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Determinants and Impacts of Improved Maize Variety Adoption Among Small-Scale Farmers in Matabula Village, Zambia

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Abstract

Improved maize varieties play a vital role in enhancing productivity and strengthening food security in Sub-Saharan Africa. However, their continued use among small-scale farmers remains difficult to sustain. This study examined the adoption and use of improved maize varieties in Matabula Village in Chibombo District, Zambia. A cross-sectional survey design was used, and information was collected from one hundred and thirty-five randomly selected small-scale farmers through structured questionnaires. The study found a high level of adoption, with farmers largely influenced by peer interactions, access to extension services, and expectations of higher profitability. The main challenges reported were high seed cost, frequent drought, and the occurrence of pests and diseases. Although many farmers had adopted improved maize varieties, access to financial support remained limited. Farmers also proposed increased extension services, more demonstration activities, and measures aimed at reducing production costs to support long-term adoption. Overall, while adoption is encouraging, its sustainability is affected by economic limitations, climatic conditions, and institutional constraints. Strengthened extension systems, enhanced affordability of inputs, and improved climate-resilient practices are essential for long-term adoption.

Keywords: Technology Adoption, Improved Maize Varieties, Small-Scale Farmers, Zambia, Agricultural Productivity, Constraints

1. Introduction

Maize is the principal staple crop in Zambia and serves as an essential source of food and income for many small-scale farmers across the country (Chisanga *et al*., 2022) [1]. In an effort to improve productivity and strengthen food security, the Zambian government and various development partners have encouraged the use of improved maize varieties (Fisher *et al*., 2015) [2]. These varieties are developed to provide higher yields and greater tolerance to drought, pests, and diseases (Khonje *et al*., 2015) [3]. However, the adoption and continued use of these varieties among smallholders remain uneven and often fall short of expected levels.

Adoption decisions are shaped by a range of social, economic, and institutional factors, with studies in Zambia showing that access to credit, extension services, seed cost, and farmer education all influence the extent to which improved varieties are used (Mason & Smale, 2013; Sitko *et al*., 2020) [4, 6]. While national studies offer valuable insights, localized assessments are important for understanding the specific circumstances that guide farmer behaviour (Smale & Jayne, 2003) [7]. This study examines these issues in Matabula Village in Chibombo District, a community that reflects the broader characteristics of small-scale maize production in Central Zambia. The purpose of the study is to assess the extent of adoption of improved maize varieties, to identify the factors that influence adoption decisions, to explore farmer perceptions of the benefits and challenges associated with these varieties, and to propose strategies that may support more sustainable use.

2. Materials and Methods

2.1 Study Area

The study was carried out in Matabula Village in Chibombo District, located in the Central Province of Zambia. The village contains slightly more than two hundred households and depends mainly on rain-fed maize farming as a primary livelihood

activity. The area experiences notable rainfall variability, which contributes to production risk for the small-scale farming community (Fisher *et al*., 2015) [2].

2.2 Research Design and Sampling

A cross-sectional survey design was used to obtain information from farming households (Khonje *et al*., 2015) [3]. The sample size was determined using a standard formula for finite populations (Yamane, 1967) [9], based on a total of two hundred and three households and a margin of error of five percent. This procedure resulted in a sample of one hundred and thirty-five households. A simple random sampling method was employed to ensure that each household had an equal opportunity to participate in the study.

2.3 Data Collection and Analysis

Information was gathered through direct, face-to-face administration of a structured questionnaire (Chisanga *et al*., 2022) [1]. The questionnaire captured background characteristics, farm information, adoption behaviour, access to agricultural services, and farmer perceptions regarding improved maize varieties. The data were coded and analysed using a statistical software package. The analysis relied on descriptive techniques, including computation of frequencies, means, and related summary measures (Khonje *et al*., 2015) [3].

2.4 Ethical Considerations

Ethical approval for the study was obtained from the relevant authorities. All participating households provided informed consent, and confidentiality was maintained by anonymizing all personal information.

3. Results

3.1 The respondent group consisted predominantly of men. A large share of the participants were within the economically active age range, and the average farming experience exceeded ten years, indicating a relatively knowledgeable farming population. Educational attainment was generally low, with many respondents having only primary schooling or no formal education (Chisanga *et al*., 2022) [1]. Typical household size was slightly more than five members, and the average cultivated land area for maize production was slightly less than one hectare (Mason & Smale, 2013) [4]. Socio-Demographic Characteristics.

Gender Distribution

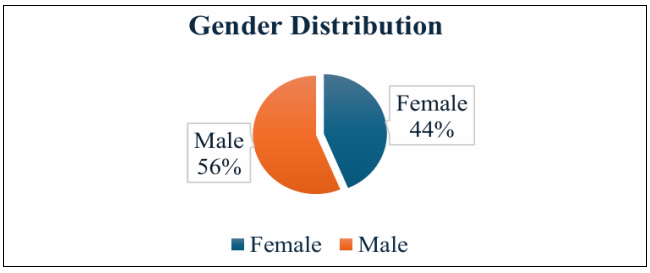
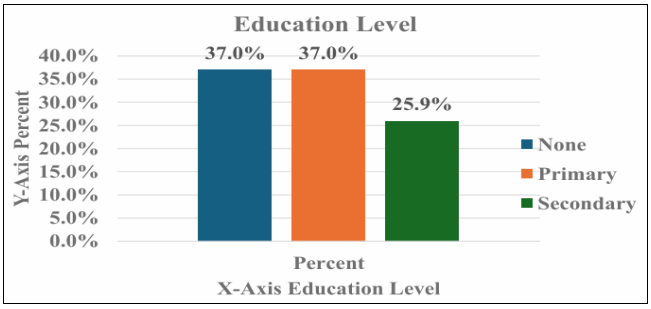


Fig 2: Gendeer of Respondents

Education Levels



Age Groups

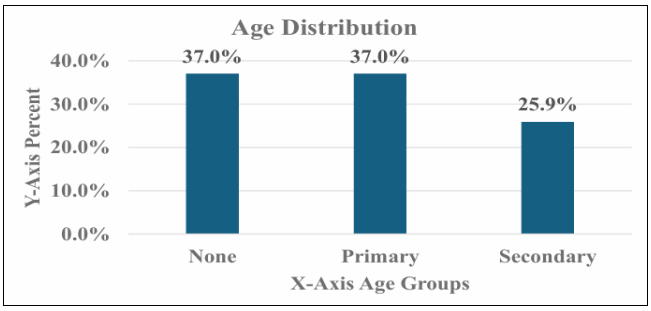


Fig 3: Age Distribution

3.2 Extent of Adoption and Varieties Used

The use of improved maize varieties was widespread among households (Khonje *et al*., 2015) [3]. The most common varieties included MRI 514, Pannar 53, and DKC 8033. Many farmers had used improved varieties for an average period of slightly more than three years, indicating recent uptake (Fisher *et al*., 2015) [2].

Table 14: Logistic Regression Classification

Classification Table[a]					
	Observed		Predicted		
			Used_Improved_Maize_Varieties		Percentage Correct
			No	Yes	
Step 1	Used_Improved_Maize_Varieties	No	21	5	80.8
		Yes	18	91	83.5
	Overall Percentage				83.0

a. The cut value is .500

Table 14: Regression Results Summary

Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Access_to_Credit(1)	-20.313	5249.018	.000	1	.997	.000	.000	
	Access_to_Extension_Services(1)	-2.234	.573	15.202	1	.000	.107	.035	.329
	Constant	22.393	5249.018	.000	1	.997	5308387599.108		

a. Variable(s) entered on step 1: Access_to_Credit, Access_to_Extension_Services.

ield	
Valid Percent	Cumulative Percent
19.3	19.3
80.7	100.0
100.0	

Table 9: Profitability

More_Profitable					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	26	19.3	19.3	19.3
	Yes	109	80.7	80.7	100.0
	Total	135	100.0	100.0	

3.3 Factors Influencing Adoption

Both institutional and social influences affected adoption. Farmers frequentlyt cited interactions with neighbours and friends as important in their decision to adopt improved varieties (Rogers, 2003) [5]. Contact with extension officers also played a significant role (Mason & Smale, 2013) [4]. Access to financial support was limited, which acted as a barrier to adoption (Tembo & Sitko, 2019) [8]. Seed was mainly obtained from agro-dealers, government programs, and cooperatives (Sitko *et al*., 2020) [6].

3.4 Perceived Benefits and Challenges

Most farmers who used improved maize varieties reported increases in yield and profitability compared to traditional varieties (Khonje *et al*., 2015) [3]. However, several constraints continued to limit production. High seed cost was the most commonly reported difficulty (Tembo & Sitko, 2019) [8]. Drought conditions affected all households (Fisher *et al*., 2015) [2], and many farmers experienced problems with pests and diseases (Smale & Jayne, 2003) [7]. Limited seed availability and inadequate extension support were also frequently mentioned (Mason & Smale, 2013) [4].

Table 10: Challenges associated with the use of improved varieties

Challenges	Frequency	Percent
High_Seed_Cost	103	76.3
Limited_Seed_Availability	63	46.7
Drought	135	100
Lack_of_Extension_Advice	58	43.0
Pests_and_Diseases	82	60.7

3.5 Strategies for Promoting Adoption

Farmers recommended several approaches to support adoption, including increased extension services, more demonstration plots, and more opportunities for training (Rogers, 2003) [5]. Economic considerations were also highlighted, with farmers suggesting reductions in seed prices and expansion of subsidy programs (Sitko *et al*., 2020) [6].

Table 11: Frequency and percentage distribution of encouragement suggestions

Strategies enhancing the adoption and effective utilization of improved maize varieties in Matabula Village					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Farmer field schools	5	3.7	3.7	3.7
	Improve seed access	6	4.4	4.4	8.1
	Improve seed availability	5	3.7	3.7	11.9
	Increase access to credit	3	2.2	2.2	14.1
	Increase credit	3	2.2	2.2	16.3
	Increase credit access	6	4.4	4.4	20.7
	Increase subsidies	8	5.9	5.9	26.7
	More demonstrations	17	12.6	12.6	39.3
	More extension services	18	13.3	13.3	52.6
	More extension support	4	3.0	3.0	55.6
	More seed outlets	7	5.2	5.2	60.7
	More training	16	11.9	11.9	72.6
	Reduce seed costs	10	7.4	7.4	80.0
	Reduce seed prices	8	5.9	5.9	85.9
	Subsidize inputs	12	8.9	8.9	94.8
	Subsidize seeds	7	5.2	5.2	100.0
	Total	135	100.0	100.0	

4. Discussion

The widespread use of improved maize varieties in Matabula Village is a positive development and exceeds adoption levels reported in broader national assessments (Chisanga *et al*., 2022) [1]. Social learning appears to play an important role, consistent with established theories of technology diffusion (Rogers, 2003) [5]. Although farmers reported improvements in yield and profitability, actual yields remained below potential levels documented in experimental settings (Fisher *et al*., 2015) [2]. Production constraints such as high input cost, drought exposure, and pest pressure likely contributed to this gap (Tembo & Sitko, 2019) [8]. Limited access to credit further restricted the ability of households to invest adequately in improved practices (Sitko *et al*., 2020) [6]. While extension contact rates were relatively high, the expressed need for additional services suggests that current support may not be sufficient to ensure sustained and correct use of improved varieties (Mason & Smale, 2013) [4].

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	Constant	22.393	5249.018	.000	1	.997	5308387599.108		
a. Variable(s) entered on step 1: Access_to_Credit, Access_to_Extension_Services.									

5. Conclusion and Recommendation

The adoption of improved maize varieties in Matabula Village is widespread and influenced by both economic benefits and social interactions (Khonje *et al*., 2015) [3]. However, several challenges threaten the long-term sustainability of this adoption, including financial limitations (Tembo & Sitko, 2019) [8], climatic pressures (Fisher *et al*., 2015) [2], and gaps within the extension system (Mason & Smale, 2013) [4]. Strengthening extension services, improving access to credit, and promoting climate-resilient agriculture can enhance sustained adoption (Sitko *et al*., 2020) [6]. Using lead farmers or community champions can also help increase diffusion (Rogers, 2003) [5].

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