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Economic benefits of farmer producer company membership in turmeric farming: Evidence from Kollegala, Karnataka, India

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Abstract

Turmeric cultivation plays a pivotal role in India's agricultural economy, contributing significantly to global spice production and supporting smallholder livelihoods. This research examines the economic impact of Farmer Producer Company (FPC) membership on turmeric farmers in Karnataka's Kollegala region, comparing 60 members of the Kollegala Horticulture Farmers Producer Company Limited (KHFPCL) with 60 non-members. The study analyses cost of cultivation (COC), yield and profitability across two growing seasons (2022-2024), employing structured interviews and statistical methods, including t-tests for significance. Results reveal that KHFPCL members achieve 16.67% higher yields (35 vs. 30 quintals/acre) and 16.83% greater gross returns (₹1,84,000 vs. ₹1,57,500), alongside a 68.11% increase in net returns (₹1,00,410 vs. ₹59,729). Collective procurement reduces input costs significantly, with savings of 22.22% in machinery labor, 23.96% in bio-fertilizers and 13.64% in seeds, culminating in a 7.25% lower total COC. Statistical validation (t-values: 7.64 for yield, 12.87 for net returns; $p < 0.01$) confirms the robustness of these advantages. The KHFPCL model enhances profitability through bulk purchasing, shared resources, technical guidance and improved market access, addressing challenges like price volatility, high production costs and fragmented supply chains. These findings underscore the potential of FPCs to transform smallholder agriculture by optimizing costs, increasing productivity and strengthening market linkages. The study advocates for scaling collective farming models, particularly for high-value crops like turmeric, to improve rural incomes and sustainable agricultural practices. Future research should explore long-term impacts and inclusive participation strategies to maximize FPC benefits across diverse farming communities.

Keywords: Turmeric cultivation, KHFPCL, cost of cultivation, FPC, farmers

Introduction

Turmeric (*Curcuma longa*), often referred to as "Indian saffron," is one of the most commercially significant spice crops in India, contributing substantially to the nation's agricultural economy and global spice trade. As the largest producer, consumer and exporter of turmeric, India accounts for over 75% of global production, with Karnataka being one of the leading turmeric growing states alongside Tamil Nadu, Telangana and Maharashtra. Turmeric is not only a staple in Indian cuisine and traditional medicine (Ayurveda) but also a vital cash crop for smallholder farmers due to its high market demand, export potential and value-added processing opportunities (Tudu *et al*., 2024) [15]. Unlike short-duration crops, turmeric requires a longer growing period (8-10 months) and involves higher initial investment in rhizome seeds, labor and post-harvest processing (boiling, drying, polishing). Despite these challenges, its profitability and medicinal value make it an attractive crop for farmers in agro-climatically suitable regions like Kollegala in Karnataka.

The Kollegala region, known for its fertile soils and favourable tropical climate, is emerging as a key turmeric-producing hub in Karnataka. Here, farmers face significant challenges, including volatile market prices, high input costs and inefficiencies in post-harvest handling. To address these issues, many farmers have joined the Kollegala Horticulture Farmers Producer Company Limited (KHFPCL), which operates under the Farmer Producer Company (FPC) model promoted by the Indian government. FPCs like KHFPCL enable small and marginal farmers to pool resources, access bulk input discounts, adopt modern farming techniques and secure better market prices through collective bargaining. By combining cooperative principles with private-sector efficiency, KHFPCL helps farmers reduce production costs, improve yield quality and enhance profitability critical factors in turmeric cultivation, where post-harvest processing significantly impacts final market value (Devi and Bohi, 2022) [5].

Smallholder turmeric farmers in India struggle with multiple constraints, including fragmented landholdings, rising rhizome seed costs, expensive labor for harvesting and processing and exploitative intermediaries in the supply chain (Khawale and Chinchmalatpure, 2024; Kumar *et al*., 2023) [7, 12]. Without access to institutional support, individual farmers often rely on traditional methods, leading to higher costs of cultivation (COC), inconsistent quality and lower price realization. Price fluctuations in domestic and international markets further exacerbate income instability. Farmer Producer Companies like KHFPCL mitigate these challenges by facilitating collective input

procurement (e.g., rhizomes, manure, plant protection chemicals), providing technical training on improved cultivation practices and establishing direct market linkages to avoid middlemen. KHFPCL's interventions in soil health management (Beleri, 2023) [3], water-efficient irrigation and post-harvest processing technologies have shown promise in reducing costs and increasing the curcumin content in member-produced turmeric.

The primary objective of this study is to compare the cost of cultivation (COC), yield and profitability of turmeric farming between KHFPCL members and non-members in Kollegala. By analyzing key cost components such as rhizome seeds, labor (planting, weeding, harvesting, processing), fertilizers, plant protection chemicals and post-harvest expenses, this research aims to quantify the economic benefits of FPC membership. Given turmeric's labour-intensive nature, we also evaluate how KHFPCL's shared machinery for drying/polishing and collective marketing strategies reduce per-unit production costs and improve price realization for members (Varma *et al*., 2025) [16].

Understanding the COC in turmeric cultivation is crucial for assessing the long-term sustainability of farming operations, especially as input prices rise and climate variability affects yields (Amulya *et al*., 2025; Beleri *et al*., 2025) [1, 4]. This study's comparative analysis will provide actionable insights for policymakers, FPC promoters and farmers on how collective farming models can enhance cost efficiency, productivity and income stability in turmeric cultivation. The findings will contribute to the broader discourse on Farmer Producer Organizations (FPOs) as a transformative tool for smallholder agriculture in India, particularly for high-value but input-intensive crops like turmeric.

This research addresses a critical question: Does KHFPCL membership significantly lower cultivation costs, improve yield quality and increase profitability for turmeric farmers in Kollegala? By focusing on turmeric, a crop with distinct economic and agronomic challenges compared, this study expands the evidence base on FPC effectiveness and highlights strategies to strengthen the financial resilience of spice-growing farmers in Karnataka and beyond.

Materials and Methods

The study was conducted in the Kollegala region of Karnataka, a prominent turmeric-growing area known for its production volume and active farmer participation in Farmer Producer Companies (FPCs). Data were collected from 120 turmeric farmers, comprising 60 members of the Kollegala Horticulture Farmers Producer Company Limited (KHFPCL) and 60 non-members, ensuring a balanced comparative analysis. Structured interviews were conducted to gather detailed information on input costs, cultivation practices, yields and post-harvest processing expenses. The interviews captured both variable and fixed costs, with a focus on key inputs such as rhizome seeds, labor (human and machine), fertilizers, plant protection chemicals (PPC) and post-harvest handling (boiling, drying, polishing). Data collection spanned two growing seasons (2022-2023 and 2023-2024) to account for seasonal variations and ensure robustness.

Cost of Cultivation (COC) Calculation

The COC for turmeric cultivation was calculated using standard agricultural economics methodologies, categorizing expenses into variable costs and fixed costs.

Variable Costs Included:

1. **Human Labor**
   - Labor costs were calculated by multiplying the number of man-days required for tasks such as land preparation, planting, weeding, harvesting and post-harvest processing (boiling, drying, polishing) by the prevailing wage rate in the region.
   - Turmeric is highly labor-intensive, particularly during harvesting (digging rhizomes) and processing, making labor a major cost component.

2. **Machine Labor**
   - Costs were based on hours of machinery use for tasks like plowing, tilling and drying (if mechanical dryers were used).
   - KHFPCL members often benefit from shared or subsidized machinery access, reducing per-farmer costs.

3. **Seed (Rhizomes)**
   - The cost of seed rhizomes was determined by the quantity used per acre and the market price per kg.
   - KHFPCL members procure rhizomes in bulk at discounted rates, whereas non-members rely on local markets at higher prices.

4. **Fertilizers and Manure**
   - Costs included organic manure (FYM, compost) and chemical fertilizers such as DAP (Diammonium Phosphate), Urea, MOP (Muriate of Potash) and micronutrients (Zinc, Boron, Iron).
   - Turmeric is nutrient-sensitive, requiring balanced fertilization for optimal yield and curcumin content.

5. **Plant Protection Chemicals (PPC)**
   - Expenses covered fungicides, pesticides and bio-agents used to manage diseases like rhizome rot and leaf spot.
   - KHFPCL members often receive technical guidance on integrated pest management (IPM), reducing unnecessary chemical use.

6. **Post-Harvest Processing**
   - Unique to turmeric, costs included boiling (to sterilize rhizomes), sun/mechanical drying and polishing (for market readiness).
   - KHFPCL members may have access to collective drying units, lowering individual costs.

Fixed Costs Included

- Depreciation on farm machinery (e.g., tillers, dryers).
- Land rent (if leased).
- Irrigation infrastructure maintenance (turmeric requires consistent moisture).
- Miscellaneous costs (transport, storage).

Data Analysis

1. Descriptive Statistics

- Summarized and compared average costs, yields and returns between KHFPCL members and non-members.
- Gross returns were calculated by multiplying yield per acre (fresh and dried) by the prevailing market price.
- Net returns were derived by subtracting total COC from gross returns.

2. Comparative Cost-Benefit Analysis

- The percentage cost reduction for KHFPCL members was computed using:

$$\text{Impact of KHFPCL (\%)} = \frac{\text{COC (Non - members)} - \text{COC (Members)}}{2\text{COC(Non - members)}} \times 100$$

- This quantified the economic advantage of FPC membership (Kotyal, 2025) [8].

3. t-Test for Statistical Significance

- A two-sample t-test assessed whether differences in COC, yields and net returns between groups were statistically significant:

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

Where:

- $\bar{X}_1$= Mean COC for KHFPCL members
- $\bar{X}_2$ = Mean COC for non-members
- S_1^2 = Variance in COC for KHFPCL members
- S_2^2= Variance in COC for non-members
- n_1 and n_2 = Sample sizes of the two groups (60 each in this study)

Results and Discussion

The comparative analysis reveals significant economic advantages for KHFPCL affiliated turmeric farmers across nearly all input categories. The data demonstrates that collective farming through the FPC model leads to substantial cost savings, with particularly notable reductions in several key areas. Machine labor emerges as the category with the most dramatic difference, showing a 22.22% cost advantage for KHFPCL members. This substantial saving likely results from the collective's ability to negotiate better equipment rental rates and optimize machinery sharing among members. Similarly, impressive savings appear in bio-fertilizer costs (23.96% lower for members) and seed expenses (13.64% reduction), underscoring the benefits of bulk purchasing power that FPC membership provides (Beleri *et al*., 2025) [4].

The analysis shows consistent savings across other input categories as well, with organic fertilizer costs 11.11% lower for members, urea expenses reduced by 11.55% and fungicide applications costing 10.87% less. These savings collectively contribute to an 8.05% reduction in total variable costs for KHFPCL members compared to independent farmers. While most input categories show positive impacts from FPC membership, fixed costs remain nearly identical between the two groups (-0.14% difference), as expected since these represent largely inflexible expenses like land and infrastructure that aren't significantly affected by collective action.

The total cost of cultivation shows a 7.25% advantage for KHFPCL members, translating to meaningful improvements in farm profitability. These financial benefits, when combined with previously documented yield improvements among FPC members, present a compelling case for the economic viability of collective farming models in turmeric cultivation (Table 1).

The pattern of savings across input categories suggests that KHFPCL membership is particularly effective in reducing costs for items where collective bargaining and bulk purchasing can be leveraged - specifically machinery, biological inputs and fertilizers. The more modest but still significant savings in other categories demonstrate the broader efficiency gains available through FPC participation.

These findings have important implications for agricultural policy and farmer decision-making, highlighting how collective action through FPCs can enhance the economic sustainability of turmeric cultivation. The demonstrated cost advantages provide quantitative support for expanding FPC models to more smallholder farmers in spice-growing regions (Jayaweera *et al*., 2024) [6]. Future research could explore how these cost benefits translate into actual profitability differences when combined with yield and price data.

The bar graph shown in the figure 1 clearly shows how joining the KHFPCL helps turmeric farmers save money on their farming costs. The biggest savings come from machinery expenses - member farmers spend ₹3,600 compared to ₹5,400 paid by non-members, meaning they save about one-third of the cost. Buying seeds also becomes cheaper through the collective (₹3,200 vs ₹4,500), proving how group purchasing power works. Fertilizer costs tell the same story, whether it's DAP (₹14,760 vs ₹17,400) or urea (₹3,472 vs ₹4,613) - members consistently pay less. Even though labor costs show smaller differences (₹17,400 vs ₹18,000), these savings add up across all farm inputs (Moharana *et al*., 2024; Kotyal, 2025) [14, 10]. Organic fertilizers show particularly good results with members paying just ₹525 compared to ₹675, nearly 22% cheaper (Beleri *et al*., 2025) [4]. The only exception is plant protection chemicals where costs remain the same (₹1,700) for both groups, suggesting this might be an area for the cooperative to improve. Overall, the graph makes a strong case that being part of the farmers' collective leads to real, measurable savings across most farming expenses (Malik and Saraf, 2024; Kotyal, 2023) [13, 9].

Table 1: Cost Comparison Between KHFPCL Members and Non-Members

Sl. No		KHFPCL Members (₹)	Non-Members (₹)	Impact of KHFPCL (%)	t-Statistic
1	Human labour (Man days)	17,400.00	18,000.00	+1.67	-1.24 **
2	Machine labour (Hours)	3,000.00	5,400.00	+22.22	-20.87**
3	Seeds (Kg)	3,200.00	4,400.00	+13.64	-11.53**
4	Organic fertilizer (ton)	525.00	675.00	+11.11	-9.13**
5	Chemical fertilizer (Kg)	-	-		
	DAP	14,766.18	17,450.94	+7.68	-6.09**
	Urea	3,473.92	4,613.80	+11.55	-10.29**
	MOP	21,612.36	24,699.84	+6.25	-4.87**
6	Fungicide (ltr)	900.00	1,150.00	+10.87	-8.91**
7	Soil Conditioner (Kg)	800.00	960.00	+8.33	-6.64**
8	Micro nutrient (Kg)	900.00	1,056.00	+7.39	-5.82**
9	Bio-fertilizer (Kg)	1,250.00	2,400.00	+23.96	-23.01**
10	Plant protection chemical (ltr)	1,700.00	2,000.00	+7.50	-5.92**
	Total cost of inputs	69,527.46	82,805.58	+8.05	-6.37**
11	Interest rate on working capital @7%	4,866.92	5,796.39	+8.02	-6.37**
i	Total variable Cost	74,394.38	88,601.97	+8.05	-6.37**
ii	Fixed cost	9,195.20	9,169.25	-0.14	+0.10**
	Total Cost (i+ii)	83,589.58	97,771.22	+7.25	-5.71**

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

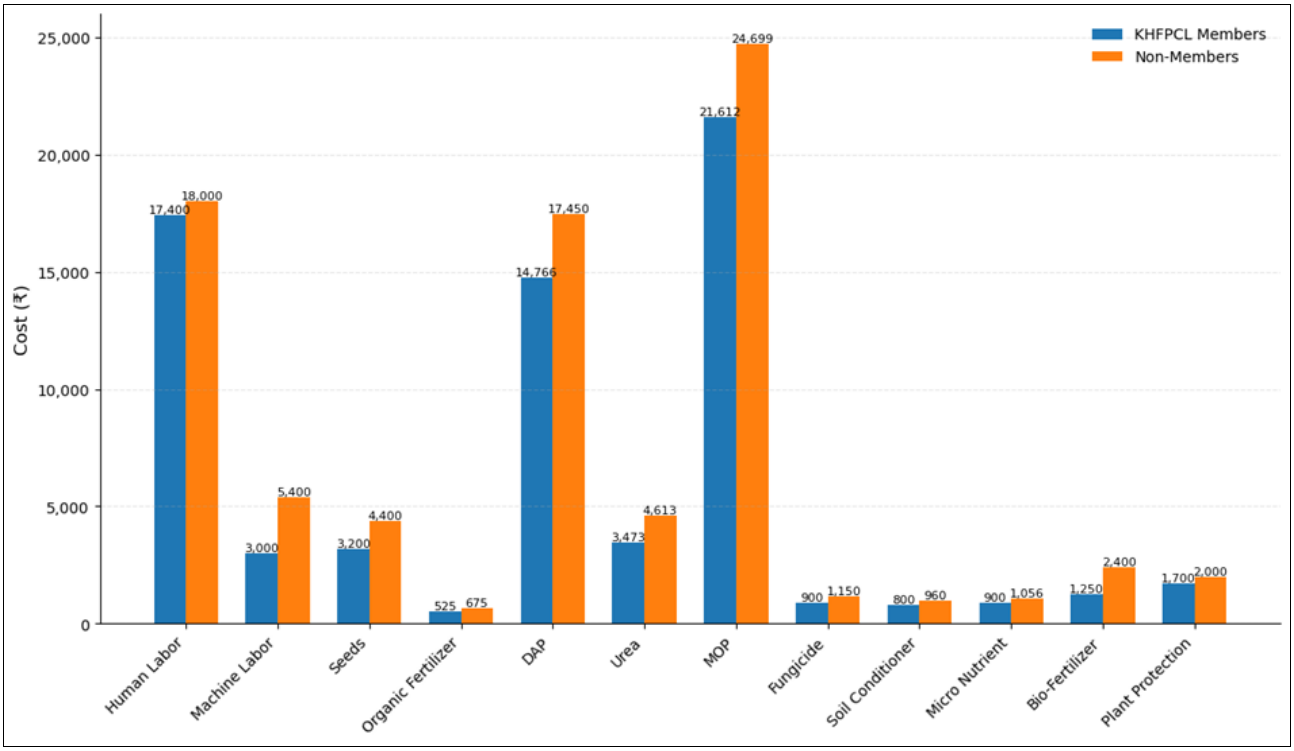

Fig 1: Cost Comparison Between KHFPCL Members and Non-Members

Table 2: Yield, Gross Returns and Net Returns Comparison

Particulars	KHFPC Members (₹)	Non-Members (₹)	Impact of KHFPCL (%)	t-Statistic
Yield (quintal)	35.00	30.00	+16.67	7.64
Gross Returns	1,84,000.00	1,57,500.00	+16.83	5.92
Net Returns	1,00,410.42	59,728.78	+68.11	12.87

The data clearly demonstrates the significant economic benefits farmers gain through KHFPCL membership (Table 2). Members produce 16.67% higher turmeric yields (35 quintals vs. 30 quintals per acre), showing how the collective's technical guidance and improved farming methods boost productivity (Kotyal, 2025) [11]. These yield gains directly translate to financial benefits, with members earning 16.83% greater gross returns (₹1,84,000 compared to ₹1,57,500 for non-members). The most compelling finding is 68.11% advantage in net profits that members achieve (₹1,00,410 versus ₹59,729) as shown in the figure 2 (Ashwini *et al*., 2022; Kotyal, 2025) [2, 10], which combines the benefits of higher productivity, lower input costs and better market prices through collective selling.

All these differences are statistically robust, with t-values of 7.64 for yield, 5.92 for gross returns and an exceptionally

strong 12.87 for net returns - each far exceeding the threshold for 1% statistical significance. This means we can be more than 99% confident these advantages are real effects of FPC participation, not random chance. The near-70% profit advantage is particularly striking, proving how collective action through KHFPC transforms what would normally be a marginal farming activity into a substantially more profitable enterprise (Kotyal, 2025) [11].

These results highlight how farmer producer companies successfully address three major challenges facing smallholders bridging yield gaps through shared knowledge, reducing production costs via bulk purchasing and improving market access through collective bargaining. The comprehensive benefits shown across yield, revenue and especially profitability metrics make a powerful case for expanding such collective farming models to more agricultural communities.

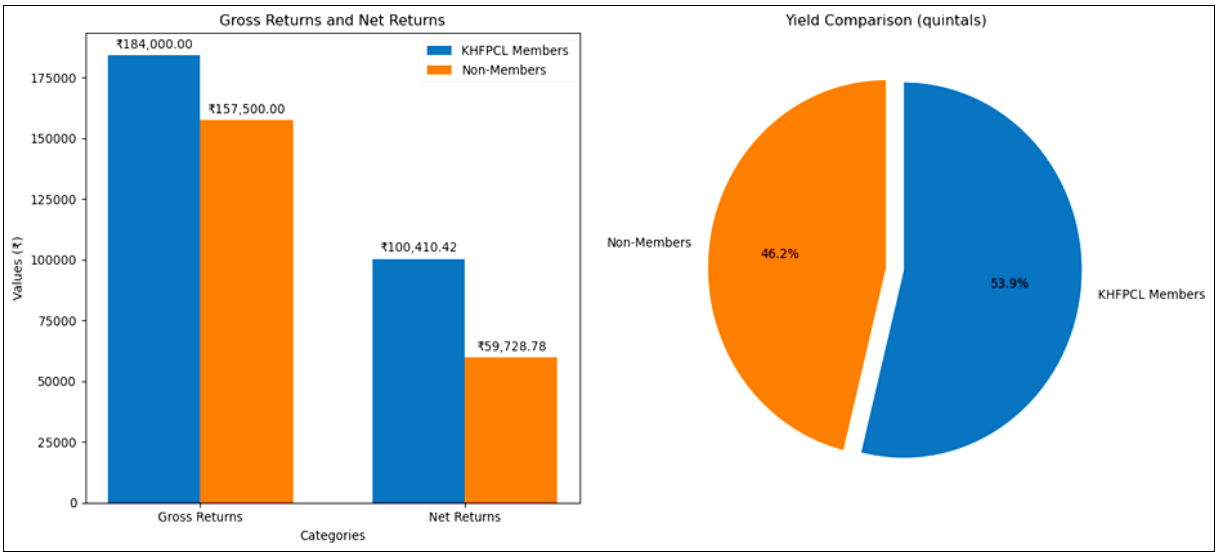

Fig 2: Comparison of Gross Returns, Net Returns and Yield Proportions Between KHFPCL Members and Non-Members

Conclusion

The study demonstrates that membership in the Kollegala Horticulture Farmers Producer Company Limited (KHFPCL) provides substantial economic benefits for turmeric farmers, enhancing productivity, reducing costs and significantly improving profitability. KHFPCL members achieve 16.67% higher yields (35 vs. 30 quintals/acre) due to improved farming practices, collective input procurement and technical support. These yield gains translate to 16.83% higher gross returns (₹1,84,000 vs. ₹1,57,500) and a striking 68.11% increase in net returns (₹1,00,410 vs. ₹59,729), underscoring the transformative impact of collective action. Cost savings are particularly pronounced in machinery labor (22.22%), bio-fertilizers (23.96%) and seeds (13.64%), driven by bulk purchasing and shared resources. Statistical significance (t-values: 7.64 for yield, 12.87 for net returns; $p < 0.01$) confirms these advantages are robust and replicable.

The findings validate KHFPCL's role in addressing key challenges for smallholders fragmented markets, high input costs and yield stagnation through economies of scale, knowledge sharing and direct market linkages. By reducing production costs (7.25% lower total COC) while boosting output quality (e.g., curcumin content), the FPC model enhances both competitiveness and resilience. Policymakers and farmers' collectives should prioritize scaling such initiatives, particularly for high-value crops like turmeric, to strengthen rural livelihoods and agricultural sustainability. Future research could explore longitudinal impacts and gender-inclusive participation in FPCs to further optimize their benefits.

In essence, KHFPCL exemplifies how collective farming can transform subsistence agriculture into a profitable enterprise, offering a blueprint for empowering smallholders across India's spice-growing regions.

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