Thereafter, interpret the findings, considering the context and the research objectives, develop a narrative or summary that describes the key themes, patterns, and insights derived from the content analysis and present the findings in a clear and meaningful way, using illustrative quotes, examples, or visual representations as appropriate. In this study, content analysis was used because it allows for both qualitative and quantitative research, enabling researchers to explore themes in-depth while also making quantifiable comparisons. It's a versatile method, adaptable to a variety of research questions and data sources.

Reliability and Validity

To ensure reliability, the researcher conducted a pilot study to pre-test the research instruments, allowing for revisions to address any ambiguities in the questionnaire. Validity was achieved by designing a close-ended questionnaire, which limited responses to

positive, negative, or no answers. This structure ensured that the questionnaire effectively measured the intended constructs and reflected the respondents' unbiased perspectives.

Ethical Considerations

The study upheld ethical principles, including informed consent, confidentiality, justice, anonymity, and protection from harm. Participants were provided with comprehensive information about the study to make informed decisions regarding their participation. Confidentiality was assured, with no coercion involved in the research process. The researcher ensured fair distribution of benefits and risks, avoiding exposure of any group to undue risks. Anonymity was maintained by not collecting identifying information, and informed consent was obtained to protect respondents from harm.

Analysis of Results

Response Rate

Table 1: Response rate

Response rate	Frequency	Percentage
Returned Questionnaires	154	100
Unreturned Questionnaires	0	0
Total	154	100.0

As evident in the table above, the study achieved a complete response rate of 100%. All 154 distributed questionnaires were successfully returned, indicating full participation from the selected respondents. This response rate is considered excellent, as it surpasses the typical thresholds for data analysis. Babbie and Earl (2009) suggest that a response rate of 50% is satisfactory, while a rate of 70% or above is deemed good. Therefore, the full return rate in this study ensures robust data for addressing the research objectives effectively.

Influential behaviours that affect maize yield maximization among smallholder farmers

Table 2: Influential behaviours

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Farmer demographics	0	12	44	90	8
Adoption of modern farming methods	4	1	8	67	74
Climate change adaptation strategies	6	0	5	78	65
Agronomical practices	3	2	3	67	79
Access to credit and financial resources	5	3	2	49	95

Source: field data (2024)

Overall, these findings indicate that smallholder farmers in Mkushi District believe that these behaviors significantly influence their ability to maximize maize yields.

Some qualitative responses from the agricultural specialist

Specialist number 3 noted that, "Being a field officer, I have noted that education plays a critical role in the adoption of modern agricultural techniques.... This gap in knowledge leads to reluctance in adopting new methods, as they may not fully understand the benefits. By providing targeted education and hands-on training, we can empower farmers to make informed decisions that positively impact their maize yields." Specialist number 4 was of the view that, "The demographics of farmers, including age, education level, and experience, significantly influence their willingness to adopt new agricultural practices... Understanding these demographic factors can help us tailor our outreach and training programs to better meet the needs of different groups, ultimately leading to greater adoption of practices that maximize maize yield."

Furthermore, Specialist number 6 strongly argued that, "I think despite other existing influential behaviour affect maize yield maximization, I have noted that among majority of the farmers, financial constraints are one of the most significant barriers to maximizing maize yields among smallholder farmers. Many farmers struggle to access credit or financial resources needed to purchase quality seeds, fertilizers, and other essential inputs. This lack of financial support often leads them to use substandard materials, which directly impacts their productivity. By improving access to financial services and providing targeted subsidies, we can help farmers invest in the resources they need to enhance their maize production."

Effects of the influential behaviours on maize yield maximization among Smallholder farmers in Mkushi District

Effect of demographics

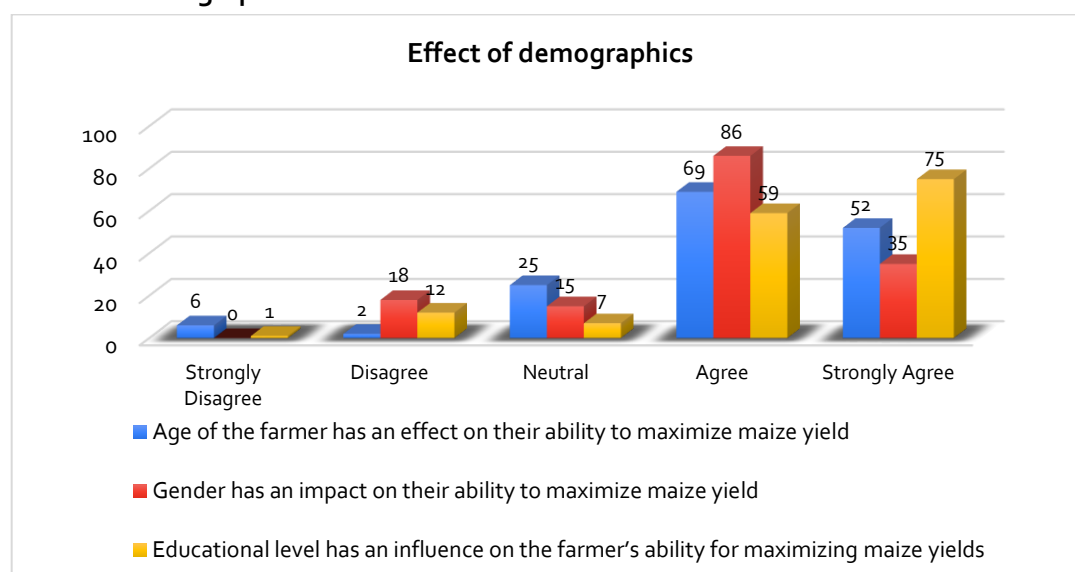


Figure 1: Effect of demographics Source: field data (2024)

The frequencies above illustrate a strong belief among farmers that age, gender, and education significantly influence their maize production capabilities.

Effect of adoption of modern farming practices

Table 3: *Effect of adoption*

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Reluctance to adopt modern farming practices	0	1	4	95	54
Without access to tools such as improved seeds, fertilizers, etc.	0	1	34	81	38
This reluctance to adopt modern farming stems from various challenges	0	1	4	108	41
When smallholder farmers are supported with resources	0	27	6	84	37

Source: *field data (2024)*

The data suggests that while there are challenges, the majority of farmers recognize the importance of adopting modern practices for maximizing maize yields.

Effect of climate change adaptation practices

SD=strongly disagree, D=disagree, N=neutral, A=agree, SA=strongly agree

Table 4: *Effect of climate*

Statement	SD	D	N	A	SA
Low application of NPK fertilizer results in decreased yields	0	9	9	103	33
An improved understanding of water resources and water storage is crucial	0	1	21	95	37
The uneven spatiotemporal distribution and shortage of water affects yields	0	1	4	88	61
Management of resources is essential for maximizing yields	0	2	4	81	67

Source: *field data (2024)*

The findings in the table suggest that farmers are aware of the significant impact of climate change adaptation practices on their maize production and recognize the need for improved resource management and fertilizer application.

Effect of agronomical practices

SD=strongly disagree, D=disagree, N=neutral, A=agree, SA=strongly agree

Table 5: *Effect of agronomical practices*

Statement	SD	D	N	A	SA
Good agricultural practices are essential	0	3	13	85	53
Choosing the right seeds is crucial	0	2	2	91	61
The timing of planting affects yields	0	0	3	97	54
Harvesting at the right time maximizes yield	0	1	5	113	35
It is generally accepted that proper practices improve yield	0	3	3	118	30

Source: field data (2024)

These results suggest that smallholder farmers in Mkushi District acknowledge the significant impact of agronomical practices on optimizing maize production.

Effect of access to credit and financial resources

SD=strongly disagree, D=disagree, N=neutral, A=agree, SA=strongly agree

Table 6: *Effect of access to credit*

Statement	SD	D	N	A	SA
Farmers who have access to credit can invest in high-quality inputs	0	1	15	111	27
Credit and financial resources are easily accessible	0	0	8	127	19
Access to financial resources can help farmers manage risks such as crop failure	17	60	5	56	16

Source: field data (2024)

Overall, these findings highlight the perceived importance of credit access for improving maize yields, despite some challenges related to accessibility and risk management.

Qualitative responses and analysis on the effects of the influential behaviours on maize yield maximization among smallholder farmers in Mkushi District

Table 7: Qualitative responses

Themes	Effect on Maize Yield Maximization
Farmer Demographics	Younger and more educated farmers tend to adopt innovative practices, leading to higher yields, while older farmers may rely on traditional methods, creating yield disparities. (SP ₄)
Adoption of Modern Farming Practices	Implementing modern techniques, such as precision agriculture and improved seed varieties, significantly boosts productivity and enhances overall yields. (SP ₃)
Climate Change Adaptation Strategies	Adapting to climate change through practices like drought-resistant crops and adjusted planting schedules helps maintain yields despite adverse weather conditions. (SP ₁₂)
Agronomical Practices	Effective agronomical practices, such as crop rotation and soil management, improve soil health and increase maize productivity among smallholder farmers. (SP ₁₄)
Access to Credit and Financial Resources	Financial support enables farmers to invest in quality inputs and modern equipment, which is crucial for maximizing yields; lack of access can hinder productivity. (SP ₁)

Source: field data (2024)

Interventions that can be used to enhance maize yield maximization among

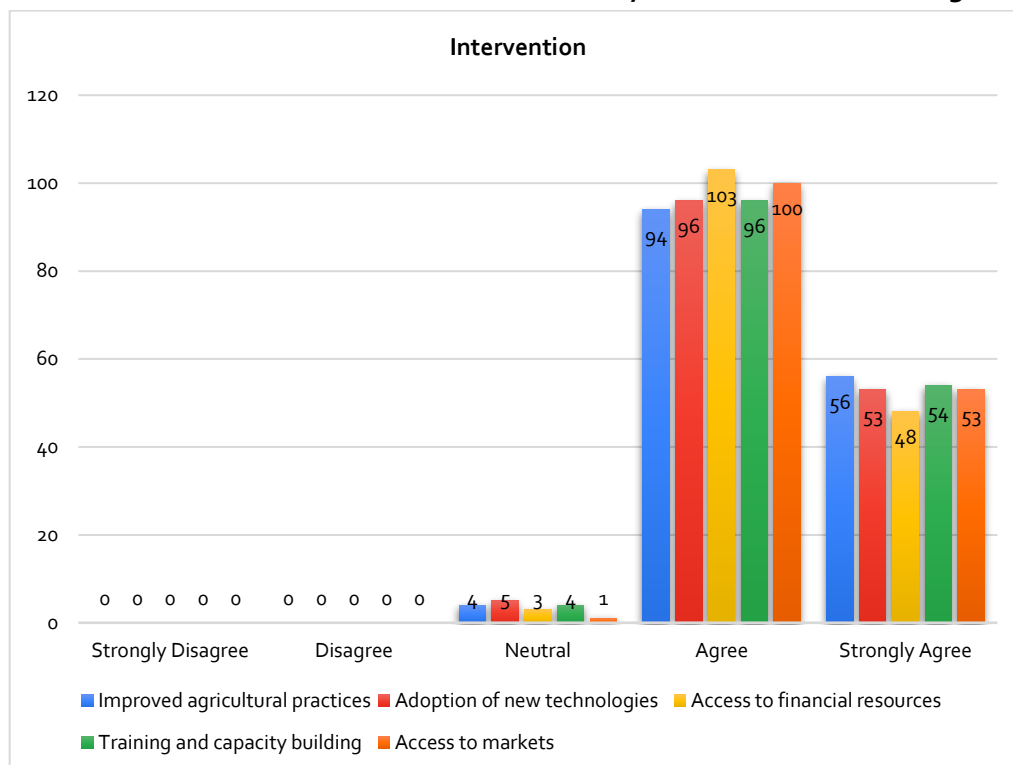


Figure 2: Interventions

Source: field data (2024)

The responses indicate a strong consensus on the importance of these interventions, with the highest agreement observed for the adoption of new technologies. This suggests that targeted support in these areas could be effective in addressing the challenges faced by smallholder farmers in maximizing their maize production.

Regression Coefficients

Table 8: Regression coefficients

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.292	.241		-1.212	.231
	Farmer demographics	.393	.121	.429	3.259	.002
	Adoption of modern farming practices	-.035	.149	-.031	-.238	.813
	Climate change adaptation practices	-.160	.134	-.104	-1.193	.238
	Agronomical practices	.348	.198	.314	1.762	.084
	Access to credit and financial resources	.400	.128	.364	3.119	.003
a. Dependent Variable: Maize yield maximization						

According to the study findings, the coefficient for farmer demographics is positive at 0.393, which indicates that enhancements in demographic factors such as age, education, and experience of the farmers significantly correlate with improved maize yields; this is statistically significant with a p-value of 0.002. This finding implies that demographic factors are critical levers for optimizing yield outcomes, as experienced or educated farmers are likely to employ better farming strategies.

On the other hand, both the adoption of modern farming practices and climate change adaptation practices present negative coefficients of -0.035 and -0.160, respectively, with p-values of 0.813 and 0.238, indicating that these factors do not have a significant or meaningful impact on yield maximization. These results suggest that, despite modern farming methods being widely promoted, they may not be effectively increasing yields among the smallholder farmers in this district, potentially pointing to barriers in implementation or contextual challenges faced by farmers.

The coefficient for agronomical practices stands at 0.348 with a p-value of 0.084, suggesting a positive association with maize yields that approaches significance. While this finding does not meet the conventional threshold for statistical significance ($p < 0.05$), it

nonetheless highlights the importance of agronomical practices and merits further investigation, as it indicates a trend that, if leveraged, could enhance yield outcomes.

Further, access to credit and financial resources has a notably positive coefficient of 0.400, paired with a significant p-value of 0.003, underscoring its pivotal role in maximizing maize production. This result strongly suggests that when smallholder farmers have better access to financial resources, they can invest in quality seeds, fertilizers, and modern technologies, ultimately leading to higher yields. This reinforces the need for policies targeted at improving financial support systems for smallholder farmers, as optimizing this factor could significantly advance maize yield maximization efforts in the agriculture sector of Zambia. Conclusively, the coefficients analysis reveals critical insights into which factors significantly affect maize yields, suggesting actionable areas for intervention to support smallholder farmers effectively.

Discussion of Results

Influential Behaviors Affecting Maize Yield Maximization among Smallholder Farmers in Mkushi District

The study identifies several influential behaviors impacting maize yield maximization among smallholder farmers in Mkushi District, emphasizing the role of farmer demographics such as age, education, and experience. Younger, more educated farmers tend to adopt modern farming practices more readily, while older farmers often adhere to traditional methods, hindering productivity. Agricultural specialists noted the importance of modern techniques and climate change adaptation strategies, highlighting farmers' awareness of these issues. Additionally, access to credit and financial resources emerged as critical barriers to maximizing yields, with many farmers struggling to invest in necessary inputs. Soil health, the lack of modern machinery, disease management challenges, and the need for agricultural training were also identified as significant factors affecting productivity. Addressing these multifaceted behaviors through targeted interventions and education is essential for enhancing maize yields and ensuring food security in the region.

The findings align with Behavioral Theory, which posits that farmers' decisions are heavily influenced by their attitudes and knowledge (Ajzen, 1991). Younger, more educated farmers are more likely to adopt modern farming practices, reflecting the notion that increased education enhances the willingness to embrace innovation. Conversely, older farmers often adhere to traditional methods, which can hinder productivity, underscoring the need for targeted educational interventions. Additionally, the study connects with Market Transition Theory, which emphasizes how shifts from state-controlled economies to market-oriented systems can create opportunities for smallholder farmers. In Mkushi District, the transition towards market participation is crucial for enhancing income and productivity, as farmers who engage more actively in market systems tend to adopt better agricultural practices.

While the study provides valuable insights, it has limitations. The reliance on self-reported data may introduce biases, as farmers might overstate their adoption of modern practices or downplay challenges. Furthermore, the cross-sectional nature of the study restricts the ability to draw causal conclusions regarding the relationship between behaviors and yield maximization.

Effects of Influential Behaviors on Maize Yield Maximization among Smallholder Farmers in Mkushi District

The assessment of influential behaviors reveals that demographic factors, modern farming practices, and access to resources significantly affect maize yield maximization among smallholder farmers in Mkushi District. Younger and more educated farmers demonstrate a greater willingness to adopt innovative practices, leading to improved yields. Gender dynamics also play a role, as women face more challenges in accessing resources compared to men, impacting their productivity. The study highlights the importance of modern farming techniques, effective climate change adaptation practices, and good agronomical practices in enhancing yields. Furthermore, access to credit is identified as a game changer, enabling farmers to invest in quality inputs. However, many face barriers in obtaining financial resources, underscoring the need for targeted interventions to empower farmers and improve agricultural productivity sustainably.

This aligns with Transaction Costs Theory, which emphasizes the costs incurred during exchanges that can impact farmers' ability to access necessary inputs (Williamson, 1981). Younger and more educated farmers are generally better positioned to navigate these costs and adopt innovative practices, leading to improved yields. Furthermore, the barriers faced by women farmers in accessing resources highlight the need for interventions that reduce transaction costs and enhance equitable access to inputs.

One limitation is the potential for gender bias in resource access, as the study may not fully capture the systemic barriers that women face in agricultural practices, potentially skewing the understanding of how demographic factors affect yield maximization.

Interventions that can Enhance Maize Yield Maximization among Smallholder Farmers in Mkushi District

To enhance maize yield maximization among smallholder farmers in Mkushi District, several targeted interventions have been proposed, emphasizing improved agricultural practices, adoption of new technologies, and access to financial resources, training, and market access. Agricultural specialists advocate for promoting good practices like crop rotation and soil conservation through workshops, which can significantly boost productivity. The adoption of innovative technologies, such as precision agriculture, is also crucial for optimizing inputs and increasing yields. Access to financial resources is vital for enabling farmers to invest in quality seeds and fertilizers, with microfinance options suggested as a potential solution. Training programs focusing on modern farming techniques and resource management are essential for equipping farmers with necessary

skills. Lastly, ensuring market access is critical for farmers to sell their produce at fair prices, thereby enhancing their income and investment capacity. Collaborative efforts among stakeholders, incorporating farmers' insights, and establishing monitoring mechanisms are essential for the successful implementation of these interventions.

These interventions can be informed by the principles of Behavioral Theory, emphasizing the importance of education and training programs that cater to farmers' specific demographics. By promoting good practices and modern techniques through tailored workshops, the study aligns with the need to shift farmer attitudes and knowledge toward more productive methods. Additionally, addressing the barriers identified through Market Transition Theory is essential. As farmers transition into more market-oriented practices, interventions should facilitate access to markets and financial resources, ultimately encouraging the adoption of better agricultural practices.

However, the effectiveness of these interventions may be limited by existing infrastructure and market access. Without addressing systemic issues such as poor transportation networks and market inefficiencies, even well-designed interventions may not achieve the desired impact on maize yield maximization.

Conclusion and Recommendations

Conclusion

It can be stated that this study assessed the influential behaviors affecting maize yield maximization among smallholder farmers in Mkushi District, Zambia. The findings highlighted that farmer demographics, adoption of modern farming practices, resource management, and access to credit and markets are critical determinants of maize productivity. Despite the availability of interventions, persistent challenges such as inadequate training, limited access to credit, and poor market infrastructure constrain farmers' ability to maximize yields. The study contributes to the theoretical understanding of maize yield maximization by integrating Behavioral Theory, Market Transition Theory, and Transaction Cost Theory. These frameworks provided a robust lens to analyze the decision-making processes of farmers, the impact of market dynamics, and the cost implications of agricultural transactions. However, practical application of these theories requires tailored, context-specific interventions.

Recommendations

Some of the key recommendations arising from the study include the following:

- i. Develop training programs for smallholder farmers that account for their educational background, age, and experience, incorporating relevant modules and utilizing local agricultural extension workers for better accessibility.
- ii. The government and private sector should establish microcredit schemes with flexible repayment plans aligned with harvest cycles and introduce weather-

indexed insurance to encourage investment in higher-yield inputs for smallholder farmers.

- iii. There is need to investigate the role of emerging technologies, such as artificial intelligence, precision agriculture, and Internet of Things (IoT)-enabled devices, in enhancing maize yield maximization among smallholder farmers.

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