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ECONOMIC VIABILITY AND MARKET DYNAMICS OF HYBRID MAIZE PRODUCTION IN GARIYABAND DISTRICT, CHHATTISGARH

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Abstract

This study presents an economic analysis of the production and marketing of hybrid maize in the Gariyaband district of Chhattisgarh. Primary data were collected from 70 randomly selected maize growers across three villages in the Mainpur block for the agricultural year 2021-22. The average household comprised 2.45 members, with an observed cropping intensity of 178.33%. The average farm sizes among the sampled growers were 0.71 hectares for marginal, 1.65 hectares for small, 2.75 hectares for medium, and 4.94 hectares for large farmers. The overall average cost of cultivating hybrid maize was found to be Rs. 29,731.81 per hectare, with costs increasing in relation to farm size. The input-output ratio for hybrid maize cultivation was 1:2.35, indicating favorable returns. The net return averaged Rs. 69,723.94 per hectare, while the average yield in the study area was 52.28 quintals per hectare. The income over various cost concepts was calculated as follows: Cost A1 at Rs. 86,217.89, Cost A2 also at Rs. 86,217.89, Cost B1 at Rs. 85,450.64, Cost B2 at Rs. 32,169.18, Cost C1 at Rs. 81,532.78, Cost C2 at Rs. 69,733.94, and Cost C3 at Rs. 66,761.81. These findings highlight the economic viability of hybrid maize farming and underscore the importance of adopting improved agricultural practices to enhance productivity and profitability.

Keywords: Gross returns, net returns, B: C ratio, input-output ratio

Introduction

Maize (*Zea mays* L) is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. Globally, maize is known as queen of cereals because it has the highest genetic yield potential among the cereals. It is cultivated on nearly 150 m ha in about 160 countries having wider diversity of soil, climate, biodiversity and management practices that contributes 36% (782 m/t) in the global grain production. The United States of America (USA) is the largest producer of maize contributes nearly 35% of the total production in the world and maize is the driver of the US economy. The USA has the highest productivity (> 9.6 t/ha^{-1}) which is double than the global average (4.92 t/ha^{-1}). The average productivity in India is 2.43 t/ha^{-1}. In India, maize is the third most important food crops after rice and wheat. According to advance estimate its

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production is likely to be 31.51 M Tonnes (2020-21) mainly during Kharif season which covers 80% area. Maize in India, contributes nearly 9% in the national food basket. Chhattisgarh is expecting Maize crop output of nearly 7.45 lakh metric tonnes this year, officials stated. About 40 per cent of the Maize production comes from Kondagaon, Kanker and Bastar districts in the State. A reasonably favorable crop output is also expected from Surguja division this year, officials stated. In view of enormous prospect of promoting food processing units using Maize as raw material, the Chhattisgarh government signed Memorandum of Understanding (MoU) with three companies mainly- BMD Starch Pvt ltd., Kakkad Udyog ltd and Indian Agro and Food Industries recently.

Methodology

Because of its substantial area devoted to maize agriculture, which is vital to the local economy, the Gariyaband district of Chhattisgarh was especially chosen for this study. A multistage simple random selection (SRS) technique was used to choose the villages and the farmers who produced and sold maize in the district in order to collect thorough data. An outline of the sample methods used at different phases is provided below.

Method of Sampling

Village Selection: A random sample of villages was selected based on their area used for maize cultivation after a list of all the villages in the Gariyaband district was first created.

Respondent Selection: Farmers engaged in the cultivation of maize were chosen at random from each chosen hamlet. In order to capture a broad range of farming practices and economic conditions, it was intended to guarantee a diversified representation of farmers, including small, medium, and large-scale producers.

Data collection: To gather information on farming methods, inputs used, expenses incurred, and returns produced, structured interviews and questionnaires were carried out.

The Expenses and Benefits of Growing Maize

A standardized method for estimating the expenses of growing maize, approved by the Commission of Agricultural expenses and Prices (CACP), was also used, even if the costs and returns were analyzed using conventional techniques. Seven cost categories are taken into account by this method; they are called X1, X2, Y1, Y2, Z1, Z2, and Z3.

The 16 expense components listed below are included in Cost X1:

1) The worth of temporary and permanent labor that has been hired
2) The worth of hired animal work and the value of owned animal labor
3) Equipment value that is owned
4) Fees associated with renting equipment
5) The worth of fertilizers
6) Manure's worth (both purchased and produced on the farm)
7) The worth of seeds (both purchased and grown on farms)
8) The importance of fungicides and insecticides
9) Costs associated with irrigation (for both owned and hired equipment)
10) Canal water fees
11) Land taxes, fees, and other costs
12) Depreciation of farm equipment (both human-operated and animal-drawn)

13) Depreciation of farm equipment and structures
14) Operational capital interest
15) Other costs (such as small tool repairs and artisan salaries)
16) Rent for leased land is added to Cost X1 to determine Cost X2.

Cost X1 plus interest on the value of owned fixed assets (not including land) equals Cost Y1. Cost Y2 is equal to Cost Y1 plus the land's rental value.
Cost Y1 plus the imputed value of family labor is used to determine Cost Z1, and Cost Y2 plus the imputed value of family labor is used to get Cost Z2.
10% of Cost Z2 is added as a managerial allowance to get at Cost Z3.
Income Estimates
The following formula is used to determine the income over various costs:
Total Revenue minus Cost equals Income over Cost X1 Total revenue less cost x2 is X1 income over cost x2. Y1 = Total Income - Expense Total Revenue minus Cost = Y1 Income over Cost Y2 Z1 = Total Revenue - Cost Y2 = Income over Cost Z2 = Total Revenue - Cost Z1 = Income over Cost Z3 = Total Revenue - Cost Z2 = Income over Cost Z3
Net Income
The difference between total revenue and entire costs is known as net income.

Total Revenue minus Total Expenses equals Net Income.
This measure aids farmers and policymakers in understanding profitability patterns and offers insightful information about the region's maize farming's financial sustainability.
Ratio of input to output
This ratio, which measures the efficiency of maize production, illustrates the link between inputs and outputs:
Value of Output / Value of Input Used = Input-Output Ratio
Farmers are producing more value from their inputs when the ratio is higher, which denotes increased efficiency. Farmers can use this ratio as a reference for allocating resources and to find best practices.
Policy and Practice Implications
Local agricultural strategies and activities aiming at increasing maize production can benefit from the study's conclusions. Policymakers can create focused interventions, like granting access to high-quality inputs, upgrading irrigation systems, and providing farmer training programs, to increase productivity and profitability by knowing the cost structures and revenue potential related to maize cultivation.

Results and Discussion

Cost of cultivation of hybrid maize

Understanding the cost of growing hybrid maize is crucial for determining how much various inputs cost and whether or not farmers are making a sufficient profit. The estimated total cost of growing hybrid maize on the farms that were tested was Rs. 29,731.81 per hectare, of which Rs. 16,886.33 per hectare was the total variable cost and Rs. 12,845.48 per hectare was the fixed cost. The highest percentage of the overall cost of human labor (Rs. 7,282.06/ha) was followed by the total cost of materials (Rs. 4,643.12/ha). Interest on working capital was

Rs. 512.51/ha, while the total cost of power was Rs. 4,221.37/ha. Seeds cost Rs. 1,083.76 per hectare, while fertilizer and manure cost Rs. 2,474.27 per hectare. Compared to family labor, which was found to be Rs. 3,917.91/ha for family labor and Rs. 3,339.61/ha for hired labor, the hired labor cost was somewhat higher. Bullock power accounted for only Rs. 325.36/ha of the overall variable cost, whereas machine power was found to be Rs. 3,896.01/ha.

Regardless of the size of the farm or holdings, the total fixed cost was Rs. 12,845.48/ha of the total cost of cultivation. Because of economies of scale, the overall fixed cost was steadily declining in relation to the size of the holdings' farms. Based on available data, the primary fixed cost was the land rental value, which was Rs. 11,798.85 per hectare. The entire cost of growing hybrid maize increased with farm size, reaching a minimum of Rs. 26,822.48 per hectare in marginal farms and a maximum of Rs. 32,692.81 per hectare in large farms. It's crucial to remember that overall variable costs rose as farm size increased. Because large farmers may have to spend more on material inputs, it can be inferred that the overall cost of growing hybrid maize in the study area increased with farm size.

Table 1: Analysis of cost of cultivation of hybrid maize per hectare on the basis of cost concept (Rs./ ha.)

S. No.	*Particular*	*Marginal*	*Small*	*Medium*	*Large*	*Overall*
A.	**Variable cost**					
1	Human labour					
a.	Family labour	3955.69211	4029.124233	4010.387041	3676.426301	3917.908366
		14.77882722	14.33610653	13.17355067	11.25518225	13.23472233
b.	Hired labour	2387.663144	2799.958257	3715.304641	4455.488355	3339.612663
		8.930406097	9.965321979	12.14793075	13.65199407	11.30550909
Total human labour cost		**6367.064487**	**6853.383918**	**7751.013164**	**8156.821832**	**7282.061261**
		23.65	24.21	25.3	24.87	24.41
2	Power use cost					
a.	Bullock	750.5397913	550.6044432	0.029721145	0.052384061	325.3637725
		2.8	1.95	0	0	1.09
b.	Machine power	3500.041691	3609.189195	4025.592938	4449.285351	3896.009837
		13.05	12.8	13.18	13.61	13.1
Total power use		**4250.58148**	**4159.79363**	**4025.62265**	**4449.33773**	**4221.37360**

cost		**3**	**8**	**9**	**5**	**9**
		15.85	14.75	13.18	13.61	14.2
3	Seed	1016.000239	1046.068443	1120.090503	1153.090714	1083.761225
		3.79	3.71	3.67	3.53	3.65
4	Manure & fertilizes	1308.033769	2352.023443	2871.092869	3366.080998	2474.267167
		4.88	8.34	9.4	10.3	8.32
5	Plant protection	315.4792193	613.7137379	850.5548508	1170.965935	737.6718261
		1.18	2.18	2.79	3.58	2.48
6	Irrigation charge	294.1541612	320.7666423	376.9759151	398.1411305	347.549433
		1.1	1.14	1.23	1.22	1.17
7	Miscellaneous cost	150.0209188	200.0751825	250.0343611	300.0412964	251.6796586
		0.56	0.71	0.82	0.92	0.85
8	Interest on working capital	409.8519404	500.9709601	563.144622	576.0428497	512.5076679
		1.53	1.78	1.84	1.76	1.72
Total variable cost		**14087.47698**	**16022.49454**	**17783.20746**	**19545.61531**	**16886.33162**
B.	**Fixed capital**					
9	Land revenue	10.0000	10.0000	10.0000	10.0000	10.0000
		0.0400	0.0400	0.0400	0.0400	0.0400
10	Depreciation	265.0000	270.0000	269.9700	272.5700	269.3900
		0.9900	0.9600	0.8800	0.8300	0.9100
11	Interest on fixed capital	750.0000	755.0000	754.0000	810.0000	767.2500
		2.8000	2.6800	2.4700	2.4800	2.5800
13	Rental value of owned land	11710.0000	11712.5600	11718.2000	12054.6200	11798.8500
		43.6600	41.5300	38.3800	36.8700	39.6800
Total fixed cost		**12735.0000**	**12747.5600**	**12752.1700**	**13147.1900**	**12845.4800**
		47.4800	45.2000	41.7600	40.2200	43.2100
C.	**Total cost (A+B)**	**26822.4770**	**28770.0545**	**30535.3775**	**32692.8053**	**29731.8116**
		100.0000	100.0000	100.0000	100.0000	100.0000

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Measures of farm profit of hybrid maize

The measures of farm profit from hybrid maize cultivation have been analyzed by considering various economic parameters, including the yield of hybrid maize, cost of cultivation, gross return, cost of production, and input-output ratio. This analysis is rooted in agricultural economics, which evaluates how resources are allocated and the resulting financial performance of farming activities.

Empirical findings indicate that the net return over total cost of cultivation for hybrid maize is Rs. 69,723.94 per hectare, regardless of farm size, with returns ranging from Rs. 65,402.97 for marginal farms to Rs. 72,967.76 for large farms. This consistency across farm sizes suggests that hybrid maize cultivation is a viable option for farmers of all scales, promoting inclusivity in agricultural development.

The per quintal cost of production varies by farm size, being Rs. 553.03 for marginal, Rs. 548.18 for small, Rs. 569.16 for medium, and Rs. 589.06 for large farms. Notably, the decreasing cost of production with increasing farm size indicates economies of scale, where larger farms can spread their fixed costs over more units of output. This phenomenon highlights the importance of scale in enhancing profitability.

The input-output ratio demonstrates an increasing trend with respect to farm size, with an overall input-output ratio of 1:2.35. This indicates that for every rupee invested, farmers are able to generate a return of Rs. 2.35, underscoring the economic viability of hybrid maize cultivation.

The findings emphasize the profitability and efficiency of hybrid maize cultivation across different farm sizes. The positive net returns and favorable input-output ratios suggest that hybrid maize can serve as a strategic crop for enhancing farm income and promoting sustainable agricultural practices. Policymakers and agricultural stakeholders should consider supporting hybrid maize cultivation to improve food security and farmer livelihoods, particularly in regions where farming is a primary source of income. Further research could explore the impact of market access, extension services, and technological advancements on maximizing the benefits of hybrid maize cultivation.

Table 2: Economics of hybrid maize cultivation under different farms size groups (Rs./ha.)

Particulars	Marginal	Small	Medium	Large	overall
Yield (qt/ha)	48.50	51.46	53.66	55.51	52.28
Cost of cultivation (Rs/ha)	26822.04	28203.89	30534.82	32692.25	29731.32
Gross return (Rs/ha)	92225.01	97846.50	102089.50	105660.00	99455.26
Net return (Rs/ha)	65402.97	69642.63	71554.68	72967.77	69723.94
Cost of production (Rs/ha)	553.03	548.18	569.16	589.06	538.55

Input – output ratio	01:02.4	01:02.5	01:02.3	01:02.2	01:02.4

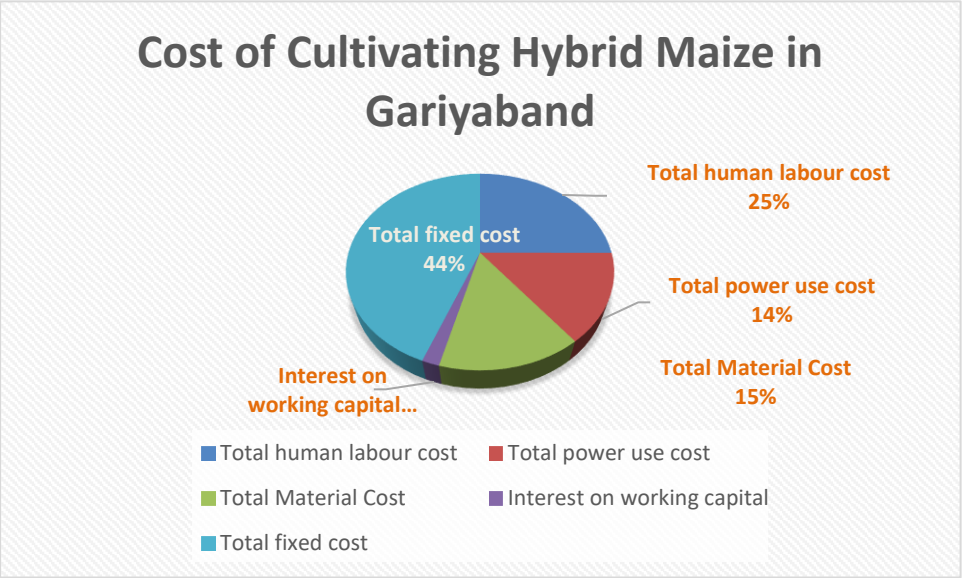

Fig 1: Cost of cultivation of hybrid maize

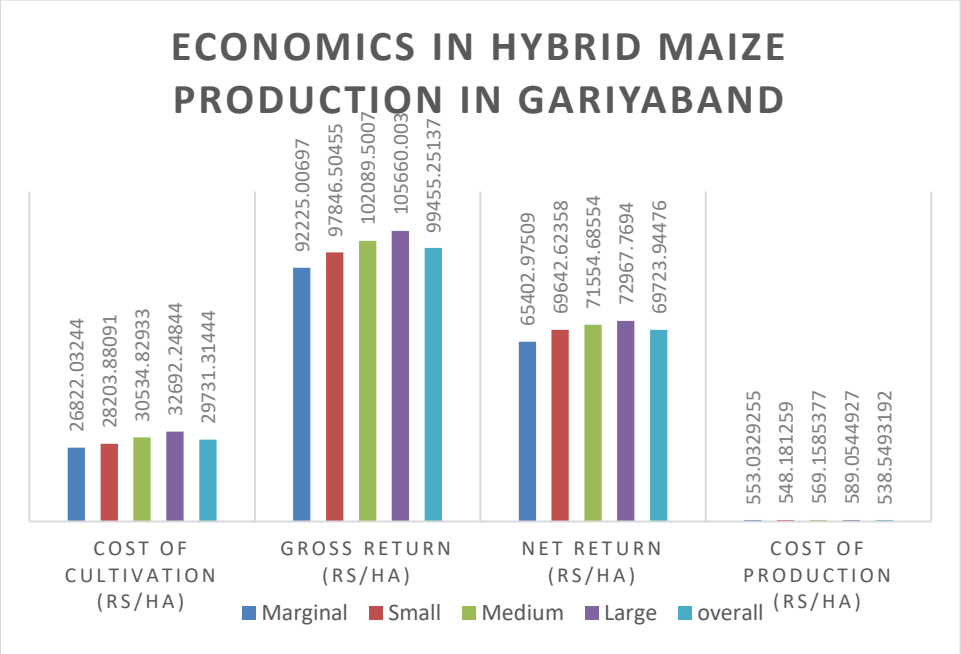

Fig 2: Economics of hybrid maize production

Cost on the basis of different cost concept

The cost of cultivation of hybrid maize on sample farms in the study area has been thoroughly analyzed using seven cost concepts established by the Commission for Agricultural Costs and Prices (CACP), Government of India. Cost A1, which represents the

variable cost—including land revenue and interest on working capital while excluding family labor—was found to be Rs. 13,237.36 per hectare on an overall basis. When broken down by farm size, marginal farms incurred Rs. 10,396.40, small farms Rs. 11,697.26, medium farms Rs. 14,042.26, and large farms Rs. 16,141.26. Cost A2, which includes rent paid for leased land, showed the same value as Cost A1 because there were no instances of leased land reported during the investigation.

Cost B1 is derived by adding interest on the value of owned capital assets (excluding land) to Cost A1, resulting in an overall figure of Rs. 14,004.61 per hectare. The specific costs for marginal, small, medium, and large farms were Rs. 11,146.39, Rs. 12,452.26, Rs. 14,796.25, and Rs. 16,951.27, respectively. Cost B2, which incorporates the rental value of owned land, totaled Rs. 25,803.45 overall, with marginal farms at Rs. 22,856.40, small farms Rs. 24,164.81, medium farms Rs. 26,514.46, and large farms Rs. 29,005.88.

Further analysis reveals Cost C1, which adds the imputed value of family labor to Cost B1, amounting to Rs. 17,922.47 overall. The specific costs for marginal, small, medium, and large farms were Rs. 15,102.04, Rs. 16,481.32, Rs. 18,806.63, and Rs. 20,627.63, respectively. Cost C2 incorporates the imputed value of family labor into Cost B2, reaching Rs. 29,721.31 overall. Finally, Cost C3 includes the value of management input calculated at 10% of Cost C2, resulting in an overall figure of Rs. 32,693.44 per hectare.

These detailed cost estimates provide crucial insights into the financial dynamics of hybrid maize cultivation across various farm sizes. Understanding these cost structures is essential for stakeholders, as they enable farmers to assess the economic viability of hybrid maize, make informed decisions about resource allocation, and identify areas for improvement in agricultural practices. Moreover, the analysis can guide policymakers in formulating strategies to enhance support for farmers, ensuring they have access to the necessary inputs, training, and resources to optimize their yield and profitability in the increasingly competitive agricultural landscape. By facilitating the transition to more productive practices, these efforts can significantly contribute to enhancing food security and rural livelihoods.

Table 3: Break-up of total cost according to cost concept (Rs. /ha.)

Particulars	Marginal	Small	Medium	Large	overall
Cost A1	10396.3969	11697.258	14042.259	16141.262	13237.369
Cost A2	10396.3964	11697.251	14042.251	16141.263	13237.366
Cost B1	11146.3937	12452.256	14796.254	16951.265	14004.611
Cost B2	22856.396	24164.814	26514.459	29005.881	25803.457
Cost C1	15102.0369	16481.324	18806.63	20627.625	17922.472
Cost C2	26812.0357	28193.888	30524.822	32682.244	29721.315
Cost C3	29493.2381	31013.261	33577.308	35950.463	32693.448

Return obtained over different costs

The returns obtained over different cost concepts for hybrid maize on sample farms in the study area have been analyzed, revealing significant insights into the profitability of this crop. The overall returns over Cost A1 and A2, which represent variable costs, are both Rs.

86,217.89 per hectare, indicating a consistent profitability margin across different farm sizes.

For Cost B1, which includes interest on owned capital assets, the overall return is Rs. 85,450.64 per hectare. This reflects the importance of accounting for capital investments in assessing farm profitability. However, when considering Cost B2, which incorporates the rental value of owned land, the return drops significantly to Rs. 32,169.18 per hectare, highlighting the substantial impact that land costs can have on overall profitability.

Examining the returns by farm size, marginal farms report returns over Cost A1 of Rs. 81,828.61, while small, medium, and large farms show returns of Rs. 86,149.26, Rs. 88,047.25, and Rs. 89,518.74, respectively. This trend suggests that larger farms benefit from economies of scale, achieving higher profitability per hectare.

The returns over Cost C1, which includes the imputed value of family labor, average Rs. 81,532.78 overall, indicating that labor contributions are significant in enhancing farm returns. In contrast, the returns over Cost C2, which incorporates family labor in addition to other costs, average Rs. 69,733.94, while returns over Cost C3, including management input, are Rs. 66,761.81 overall.

These findings underscore the financial viability of hybrid maize cultivation, particularly when managed effectively. By understanding the impact of different cost components on returns, farmers can make informed decisions about resource allocation and investment strategies, ultimately leading to improved profitability and sustainability in their operations.

Table 4: Return obtained over different costs (Rs/ha)

Particulars	Marginal	Small	Medium	Large	Overall
Return over cost A1	81828.6136	86149.255	88047.25	89518.742	86217.897
Return over cost A2	81828.616	86149.254	88047.256	89518.744	86217.892
Return over cost B1	81078.6163	85394.253	87293.25	88708.748	85450.649
Return over cost B2	69368.6165	34099.659	31379.925	30830.705	32169.181
Return over cost C1	77122.9765	81365.188	83282.881	85032.387	81532.784
Return over cost C2	65412.9747	69652.629	71564.688	72977.763	69733.941
Return	62731.7792	66833.248	68512.209	69709.547	66761.81

over cost C3					

Suggestions for further improvement

The empirical findings of study envisaged the maize growers still growing the traditional variety of maize which low yield potential. Therefore it is being suggested that extension workers should come forward to aware the maize growers to grow improved or high yielding variety or hybrid. To increase maize production, the government should arrange for the timely supply of quality seeds and other inputs at reasonable prices for maize growers.

In conclusion, this comprehensive study on hybrid maize cultivation reveals both the potential and challenges faced by maize growers. The empirical findings indicate that many farmers still rely on traditional maize varieties, which offer low yield potential, underscoring the urgent need for agricultural interventions. Promoting the adoption of high-yielding hybrid varieties through targeted outreach by extension workers can significantly enhance productivity. Additionally, ensuring timely access to quality seeds and other essential inputs at reasonable prices is crucial for facilitating this transition.

The analysis of costs associated with growing hybrid maize highlights that the total cultivation cost averages Rs. 29,731.81 per hectare, with variable costs and fixed costs contributing significantly to this figure. Understanding these cost structures is vital for farmers to evaluate their economic viability and profitability. The study demonstrates that, regardless of farm size, hybrid maize cultivation can yield positive net returns, averaging Rs. 69,723.94 per hectare, indicating that it is a financially sound choice for farmers of all scales.

Furthermore, the input-output ratio of 1:2.35 illustrates the economic efficiency of hybrid maize production, suggesting that for every rupee invested, farmers can generate substantial returns. The findings emphasize the importance of economies of scale, as larger farms tend to achieve lower per-unit costs, reinforcing the need for strategic investments in farming operations.

Overall, the results advocate for policy support aimed at enhancing hybrid maize cultivation, which can contribute to food security and improved livelihoods for farmers. Future research should continue to explore the impacts of market access, technological advancements, and extension services to maximize the benefits of hybrid maize farming. By facilitating a shift towards more productive agricultural practices, stakeholders can help ensure a sustainable and prosperous future for maize growers.

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