

Institutional Factors and Adoption of Hybrid Maize Among Smallholder Farmers in Elgeyo-Marakwet County, Kenya

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Abstract

Institutional factors such as extension services, access to credit, market linkages, and agricultural information play a critical role in influencing the adoption of hybrid maize among smallholder farmers. Despite the availability of improved hybrid maize varieties that can enhance productivity and food security, adoption remains relatively low in Elgeyo-Marakwet County due to institutional constraints. The study examined the effect of institutional factors on hybrid maize adoption among smallholder farmers in the county. The study adopted a descriptive survey design using both quantitative and qualitative approaches. A sample of 189 smallholder farmers was selected through stratified random sampling from a target population of 358 farmers across three wards. Data were collected using structured questionnaires and key informant interviews. Quantitative data were analyzed using descriptive statistics, correlation, and regression analysis in SPSS version 26, while qualitative data were analyzed thematically. The findings revealed that institutional factors significantly influenced hybrid maize adoption. Institutional support showed a strong positive correlation with adoption ($r = 0.710$, $p < 0.001$). Regression analysis further established that institutional factors had a positive and statistically significant effect on adoption ($B = 0.313$, $\beta = 0.379$, $p < 0.001$). Access to extension services, farmer training, credit facilities, and market access emerged as key determinants promoting adoption among smallholder farmers. The study concludes that strengthening institutional support substantially enhances hybrid maize adoption among smallholder farmers. Improved extension services, affordable credit, farmer training, and efficient market systems increase farmers' willingness and capacity to adopt hybrid maize technologies, thereby contributing to improved agricultural productivity and household food security. The study recommends expanding agricultural extension coverage, improving access to affordable credit, strengthening local seed distribution systems, enhancing rural market infrastructure, and promoting supportive public policies that increase institutional support for hybrid maize adoption among smallholder farmers.

Keywords: *Institutional factors, hybrid maize adoption, market access, smallholder farmers, Elgeyo-Marakwet County*

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1. Introduction

Institutional factors play a significant role in shaping smallholder farmers' decisions to adopt hybrid maize varieties. Weak extension services, limited access to credit, poor market linkages, and inadequate delivery of agricultural information continue to constrain the uptake of hybrid maize technologies among smallholder farmers (Mutea, Jacobi, Rist, Kiteme & Hossain, 2025). These institutional barriers limit farmers' awareness of improved variety performance traits and reduce their capacity to make informed adoption decisions, thereby perpetuating dependence on traditional open-pollinated varieties despite the demonstrated productivity advantages of hybrid maize (Ndeko Chuma, Mondo, Kazamwali, Civava, Bisimwa & Mushagalusa 2025).

Globally, institutional variables have been consistently identified as critical determinants of hybrid maize adoption among smallholder farmers. Access to agricultural extension services, reliable farm information channels, and supportive subsidy programs significantly influence farmers' varietal adoption decisions (Fatima, 2024). In Pakistan, institutional support through improved market access and social networks positively influenced hybrid maize adoption, with adopters recording grain yields of 94–124 kilograms per hectare higher than non-adopters (Paudel, Krishna Rahut & McDonald, 2021). Furthermore, policies aimed at lowering seed costs through research and subsidy programs have been recommended to enable poor farmers in remote areas to adopt hybrid maize varieties, underscoring the foundational role of institutional frameworks in driving technology adoption among smallholder farming communities (Spies, 2025).

In Africa, institutional weaknesses in seed delivery systems, extension service provision, and subsidy mechanisms have significantly constrained hybrid maize adoption among smallholder farmers. In Rwanda, approximately 80 percent of farmers are smallholders whose limited purchasing capacity for hybrid seeds is compounded by inadequate delivery channels and insufficient extension services, collectively reducing adoption rates (Benimana, 2021). The provision of subsidies for hybrid maize seed alongside improvements in delivery channels and extension services has been proposed as a critical institutional intervention to support smallholder adoption (Magielse, 2025). In Ghana, despite national agricultural research institutions developing and releasing 55 improved maize varieties, including 29 hybrid varieties, none have been fully adopted, partly due to inadequate institutional support for awareness creation through demonstration trials and farmer field schools (Ifie, Kwapong, Anato-Dumelo, Konadu, Tongoona & Danquah, 2022). These findings underscore that institutional capacity gaps remain a persistent barrier to hybrid maize adoption across African smallholder farming systems (Naazie, Dakyaga & Derbile, 2023).

In Kenya, institutional and market-related challenges constitute major barriers to hybrid maize adoption among smallholder farmers. Weak extension services, limited credit access, and poor market linkages have significantly reduced adoption rates, particularly among farmers in marginal and remote areas. Inadequate access to reliable information sources and poor awareness of hybrid variety performance traits have further constrained adoption decisions among smallholder farmers (Mucheru-Muna, 2021; Muriithi, 2023). In Elgeyo-Marakwet County, these institutional barriers are compounded by drought-related challenges, with annual maize yield losses averaging 15–20% in rainfed farming areas, underscoring the urgent need for strengthened institutional support to disseminate drought-resistant hybrid varieties. Consequently, domestic maize production has failed to keep pace with national demand, as imported maize increasingly fills gaps left by insufficient institutional support for the adoption of hybrid technology among smallholder farmers (Rutsaert, Donovan & Kimenju, 2021).

1.1 Problem Statement

Elgeyo-Marakwet County has recently experienced a drastic decline in maize production, leading to difficulties meeting both local and national food supply needs. Although improved hybrid maize varieties tolerant to abiotic stress hold great potential for addressing productivity challenges, their development and distribution remain limited within both public and private sector programs (Heaton, 2024). Institutional barriers including weak extension services, restricted access to proprietary seed information, and inadequate market support continue to constrain smallholder farmers' awareness and adoption of hybrid maize varieties. The development of overall maize improvement is estimated to be under 25% of the total seed distributed in Kenya, reflecting significant institutional gaps in seed delivery and technology dissemination.

Despite the recognized importance of institutional support in driving hybrid maize adoption, limited empirical evidence exists regarding how extension services, credit access, market linkages, and agricultural information delivery specifically influence smallholder farmers' adoption decisions in Elgeyo-Marakwet County. Compared access to detailed seed trait information (Tambo & Mockshell, 2018). This study therefore sought to bridge this gap by examining institutional factors influencing hybrid maize adoption among smallholder farmers in Elgeyo-Marakwet County, providing evidence to guide targeted interventions enhancing maize productivity.

1.2 Objective of the Study

The study examined institutional factors influencing the adoption of hybrid maize among smallholder farmers in Elgeyo-Marakwet County, Kenya.

1.3 Research hypothesis

H₀: Institutional factors have no statistically significant effect on the adoption of hybrid maize among smallholder farmers in Elgeyo-Marakwet County, Kenya.

H_a: Institutional factors have a statistically significant effect on the adoption of hybrid maize among smallholder farmers in Elgeyo-Marakwet County, Kenya.

2. Literature Review

2.1 Theoretical Review

The study was anchored on the Technology Characteristics Framework Model, as categorized by Negatu and Parikh (1999), which posits that adoption outcomes are influenced by both the features of advanced technology and the farmer's physical, ecological, socio-economic, and institutional environments. Unlike the innovation-diffusion model, which focuses on individual farmers' characteristics, or the economic constraint model, which emphasizes resource endowments, the Technology Characteristics Framework Model uniquely integrates institutional environments as a central determinant of adoption decisions, making it particularly relevant to this study.

The Technology Characteristics Framework Model is especially appropriate for examining institutional factors influencing hybrid maize adoption because it explicitly recognizes that farmers' adoption decisions are shaped by the institutional conditions surrounding them, including access to extension services, credit facilities, market linkages, and agricultural information delivery systems. Institutional environments either facilitate or constrain farmers' ability to access, evaluate, and ultimately adopt hybrid maize technologies. In Elgeyo-

Marakwet County, weak extension service delivery, limited access to credit, and inadequate market support constitute significant institutional barriers that directly influence smallholder farmers' decisions to adopt hybrid maize varieties (Mutea, 2025). Furthermore, the framework explains how institutional provisions such as subsidized seed supply, organized marketing systems, and regulated grain prices historically accelerated hybrid maize adoption rates in Kenya, confirming that institutional environments fundamentally shape technology adoption behavior among smallholder farming communities (Smale & Jayne, 2010). The model therefore provides a comprehensive theoretical lens for understanding how institutional factors collectively determine both the likelihood and intensity of hybrid maize adoption among smallholder farmers in Elgeyo-Marakwet County.

2.2 Empirical Review

Institutional factors, including extension services, credit access, market access, group membership, and agricultural training, have consistently been identified as significant determinants of hybrid maize adoption among smallholder farmers. Evidence drawn from 22 case studies conducted across Eastern Africa by the International Maize and Wheat Improvement Center demonstrated that extension services, credit access, market access, and group membership recorded strong positive influences on hybrid maize adoption, confirming that institutional support structures constitute the most critical enablers of technology uptake among smallholder farming communities (Cimmyt, 2012).

Globally, institutional provisions such as subsidized seed supply, organized marketing systems, and regulated grain pricing have historically driven hybrid maize adoption among smallholder farmers. Beginning in the 1970s, the United Kingdom prioritized institutional interventions involving subsidized seed and fertilizer supply, government-regulated grain prices, and organized marketing systems, which collectively accelerated adoption rates and substantially increased national maize output (MacCarthy, Oppong-Mensah, Aboagye & Mensah, 2023). Similarly, in Pakistan, institutional support through improved market access and social networks positively influenced hybrid maize adoption, with adopters recording significantly higher grain yields than non-adopters (Paudel, Krishna Rahut & McDonald, 2021), confirming that institutional frameworks fundamentally shape technology adoption behavior among smallholder farmers worldwide.

In Africa, institutional weaknesses in extension service delivery, credit systems, and market linkages have significantly constrained the adoption of hybrid maize among smallholder farmers. In Ghana, despite national agricultural research institutions releasing 29 hybrid maize varieties, none achieved full adoption, partly due to inadequate institutional support for awareness-raising and technology dissemination (Ifie, Kwapong, Anato-Dumelo, Konadu, Tongoona & Danquah, 2022). In Rwanda, limited seed delivery channels and insufficient extension services reduced smallholder adoption rates (Benimana, 2021).

In Kenya, the collapse of the agricultural credit system and removal of input subsidies significantly undermined institutional support structures, reducing hybrid maize adoption rates particularly among resource-limited smallholder farmers (Kipkoge, Han, Mwalupaso, Tanui & Brenya). Agricultural training had a significant positive influence on adoption, while market access had a strong positive influence in Kenya, indicating that institutional market linkage mechanisms incentivize continued hybrid maize adoption among smallholder farmers in marginal areas, including Elgeyo-Marakwet County (Muriithi, 2023).

3. Methodology

The study was conducted in Elgeyo-Marakwet County in Kenya's North Rift Region, characterized by a bimodal rainfall pattern and diverse farming systems, with maize as the predominant food crop. The study adopted a descriptive survey design employing both quantitative and qualitative approaches to provide a comprehensive understanding of factors influencing hybrid maize adoption among smallholder farmers (Daikeler, Silber, & Bošnjak, 2022). Quantitative data were collected through structured questionnaires administered to farmers, while qualitative data were gathered through key informant interviews with agricultural experts, providing contextual explanations that enriched the quantitative findings.

The target population comprised 358 eligible smallholder maize-growing farmers drawn from official farmer registers maintained by the County Department of Agriculture across three wards: Kamariny (103), Kaptarakwa (107), and Kapchemutwo (148), alongside three key informants from Kenya Seed Company, the County Crops Officer, and the Ministry of Agriculture. Using Cochran's formula with a 0.05 margin of error, a representative sample of 189 farmers was selected. Probability stratified sampling was employed to ensure proportionate representation across the three agricultural wards, with simple random sampling used within each stratum.

Instruments were pretested with 18 farmers in Baringo County to assess clarity, relevance, and consistency without contaminating the main study sample (Creswell & Creswell, 2017). Validity was established through construct and content validity using Lawshe's (1975) Content Validity Ratio, while reliability was assessed using Cronbach's Alpha coefficient, with a threshold of 0.70 considered acceptable (Taber, 2018). Diagnostic tests, including normality, multicollinearity, and autocorrelation tests, were conducted prior to the main analysis.

Quantitative data were analyzed using SPSS version 26 through descriptive statistics, correlation analysis, and multiple regression analysis to determine the influence of independent variables on hybrid maize adoption. Qualitative data from key informant interviews were subjected to thematic analysis and triangulated with quantitative findings to generate an integrated understanding of factors influencing hybrid maize adoption among smallholder farmers in Elgeyo-Marakwet County.

4. Results and Discussion

4.1 Response Rate

The researcher administered a total of 189 structured questionnaires to respondents, out of which 187 were successfully completed and returned, representing a high response rate of 98.9%. Only 2 questionnaires (1.1%) were either not returned or inadequately filled and were thus considered non-responses. The high response rate was attributed to the researcher's established rapport with respondents, the structured questionnaire format, pretesting that enhanced clarity, and the relevance of the research topic to respondents' daily farming experiences (Sataloff & Vontela, 2021). A response rate of 70% or higher is generally considered acceptable in survey-based research, further underscoring the strength of this study's participation rate (Daikeler, Silber, & Bošnjak, 2022).

4.2 Reliability Tests Results

Table 1: Reliability Test

Construct	No. of Items	Cronbach's Alpha	Interpretation
Institutional Factors	9	.911	Excellent

The Cronbach's Alpha coefficient for institutional factors recorded the highest reliability score ($\alpha = 0.911$), indicating excellent internal consistency and confirming that the items used to measure the construct were reliable and internally consistent, exceeding the minimum acceptable threshold of 0.70 (Izah, Sylva & Hait, 2023).

4.3 Descriptive Statistics for Institutional/Market Factors

The study conducted descriptive statistics to assess respondents' perceptions of how institutional factors, specifically extension access, credit access, and market access, influence the adoption of hybrid maize among smallholder farmers in Elgeyo-Marakwet County.

Table 2: Respondents' Opinion on Institutional/Market Factors

Statement	SD	D	M	A	SA	Mean	Std. Dev
Extension officers regularly provide advice on hybrid maize adoption.	3 (1.6%)	4 (2.1%)	54 (28.9%)	80 (42.8%)	46 (24.6%)	3.87	.867
Training and demonstrations on hybrid maize varieties are frequently available.	3 (1.6%)	2 (1.1%)	38 (20.3%)	111 (59.4%)	33 (17.6%)	3.90	.749
Some areas lack sufficient extension services on hybrid maize production.	0 (0.0%)	4 (2.1%)	34 (18.2%)	115 (61.5%)	34 (18.2%)	3.96	.671
Credit facilities for purchasing hybrid maize seeds are generally accessible.	0 (0.0%)	2 (1.1%)	17 (9.1%)	107 (57.2%)	61 (32.6%)	4.21	.645
Loans or cooperative support are often available for adopting hybrid maize.	0 (0.0%)	13 (7.0%)	24 (12.8%)	108 (57.8%)	42 (22.5%)	3.96	.795
Limited access to credit sometimes prevents adoption of hybrid maize.	3 (1.6%)	1 (0.5%)	53 (28.3%)	93 (49.7%)	37 (19.8%)	3.86	.793
Hybrid maize seeds are usually available in local markets when needed.	1 (0.5%)	3 (1.6%)	44 (23.5%)	99 (52.9%)	40 (21.4%)	3.93	.748
Farmers often need to travel long distances to access hybrid maize seed markets.	1 (0.5%)	2 (1.1%)	46 (24.6%)	104 (55.6%)	34 (18.2%)	3.90	.715
Unreliable local markets sometimes hinder adoption of hybrid maize.	1 (0.5%)	22 (11.8%)	39 (20.9%)	83 (44.4%)	42 (22.5%)	3.76	.949

The study found that institutional support and market access significantly influence hybrid maize adoption. Regarding extension services, 67.4% of farmers agreed that extension officers regularly provided advice on hybrid maize adoption (Mean = 3.87, SD = 0.867), while 77.0% indicated that training and demonstrations were frequently available (Mean = 3.90, SD = 0.749). However, 79.7% acknowledged that some areas still lacked sufficient extension services (Mean = 3.96, SD = 0.671), suggesting unequal access across regions, consistent with Abebe et al. (2021), who established that gaps in extension service provision remain a challenge in rural communities. Concerning credit access, 89.8% agreed that credit facilities for purchasing hybrid maize seeds were generally accessible (Mean = 4.21, SD = 0.645), while 69.5% acknowledged that limited credit access sometimes prevented adoption (Mean = 3.86, SD = 0.793), aligning with Ojo et al. (2022), who reported that institutional barriers such as collateral requirements limit credit access for resource-poor farmers. Regarding market factors, 74.3% agreed that hybrid maize seeds were available in local markets (Mean = 3.93, SD = 0.748), though 73.8% indicated they traveled long distances to access seed markets (Mean = 3.90, SD = 0.715), consistent with Kansime and Wambugu (2020), who noted that long travel distances reduce adoption rates of improved seed varieties among smallholder farmers.

4.4 Correlation Analysis

The results are presented in Table 3.

Table 3: Correlation Results

Variable		Hybrid Adoption	MaizeInstitutional Factors
Hybrid Maize Adoption	Pearson Correlation	1	
	Sig. (2-tailed)		
	N		
Institutional Factors	Pearson Correlation	.710**	1
	Sig. (2-tailed)	.000	
	N	187	187

**. Correlation is significant at the 0.01 level (2-tailed).

The study established a strong positive and statistically significant correlation between institutional factors and adoption of hybrid maize ($r = 0.710$, $p < 0.001$). This implies that institutional support, particularly access to extension services, credit facilities, and reliable markets, plays a crucial role in farmers' decisions to adopt hybrid maize. These findings align with Wossen et al. (2021), who found that institutional linkages and access to extension services significantly enhance technology uptake among African smallholders, and with Tambo and Mockshell (2018), who emphasized that institutional arrangements and farmer support systems are vital to sustaining the adoption of improved technologies.

4.5 Regression Analysis

The study conducted a simple regression analysis to determine the specific influence of institutional factors on hybrid maize adoption among smallholder farmers in Elgeyo-Marakwet County.

Table 41: Regression Coefficients

		Unstandardized Coefficients		Standardized Coefficients	
Model		B	Std. Error	Beta	t
1	(Constant)	5.992	1.519		3.946
		.313	.034	.379	9.341

a. Dependent Variable: Hybrid Maize Adoption

The unstandardized coefficient for institutional factors ($B = 0.313$, $p < 0.001$) indicates that a one-unit improvement in institutional support is associated with a 0.313-unit increase in hybrid maize adoption, controlling for other variables, thereby confirming that structured institutional interventions are key drivers of adoption. The standardized beta coefficient ($\beta = 0.379$, $p < 0.001$) further confirms that institutional factors recorded the largest relative contribution to hybrid maize adoption among all predictors, implying that improving institutional support has the strongest impact among all variables considered in the model.

4.6 Hypothesis Testing

H_0 : Institutional factors have no statistically significant effect on the adoption of hybrid maize among smallholder farmers in Elgeyo-Marakwet County, Kenya.

H_a : Institutional factors have a statistically significant effect on the adoption of hybrid maize among smallholder farmers in Elgeyo-Marakwet County, Kenya.

Based on the regression results ($B = 0.313$, $\beta = 0.379$, $p < 0.001$), the p-value of 0.000 is less than the 0.05 significance threshold. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted. This confirms that institutional factors have a statistically significant and positive effect on the adoption of hybrid maize among smallholder farmers in Elgeyo-Marakwet County. The findings underscore the critical importance of strengthening extension service delivery, expanding credit access, and improving market linkages as key institutional interventions to enhance hybrid maize adoption and improve agricultural productivity among smallholder farmers in the county.

5. Conclusion

The study concludes that institutional factors significantly influence the adoption of hybrid maize among smallholder farmers in Elgeyo-Marakwet County. Access to extension services, farmer training, credit facilities, and reliable markets positively enhances adoption, while inadequate institutional coverage and weak market access constrain uptake. Statistical findings confirmed that institutional support strongly predicts adoption, emphasizing that strengthening extension systems, improving credit accessibility, and enhancing market infrastructure are essential for increasing hybrid maize adoption and agricultural productivity.

6. Recommendations

Practical Implications: Expand extension service coverage, particularly in underserved rural areas; improve farmer training programs; provide affordable, flexible credit facilities; and strengthen local seed distribution and market infrastructure to ensure timely access to hybrid maize technologies.

Policy Implications: County and national governments should strengthen institutional support frameworks by investing in extension services, promoting public-private partnerships, improving rural market infrastructure, and developing policies that enhance access to credit and certified hybrid maize seeds for smallholder farmers.

Theoretical Implications: Future studies should extend the theory by examining how institutional support interacts with socioeconomic and awareness factors to more comprehensively explain hybrid maize adoption across different farming contexts.

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