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Economic Impact of Farmer Producer Company Membership on Maize Cultivation in Kollegala, Karnataka, India

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Maize is an important crop in Indian agriculture, especially in Karnataka, where it contributes significantly to food security and industrial value chains. Similar to other farmers, smallholder farmers face perennial challenges of expensive inputs, scattered land holdings and restricted market access that impair their profitability. The Kollegala Horticulture Farmer Producer Company Limited (KHFPCL) has emerged as a transformative solution, providing collective procurement, technical support and stronger linkages with the market. An econometric study based on a comparison of 160 farmers 80 KHFPCL members and 80 non-members was undertaken to determine the economic impact of membership in KHFPCL on maize cultivation. Primary data were collected through structured interviews and key cost components like labor, seeds, fertilizers and plant protection chemicals were analysed. Using descriptive statistics and t-tests, the findings

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revealed that KHFPCL members achieved higher productivity, with an average yield of 25 quintals per acre compared to 23 quintals for non-members. Besides reporting 22.9% higher gross returns, members also achieved 53.3% more net returns based on reduced inputs and better resources management. All these results put forward the sizeable economic gains of Farmer Producer Companies, signifying their prospect to improve profitability for small-scale farmers, maximize cost structures and strengthen market access, which is eventually going to contribute to sustaining agricultural communities. Statistically significant gains since KHFPCL members have higher productivity, gross returns and net returns Policy interventions should strengthen FPCs, input access and promote sustainable practices for resilience of farmers.

Keywords: Maize cultivation; KHFPCL; cost of cultivation; FPC; farmers.

1. INTRODUCTION

Maize (*Zea mays* L.), known as the "Queen of Cereals," is a globally significant and highly adaptable crop, valued for its exceptional yield potential and ability to thrive in diverse climatic conditions. With its origins traced back to Mexico, maize has been cultivated for millennia and remains a cornerstone of the global agricultural economy (Poudel, 2024; Busungu, 2025). It plays an essential role in food security and serves as a vital input for various industries, including those producing animal feed, starch, oil, protein, biofuels and processed food products. (Martínez-Ortiz et al. 2024) The economic and cultural importance of maize rivals that of rice in Asia and wheat in the Middle East, highlighting its relevance in both traditional farming systems and modern industrial uses (Hajong et al., 2024).

Maize production worldwide is dominated by a few major countries, with the United States, China, Brazil, European Union, Argentina and India leading in both cultivation area and total output (Government of India, 2020). Collectively, these nations account for a substantial share of global maize production, estimated at around 1,210 million metric tonnes, covering 193.7 million hectares, with an average yield of 5.75 tonnes per hectare. Maize has evolved into a vital industrial crop, with approximately 83% of its global output allocated to the feed, starch and biofuel sectors. Its wide range of applications and high potential for value addition have established maize as a key driver of the global agricultural economy. (USDA Foreign Agricultural Service, 2025; Food and Agriculture Organization of the United Nations [FAOSTAT], 2024)

In India, maize is the third most important cereal crop after rice and wheat, contributing significantly to the nation's agricultural production and economy (National Institute of Agricultural Extension Management, 2018). India ranks fourth in maize cultivation area and seventh in production, covering 9.2 million hectares and producing 27.8 million metric tonnes in 2023-24 (Dutta et al., 2024). The country has witnessed a remarkable increase in maize production, with average productivity rising from 547 kg/ha in 1950-51 to 2965 kg/ha in 2018-19, demonstrating a nearly 16-fold increase in output. Maize is primarily cultivated during two seasons in India: kharif (rainy) and rabi (winter), with kharif maize accounting for around 83% of the total area, often under rainfed conditions (Kumar et al., 2023; Patel et al., 2024). Despite challenges like biotic and abiotic stressors, maize remains the fastest-growing cereal crop in terms of area and productivity. Major maize-producing states in India include Karnataka, Andhra Pradesh, Uttar Pradesh, Bihar and Madhya Pradesh (Indian Institute of Maize Research, 2025).

Karnataka is one of the leading maize-producing states in India, contributing 16.45% of the nation's total output. In 2024-25, maize was grown on 1.56 million hectares in the state, yielding 4.93 million tonnes with an average productivity of 3160.26 kg/ha (Prakash & Venkataramana, 2023). Northern Karnataka, particularly districts like Davanagere, Belgaum, Chitradurga and Dharwad, dominate maize cultivation due to favorable agro-climatic conditions and well-established agricultural practices. Maize production in Karnataka supports various sectors, including poultry, livestock feed, starch industries and biofuel production (Basavaraj et al., 2022).

Given the economic significance of maize in Karnataka, the role of Farmer Producer Companies (FPCs) like the Kollegala Horticulture Farmer Producer Company Limited (KHFPCL) becomes essential in addressing the challenges faced by smallholder farmers. Indian smallholder farmers often encounter persistent issues such as fragmented land holdings, high input costs

and limited access to markets and infrastructure (Kotyal, 2025; Gautam and Mallaiah, 2024). These challenges lead to higher costs of cultivation (COC) and lower profitability due to the inability to procure inputs in bulk or adopt advanced farming techniques. Limited market access and weak bargaining power make smallholder farmers vulnerable to price volatility and exploitation by intermediaries (Nkhata et al., 2024).

KHFPCL has emerged as a transformative solution by providing a platform for collective action and empowering farmers with better access to resources, improved production efficiency and stronger market linkages. Through the bulk procurement of essential inputs like seeds, fertilizers and plant protection chemicals (PPC) at discounted rates, KHFPCL significantly reduces input costs for its member farmers. By promoting sustainable farming practices and modern agricultural techniques, the organization helps members increase productivity while minimizing dependency on costly external resources (Sergeyeva et al., 2023: Kotyal, 2023). KHFPCL also offers technical guidance on soil health management, water conservation and efficient use of fertilizers and pesticides, directly impacting cost efficiency and profitability in maize cultivation (Kotyal, 2025; Beleri, 2023; Babu & Patoju, 2021).

This study aims to evaluate the economic performance of maize cultivation among KHFPCL members and non-members in Kollegala, Karnataka. By analyzing key cost components such as labor, seeds, fertilizers and PPC, the study seeks to highlight the financial benefits of FPC membership (Anand et al., 2025). The KHFPCL model enables farmers to optimize costs through collective procurement and better resource management, significantly enhancing their profitability. This research contributes to the growing body of knowledge on the economic advantages of farmer collectives and underscores the transformative potential of FPCs in strengthening smallholder agriculture in India (Kotyal, 2025).

2. MATERIALS AND METHODS

The present study was conducted in the Kollegala region of Karnataka, a well-known maize-growing area characterized by significant production and active participation of farmers in Farmer Producer Companies (FPCs). Data were collected from 160 maize farmers, comprising 80 members of the Kollegala Horticulture Farmer Producer Company Limited (KHFPCL) and 80 non-members. A structured interview schedule was used to capture detailed information on input costs, yields and cultivation practices. The data covered multiple growing seasons to ensure a comprehensive and accurate analysis of the cost structure and profitability of maize cultivation.

To minimize selection bias, a stratified random sampling method was employed, ensuring equal representation of both members and non-members of the Kollegala Horticulture Farmer Producer Company Limited (KHFPCL) across different farm sizes and geographic locations. The list of KHFPCL members was obtained directly from the KHFPCL, while data on non-members were collected independently to capture a balanced perspective. The questionnaire was pre-tested and refined based on expert feedback to mitigate response bias and ensure the reliability and consistency of the data collected. These measures ensured a systematic and unbiased data collection process, providing a strong foundation for the subsequent analysis.

The cost of cultivation (COC) for maize was calculated following standard agricultural economics methodologies. Costs were categorized into variable costs and fixed costs. Variable costs included expenditures on human labor, machine labor, seeds, fertilizers, plant protection chemicals (PPC) and interest on working capital. Fixed costs accounted for depreciation of machinery, land rent and other miscellaneous expenses such as irrigation infrastructure maintenance.

2.1 Variable Costs

The variable costs in maize cultivation include several key components essential for ensuring productive and efficient farming. Human labor costs are calculated based on the number of man-days required for various agricultural activities such as land preparation, sowing, weeding and harvesting, multiplied by the prevailing wage rate in the region. Machine labor costs are determined by the total hours of machinery usage for operations like plowing, tilling and threshing, along with the hourly rental rate for the equipment. Seed costs are estimated by considering the quantity of maize seeds used per acre and their market price per kilogram. Fertilizer expenses encompass both organic and chemical fertilizers, including essential nutrients like Diammonium Phosphate (DAP), Urea, Muriate of Potash (MOP) and micronutrients such as Zinc and Boron, all of which play a

critical role in enhancing crop productivity and quality. Additionally, the costs for plant protection chemicals (PPC) cover the expenditure on pesticides and bio-fertilizers aimed at safeguarding the maize crop from pests and diseases, ensuring healthy growth and optimal yields (Kumar et al., 2023; Hajong et al., 2024).

2.2 Data Analysis

Descriptive statistics were used to summarize and compare the costs of cultivation between KHFPCL members and non-members. Total variable and fixed costs were computed and gross returns were estimated by multiplying the yield per acre by the prevailing market price. Net returns were calculated by subtracting the total cost of cultivation from the gross returns.

To assess the financial benefits of KHFPCL membership, a t-test was performed to determine the statistical significance of differences in the cost of cultivation between members and non-members. The impact of KHFPCL on reducing cultivation costs and enhancing profitability was calculated as a percentage difference between the two groups.

2.3 Impact of KHFPCL (%)

The impact of KHFPCL membership on reducing the cost of cultivation was measured (Kotyal, 2025).

$$\text{Impact of KHFPC (\%)} = \frac{\text{COC (Non} - \text{members)} - \text{COC (Members)}}{\text{COC(Non} - \text{members)}} \times 100$$

2.4 t-Statistic Calculation

The t-statistic was calculated to assess the significance of the difference in costs between KHFPCL members and non-members using the formula:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(\frac{S_1^2}{n_1}\right) + \left(\frac{S_2^2}{n_2}\right)}}$$

Where:

- $\bar{X}_1$= Mean COC for KHFPC members
- $\bar{X}_2$ = Mean COC for non-members
- S_1^2 = Variance in COC for KHFPC members
- S_2^2= Variance in COC for non-members
- n_1 and n_2 = Sample sizes of the two groups (80 each in this study)

To find whether the variation between KHFPCL members and non-members in cost is significant or not, t-statistic was calculated as a reliable measure of comparing the two independent group's means. Being a prerequisite for the t-test, normality and homogeneity of variances were inspected before applying it to ensure that the findings shall be reliable. The equation for the t-test is given above, where the difference between the group means is multiplied by the pooled standard error of the two groups. In this case, the two groups were of equal sample sizes (80 in both groups), which also increased the test's robustness. The calculated t-value and p-value that goes with it were compared to determine if the differences in the costs were statistically significant. This approach enlightened the economic benefit of collective action through KHFPCL membership, verifying its contribution towards cost efficiency and profitability in maize production. The results of t-tests enlighten the economic benefit of FPC membership, verifying if collective action through KHFPCL leads to cost efficiency and increased profitability in maize production.

3. RESULTS AND DISCUSSION

The economic comparison of maize cultivation between KHFPCL members and non-members highlights notable differences in cost structures, reflecting the advantages of collective participation in farmer organizations. The total cost of maize cultivation for KHFPCL members amounts to ₹31,934.44, which is ₹3,336.20 lower than the ₹35,270.64 incurred by non-members. This reduction of approximately 9.46% in total costs underscores the economic benefits that members derive from collective action, including improved access to resources, institutional support and better bargaining power. These factors enable members to manage production costs more efficiently, ultimately leading to higher profitability and sustainability in maize cultivation (Poudel, 2024).

A detailed examination of input costs reveals significant variations between the two groups, with input costs comprising 73.24% of the total expenditure for KHFPCL members and 75.16% for non-members. This results in a cost impact of 31.85% in favor of members, with a highly significant t-statistic of 7.29. Such differences indicate the more efficient cost management practices adopted by KHFPCL members. Among the various input components, the costs of machine labor, seeds and fertilizers exhibit the most pronounced disparities. The expenditure on

machine labor for members stands at ₹1,800, accounting for 5.64% of their total cost, whereas non-members spend ₹2,700, which constitutes 7.66% of their total cost. This translates to a cost impact of 9.19%, supported by a statistically significant t-statistic of 4.85, indicating the cost-efficiency achieved through collective resource utilization and better negotiation capabilities (Basavaraj et al., 2022).

Seed costs also demonstrate considerable differences, with members spending ₹2,800 (8.77% of total cost) compared to ₹3,200 (9.07%) spent by non-members. This results in a cost impact of 4.08% and a statistically significant t-statistic of 3.72. Fertilizer costs reflect consistent savings for KHFPCL members across multiple categories, including organic fertilizers, DAP, urea and MOP. The cost savings are particularly prominent for urea and DAP, with cost impacts of 5.90% and 3.98%, respectively, both supported by highly significant t-statistics. These results suggest that KHFPCL members benefit from better procurement practices, including bulk purchasing and enhanced access to subsidized agricultural inputs (Prakash & Venkataramana, 2023).

Input cost savings, KHFPCL members also exhibit greater efficiency in financial management, as evidenced by the lower interest on working capital. Members incur an interest cost of ₹1,637.28 (5.13% of total cost), compared to ₹1,855.64 (5.26%) for non-members. Although the cost impact in this category is relatively smaller at 2.23%, the difference remains statistically significant, with a t-statistic of 2.18. This suggests that KHFPCL members may have access to more favorable credit terms, such as lower interest rates or more efficient utilization of working capital, contributing to overall cost efficiency (Vimalkumar & Latha, 2025).

Fixed cost component shows minimal variation between the two groups. KHFPCL members report a fixed cost of ₹6,907.41, accounting for 21.63% of their total cost, while non-members incur a nearly identical expense of ₹6,905.92 (19.58% of total cost). The negligible difference, reflected in a non-significant t-statistic of -0.03, suggests that both groups face similar long-term investment requirements for fixed assets such as machinery, infrastructure and permanent facilities. This finding implies that the primary cost advantages for KHFPCL members arise from variable costs rather than fixed capital investments (Basavaraj et al., 2022; Hajong et al., 2024).

The total variable cost further highlights the economic efficiency achieved by KHFPCL members. Members' variable costs amount to ₹25,027.03, representing 78.37% of their total expenditure, compared to ₹28,364.72 (80.42%) for non-members. This results in a cost impact of 34.08%, with a highly significant t-statistic of 8.14, underscoring the substantial savings achieved through effective cost management and optimized input use. The ability of KHFPCL members to minimize variable costs without compromising production quality or yield demonstrates the tangible benefits of collective action and institutional support (Kiruthika et al., 2023; Sergeyeva et al., 2023).

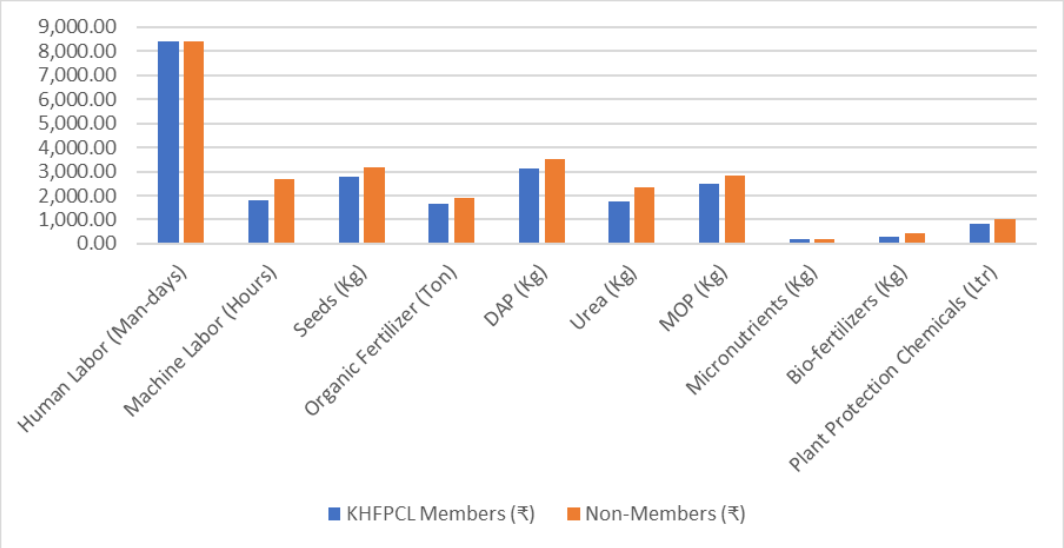

Fig. 1. Cost Comparison of Maize Cultivation Inputs for KHFPC Members and Non-Members

Table 1. Economic Comparison of Maize Cultivation for KHFPCL Members and Non-Members

Sl. No	Particulars	KHFPCL Members (₹)	% to Total Cost (Members)	Non-Members (₹)	% to Total Cost (Non-Members)	Impact of KHFPCL (%)	t-Statistic
1	Human Labor (Man-days)	8,400.00	26.30%	8,400.00	23.82%	-	0.00
2	Machine Labor (Hours)	1,800.00	5.64%	2,700.00	7.66%	9.19%	4.85**
3	Seeds (Kg)	2,800.00	8.77%	3,200.00	9.07%	4.08%	3.72**
4	Organic Fertilizer (Ton)	1,680.00	5.26%	1,920.00	5.44%	2.45%	2.68**
5a	DAP (Kg)	3,120.00	9.77%	3,510.00	9.95%	3.98%	3.91**
5b	Urea (Kg)	1,761.34	5.52%	2,339.29	6.63%	5.90%	5.24**
5c	MOP (Kg)	2,490.90	7.80%	2,815.80	7.98%	3.32%	3.45**
6	Micronutrients (Kg)	187.50	0.59%	174.00	0.49%	-0.14%	-0.52
7	Bio-fertilizers (Kg)	300.00	0.94%	450.00	1.28%	1.53%	1.23
8	Plant Protection Chemicals (Ltr)	850.00	2.66%	1,000.00	2.84%	1.53%	1.45
Total Input Cost		**23,389.74**	**73.24%**	**26,509.09**	**75.16%**	**31.85%**	**7.29**
9	Interest on Working Capital @7%	1,637.28	5.13%	1,855.64	5.26%	2.23%	2.18*
Total Variable Cost		**25,027.03**	**78.37%**	**28,364.72**	**80.42%**	**34.08%**	**8.14**
10	Fixed Cost	6,907.41	21.63%	6,905.92	19.58%	-0.02%	-0.03
Total Cost (Variable + Fixed)		**31,934.44**	**100%**	**35,270.64**	**100%**	**100%**	**-7.90**

Note: Significant at 1% level of probability (**) and 5% level of probability (*)

The economic analysis of maize cultivation reveals that KHFPCL membership significantly reduces production costs, primarily through savings in variable costs such as labor, seeds, fertilizers and working capital interest. The statistically significant differences observed across multiple input categories confirm that collective action through KHFPCL enhances cost efficiency and resource accessibility. These findings underscore the critical role of farmer organizations in improving agricultural profitability by promoting better market linkages, enabling bulk procurement and facilitating the adoption of best practices (Kotyal, 2025).

The comparison of yield, gross returns and net returns between KHFPCL members and non-members, as presented in Table 2, reveals substantial differences that underscore the economic advantages associated with collective participation in the KHFPCL organization. These differences can be attributed to improved access to resources, better market linkages and the institutional support provided to members, which contribute to enhanced productivity and profitability.

The yield per hectare for KHFPCL members stands at 25 quintals, compared to 23 quintals for non-members. This 3.9% higher yield, with a statistically significant t-statistic of 3.91, highlights the positive impact of collective action on agricultural productivity. The higher yield among members can be attributed to several factors, including better access to high-quality seeds, fertilizers and advanced agronomic practices (Beleri et al., 2025). KHFPCL members benefit from training and knowledge dissemination on improved cultivation techniques, efficient resource management and timely access to inputs, which contribute to higher productivity levels. The cooperative model allows members to share best practices and experiences, fostering a culture of innovation and continuous improvement.

Gross returns of KHFPCL membership. Members report gross returns of ₹50,000.00, which is 22.9% higher than the ₹41,400.00 earned by non-members. This substantial difference, supported by a highly significant t-statistic of 5.72, suggests that KHFPCL members not only achieve higher yields but also secure better market prices for their produce. The enhanced market access provided by KHFPCL likely enables members to engage in collective bargaining, negotiate better prices and reduce the dependency on middlemen. Additionally, the cooperative's established market linkages and institutional support help members identify and access more lucrative markets, contributing to higher revenue generation (Busungu, 2025).

The most striking difference is observed in net returns, where KHFPCL members earn ₹18,065.56 compared to ₹6,129.36 for non-members, a remarkable 53.3% higher net return. This difference, with a highly significant t-statistic of 6.82, underscores the efficiency and profitability associated with KHFPCL membership. The higher net returns can be attributed to the combination of lower production costs and higher revenue. As noted in the earlier cost analysis, KHFPCL members benefit from reduced input costs, optimized use of resources and more favorable credit terms. These cost savings, coupled with increased yields and better market prices, translate directly into higher net profitability (Hajong et al., 2024).

The ability of KHFPCL members to minimize production costs while maximizing returns indicates the effectiveness of the cooperative model in enhancing overall farm efficiency (Dutta et al., 2023). The collective approach allows members to benefit from economies of scale, bulk purchasing of inputs, shared access to machinery and collective marketing efforts. These advantages not only reduce per-unit costs but also enhance bargaining power and market access, leading to higher overall profitability (Kotyal, 2023).

Table 2. Yield, Gross Returns and Net Returns Comparison

Particulars	KHFPCL Members	Non-Members	Impact of KHFPCL (%)	t-Statistic
Yield (Quintals)	**25**	**23**	**3.9%**	**3.91**
Gross Returns (₹)	**50,000.00**	**41,400.00**	**22.9%**	**5.72**
Net Returns (₹)	**18,065.56**	**6,129.36**	**53.3%**	**6.82**

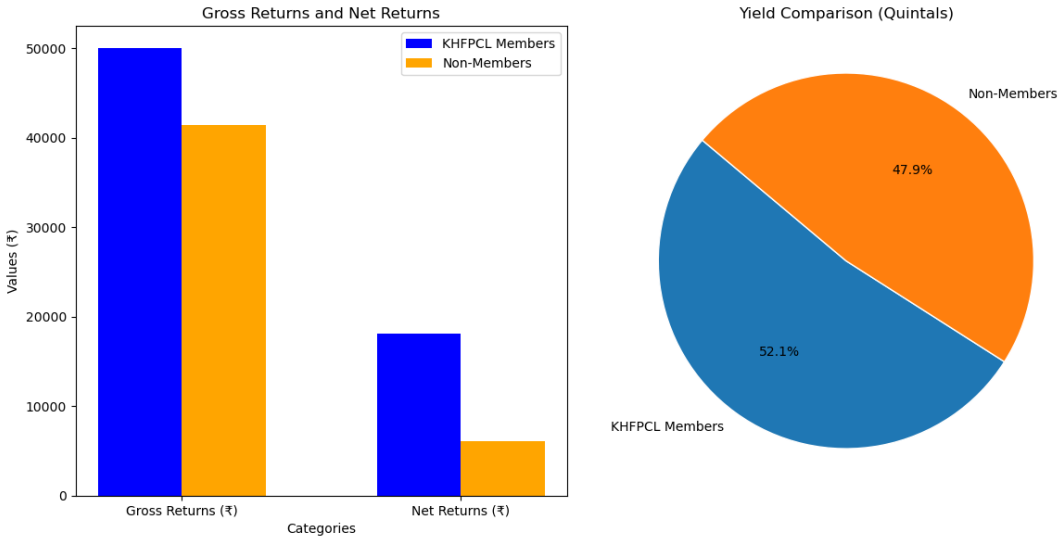

Fig. 2. Comparison of gross returns, net returns and yield proportions between KHFPCL members and non-members

4. CONCLUSION

The comparative analysis of maize cultivation in the Kollegala region reveals the substantial economic benefits gained by farmers associated with the Kollegala Horticulture Farmers Producer Company Limited (KHFPCL). Through collective procurement, resource-sharing and technical support, KHFPCL members experience reduced input costs, including expenses on labor, machinery, fertilizers and plant protection chemicals. This collaborative approach results in higher productivity, with KHFPCL members achieving an average yield of 25 quintals per acre compared to 23 quintals for non-members. Consequently, KHFPCL members witness a significant increase in both gross returns (22.9%) and net returns (53.3%). These findings underscore the crucial role of Farmer Producer Companies (FPCs) in enhancing the economic sustainability of smallholder farmers by addressing key challenges such as high input costs, limited technical knowledge and fragmented market access. Promoting and expanding such collective farming models can greatly improve resource management, strengthen market linkages and ensure long-term profitability, making them a vital strategy for improving farmer livelihoods and building resilient agricultural communities.

5. POLICY IMPLICATIONS

a. Promote and support the establishment of more Farmer Producer Companies (FPCs) like KHFPCL to enhance smallholder farmers collective bargaining power, reduce input costs and improve market access.
b. Facilitate bulk procurement and subsidized distribution of high-quality seeds, fertilizers and plant protection chemicals through FPCs to lower the cost of cultivation.
c. Develop training programs on advanced agronomic practices, soil health management and efficient input use to improve productivity and profitability among maize farmers.
d. Invest in better market linkages, storage facilities and transportation networks to minimize post-harvest losses and ensure fair pricing for farmers produce.
e. Encourage the adoption of eco-friendly farming techniques, including the use of organic fertilizers and bio-pesticides, to enhance long-term agricultural sustainability and resilience.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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