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Farmer producer organisation as catalysts for change in agriculture: Improving farmer livelihoods in Tamil Nadu

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Abstract

Farmer Producer Organizations (FPOs) are crucial for empowering smallholder farmers and contributing significantly to rural development. This study examines the role of Farmer Producer Organizations (FPOs) in enhancing the economic and social welfare of smallholder farmers in Tamil Nadu, specifically in the districts of Thanjavur, Trichy, Pudukottai, Madurai and Sivagangai. Using a sample of 600 farmers (400 FPO members and 200 non-members), the research highlights the transformative potential of FPOs in improving farmers' income and reducing disparities between members and non-members. Key factors such as farm size, participation in FPO training, and access to inputs through FPOs significantly boost income. For instance, FPO training led to a 19-unit increase in income for every unit of participation and the provision of inputs resulted in a 14-unit income increase. Conversely, challenges like high dependency ratios and reliance on hired labor were found to negatively affect income levels. The findings suggest that targeted policy measures, including the expansion of FPO access, strengthening training programs and addressing household dependency issues, are crucial to enhancing the economic benefits for smallholder farmers. FPO membership leads to a 15 per cent increase in income, this can be attributed to the benefits of reduced costs and increased efficiency. By joining an FPO, farmers typically gain access to bulk purchasing of inputs (e.g., seeds, fertilizers, machinery), shared resources and collective bargaining power, all of which contribute to cost reduction. Additionally, enhancing infrastructure, financial services and market access for FPOs could further empower farmers and contribute to rural development.

Keywords

Farmer Producer Organisation; impact analysis; southern zone

Introduction

India is the most populated country with 92 million smallholdings, constituting 21 % of the world's 450 million small agricultural holdings. Over time, the number of operational landholdings in the country has increased, leading to a steady decline in their average size, a clear sign of rising land fragmentation. Smallholder farmers, characterized by limited land resources, face inherent challenges such as the absence of economies of scale, restricted access to crucial market information and an inability to participate in effective price discovery mechanisms. These structural vulnerabilities often lead to adverse outcomes such as crop failures, market price volatility and,

tragically, an increase in farmer suicides. Smallholder farmers remain the primary and most vulnerable stakeholders in confronting agricultural risks (1).

In India, the concept of organizing farmers through formal entities dates to the early 20th century with the establishment of cooperatives. These cooperatives have long served as crucial institutions, enabling farmers to strengthen their bargaining power and access credit with reduced transaction costs. However, the economic liberalization and globalization of trade post-1990s introduced new challenges and uncertainties for small and marginal farmers. This shift underscored the need for improved access to credit, markets, timely adoption of technology, and relevant information for these farmers. To address these challenges, Farmers' Producer Organisations (FPOs) emerged as an innovative and alternative institutional framework aimed at collectivizing farmers, addressing their evolving needs and minimizing the role of intermediaries (2). A cooperative (PC) is an organization where membership is open to primary producers and their collectives, but shareholding is restricted to these groups. It includes government representation on the board, granting them veto power over decisions. Shareholders must transact with the cooperative to maintain their membership status and continue benefiting from the organization**.** A perfect example of a similar initiative is La Coop fédérée in Canada, one of the largest agricultural cooperatives, which supports farmers by providing them with market access, financial services and shared resources, much like India's FPO model. In Kenya, the Kenya Tea Development Agency (KTDA) operates as a cooperative, empowering small tea farmers by providing them with technical support, collective marketing, and better access to global markets. In Spain, COVAP is a large agricultural cooperative that supports dairy and meat producers, offering services such as bulk purchasing and joint marketing, improving profitability for its members, similar to the goals of India's FPOs.

Organizing smallholders into groups has long been recognized as a strategy to address their structural disadvantages. Various government, private and civil society interventions have aimed to connect these farmers to input and output markets through institutional frameworks. These efforts include the formation of Commodity Interest Groups (CIGs), Self-Help Groups (SHGs) and Agricultural Cooperatives (3). However, such initiatives have had limited and regionally restricted success.

Farmer Producer Organizations (FPOs) have emerged as a transformative institutional mechanism to bridge this gap. By consolidating smallholders, FPOs enable farmers to access modern markets, benefit from collective bargaining and enhance their economic and social welfare (4). Renewed interest in FPOs from policymakers, donors and researchers highlights their potential to drive sustainable and inclusive agricultural growth (5). Integrating small-scale farmers into collectives allows them to improve productivity, secure financial benefits, and enhance their overall quality of life (6, 7). Studies have shown that membership in farmer collectives directly correlates with increased agricultural productivity and improved welfare outcomes (8).

The objective of this article is to analyze the impact of Farmer Producer Organizations (FPOs) on the economic and social welfare of their members compared to non-members, focusing on the effect of various factors on farmers' income. FPOs aim to consolidate smallholders, thereby addressing critical gaps by helping farmers access modern markets, leverage collective bargaining and enhance overall livelihoods. This study evaluates the extent to which FPOs have succeeded in achieving these objectives and explores their transformative potential for smallholder farmers, ultimately aiming to assess how FPOs can improve both the economic outcomes and social well-being of their members.

Materials and Methods

The study was conducted in the southern districts and the Cauvery Delta Zone of Tamil Nadu, specifically in Trichy, Thanjavur, Pudukkottai, Madurai and Sivagangai as shown in Fig. 1,2. The purposive sampling method was adopted for the selection of respondents. These districts were selected for their agricultural significance and the active presence of Farmer Producer Organizations (FPOs). In each district, four FPOs were purposively chosen, ensuring a diverse representation of crop and commodity focus. The selected FPOs included Mullipadi FPCL, Malaikottai Paddy FPCL, Agathiyar FPCL and Srirangam Banana FPO in Trichy; Rajarajachozhan FPCL, Orathanadu FPCL, Thirunadu CFFPCL and Kumbakonam Kalanjia Jeevidam FPCL in Thanjavur; Pudukottai Organic FPCL, Mukkanicholai Agriculture FPCL, Ambuliyaru Agriculture FPCL and Karambakudi Pasumai Agriculture FPCL in Pudukkottai; Vagai Millets FPCL, Chellampatti Jasmine & Millets FPCL, T.Vadipatti Integrated System FPCL and Usilampatti FPCL in Madurai; and Kalayarkoil FPCL, Manamadurai FPCL, Suranam Traditional Crop FPCL and Neelavaanam CFFPCL in Sivagangai. From each FPO, 20 member farmers and 10

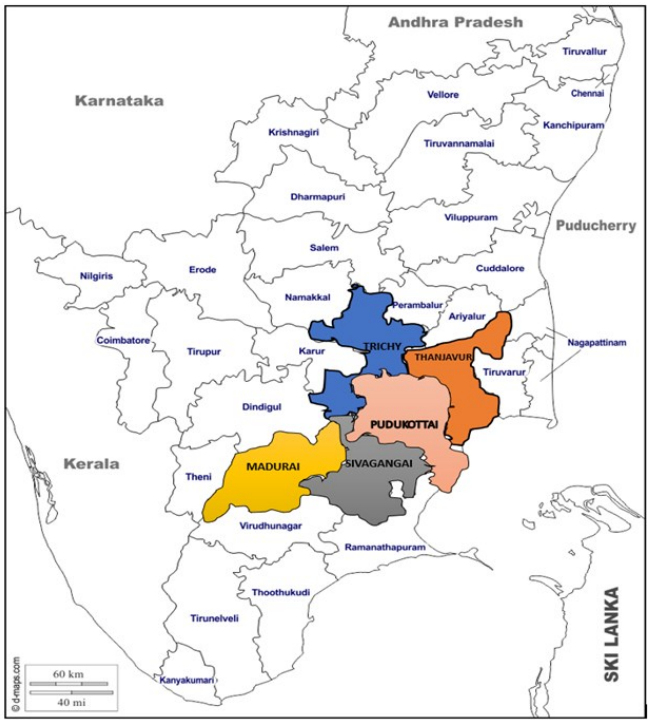

Fig. 1. Farmer Producer Organisation in the selected districts of Tamil Nadu.

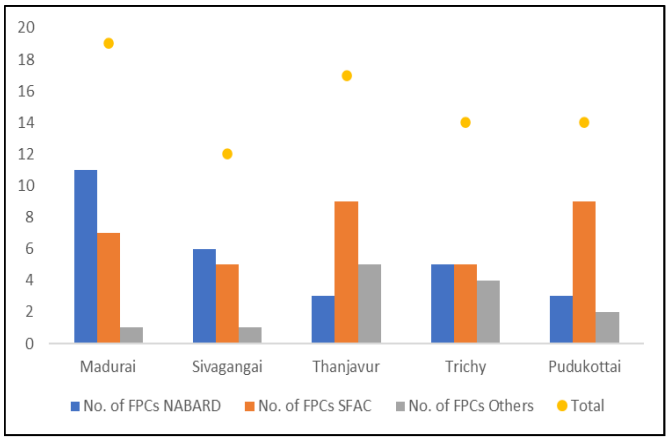

Fig. 2. No. of Farmer Producer Organisation in the selected districts of Tamil Nadu.

non-member farmers were surveyed, with non-members selected from the same geographic areas as the members. This resulted in a total sample size of 600 farmers, comprising 400 FPO members and 200 non-members. The FPO was chosen based on the authorized capital of the FPOs. Five districts were selected for the study, with four FPOs chosen in each district. To avoid selection bias, a higher number of FPO members were selected, with 20 members chosen from each FPO, while 10 non-members were selected for comparison. This approach was designed to ensure a robust sample that accurately reflects the impact of FPO membership on farmers' economic and social welfare, minimizing potential biases in the analysis. Data was collected using a structured questionnaire, focusing on socioeconomic factors, market access, production practices, income levels and the impact of FPO membership on overall welfare.

In order to avoid the selection biasedness problem of variables, the Heckman selection two state model was applied to examine the influence of factors on the income of farmers (9). The Heckman two-stage model was chosen over other methods like propensity score matching because it effectively addresses selection bias. FPO membership is influenced by factors such as farm size and education, which also affect income. The Heckman model corrects for this bias by first estimating the probability of joining the FPO (Stage 1) and then adjusting for it in the income equation (Stage 2). This provides more accurate estimates of the impact of FPO membership, while propensity score matching may not fully account for all selection factors.

In the first stage of the model, the probit model was run with the following equation:

P (0,1)=

$$\beta_0+\beta_1X_1+ \beta_2X_2+\beta_3X_3+ \beta_4X_4+ \beta_5X_5+ \beta_6X_6+\beta_7X_7+ \beta_8 X_8+ \beta_9X_9+ \beta_{10} X_{10}+ \mu_{2i}$$

Where, P(0,1) = indicating Probit estimates, β_0 = intercept, β_1 to β_{10} = slope coefficients, X_1 = gender, X_2 = education, X_3 = age of respondents, X_4 = dependency ratio, X_5 = farm size, X_6 = high yielding varieties (HYVs), X_7 = hired labour, X_8 = credit through KCC, X_9 = implements and machinery X_{10} = provision of inputs by FPO and $\mu 2_i$ =indicates the disturbance terms of model. While the model includes key variables like gender, education and credit access, omitted factors such as land quality, access to technology, market infrastructure, and social capital could also influence farmer income. Additionally, weather and climate conditions can significantly impact agricultural productivity. Including these variables would offer a more comprehensive analysis of income determinants.

$$E_i = \beta_1 + \sum \beta_2 X_{1i} + \mu_{1i}$$

Where, E_i = latent variable that indicates dichotomy (denoted by 1, otherwise 0), β_1 = intercept, β_2 = slope coefficient, X_{1i} = exogenous variables that affect the income of farmers and μ_{1i}= indicating disturbance term and μ1i ~ N (0, 1) means disturbance term is normally distrusted.

In the second stage of Heckman selection model, the ordinal least square (OLS) was run by adding the value of Inverse Mill's Ratio () as an additional exogenous variable of the model.

Y_i=

$$\delta_0+\delta_1 X_1+ \delta_2 X_2+ \delta_3 X_3+ \delta_4 X_4+\delta_5 X_5+\delta_6 X_6+\delta_7 X_7+ \delta_8 X_8+ \delta_9 X_9+ \delta_{10} X_{10}+\delta_\lambda \lambda_i+ \mu_{3i}$$

Where,

Yi = denotes income of respondents, δ_0 = intercept, δ_1 to δ_{10} = slope coefficients, X1 = gender, X2 = education, X3 = age of respondents, X4 = dependency ratio, X5 = farm size, X6 = high yielding varieties (HYVs), X7 = hired labour, X8 = credit through KCC, X9 = implements and machinery, λ_i= Inverse Mill's Ratio and μ3i = disturbance terms.

Results and Discussions

The study utilized the Heckman two-stage selection model for analysis, starting with the estimation of a probit model to identify the variables influencing farmers' income. A key assumption of the probit model is that the data must follow a normal distribution, which was validated using the Jarque -Bera (JB) normality test. The JB statistic was calculated as 7.56, which exceeded the threshold p-value of 0.05, confirming that the data were normally distributed. Additionally, the assumption of no multicollinearity, where explanatory variables should not correlate with each other or with the disturbance term (Ui), was tested using the Variance Inflation Factor (VIF). The VIF values were found to be below 10, indicating no severe multicollinearity in the dataset. The issue of selection bias was assessed using the Inverse Mills Ratio (IMR), which yielded a positive and significant value of 0.036.

The descriptive analysis highlights notable differences between member and non-member farmers under the Heckman Selection Model (n = 600). Member farmers included a higher proportion of females (37 %), showed better education levels (53 %) and were relatively younger, with an average age of 54.71 years. Although they operated smaller farms (0.22 ha), members demonstrated greater adoption of high-yielding varieties (82 %), actively participated in FPO-organized training programs (56 %) and had better access to credit through Kisan Credit Cards (54 %). They also made extensive use of agricultural

implements and machinery (67 %) and relied on inputs procured through FPOs (86 %). Member households exhibited a higher dependency ratio (0.57) and a similar reliance on hired labor (79 %) as shown in Table 1. These findings emphasize that FPO membership enhances access to education, technology, financial resources and agricultural support systems, offering significant benefits to member farmers.

The probit model analysis identifies several significant factors influencing farmers' income (n = 600). Gender positively impacted income (coefficient = 0.30, p = 0.010) with a marginal effect of -0.081, indicating variations across income levels. Education also played a significant role (coefficient = 0.08, p = 0.022) with a marginal effect of 0.098, suggesting that educated farmers have better income opportunities. Age showed a modest positive effect (coefficient = 0.02, p = 0.096, marginal effect = 0.245), while the dependency ratio significantly influenced income (coefficient = 0.45, p = 0.015, marginal effect = 0.253), reflecting efficient resource allocation in households with more dependents. Training provided by FPOs had the most substantial impact (coefficient = 0.81, p = 0.011, marginal effect = 0.332), underscoring the importance of capacity-building initiatives. The provision of inputs through FPOs significantly boosted income (coefficient = 0.17, p = 0.036, marginal effect = 0.095). In contrast, variables such as farm size, use of high-yielding varieties, hired labor and credit access through KCC showed statistically insignificant effects as depicted in Table 2. These findings emphasize the critical role of education, training and institutional support in enhancing farmers' income, with FPO interventions emerging as key drivers of improved livelihoods. Non-members typically have lower access to training and credit due to factors like lack of awareness about FPO benefits, institutional barriers where resources are prioritized for members and limited trust or financial constraints preventing them from joining. These challenges restrict their ability to access vital support, widening the gap between members and non-members.

In stage two of the Heckman selection model, the OLS estimates reveal the impact of various factors on farmers' income as shown in Table 3. A one unit increase in education reduces income by five units (coefficient = -0.05, p = 0.051), potentially reflecting contextual constraints in translating education into economic gains. The illiterate farmers were fully engaged in agricultural operations and also seeking to earn more income from agricultural activities (10). Similarly, a one unit increase in the dependency ratio decreases income by two units (coefficient = -0.02, p = 0.053), indicating the economic burden of a higher number of dependents (11). On the other hand, a one unit increase in farm size raises income by seven units (coefficient = 0.07, p = 0.012), highlighting the significant role of land availability. Training provided by FPOs leads to 19 units increase in income for everyone increase in participation (coefficient = 0.19, p = 0.017) and the provision of inputs through FPOs boosts income by units for every unit increase in access (coefficient = 0.14, p = 0.036) (12). In contrast, a one unit increase in hired labor use reduces income by 13 units (coefficient = -0.13, p = 0.051), likely due to higher labor costs. Other variables, such as gender, age, use of HYVs, credit through KCC and implements and machinery, showed no significant effects on income. The significant Inverse Mills Ratio ($\lambda = 0.11$, p = 0.036) confirms the presence of selection bias, justifying the use of the Heckman model. These results emphasize the critical roles of land, institutional

Table 1. Descriptive statistics (exogenous variables) of member farmers employed under Heckman Selection Model (n = 600)

Exogenous Variable	Definition	Members (mean)	Non members (mean)
Gender	Gender of member of households (male=1, female=0)	0.63	0.89
Education	Education of member of household (Educated=1, Uneducated=0)	0.53	0.39
Age	Age of member of households	54.71	57.82
Dependency ratio	No. of non-worker/Family size	0.57	0.32
Farm size	Land under operation by household (ha)	0.22	0.24
HYVs	Use of HYV (Yes=1, No=0)	0.82	0.73
Training by FPOs	Attended training programme organised by FPOs (Yes=1, No=0)	0.56	0.15
Hired labour	Hired labour employed under agricultural activities (Yes=1, No=0)	0.79	0.77
Credit through KCC	Suctioned loan from KCC (Yes=1, No=0)	0.54	0.46
Implements & machinery	Use of Implements and machinery in agricultural activities (Yes=1, No=0)	0.67	0.36
Provision of inputs FPOs	Procurement of inputs from FPOs (Yes=1, No=0)	0.86	0.68

Table 2. Probit model estimates of the income influencing factors (n=600)

Variables	Coefficient	SE	p-value	Marginal effect
Gender	0.30***	0.05	0.010	-0.081
Education	0.08**	0.04	0.022	0.098
Age	0.02*	0.27	0.096	0.245
Dependency ratio	0.45**	0.10	0.015	0.253
Farm size	0.23	0.36	0.109	0.336
HYVs	0.84	0.13	0.179	-0.142
Training by FPOs	0.81***	0.14	0.011	0.332
Hired labour	-0.23	0.12	0.153	-0.047
Credit through KCC	-0.09	0.14	0.125	-0.085
Implements & machinery	-0.10	0.16	0.214	0.253
Provision of inputs FPOs	0.17**	0.13	0.036	0.095
Const	0.22**	0.36	0.012	0.084

(***Source*:** Authors' calculation, ***, ** and * are indicates the level of significance at 1 %, 5 % and 10 %)

Table 3. OLS estimates of the income influencing factors (n=600)

Variables	Coefficient	SE	p-value
Gender	0.22	0.02	0.124
Education	-0.05*	0.52	0.051
Age	0.07	0.83	0.174
Dependency ratio	-0.02*	0.14	0.053
Farm size	0.07**	0.86	0.012
HYVs	0.06	0.34	0.136
Training by FPOs	0.19**	0.06	0.017
Hired labour	-0.13*	0.20	0.051
Credit through KCC	0.12	0.41	0.176
Implements & machinery	0.09	0.53	0.210
Provision of inputs FPOs	0.14**	0.61	0.036
Inverse Mills Ratio (λ)	0.11**	0.07	0.036
rho	1.79		
sigma	0.44		
lambda	0.11		

(***Source*:** Authors' calculation, ***, ** and * are indicates the level of significance at 1 %, 5 % and 10 %)

support and household dynamics in shaping farmers' economic outcomes.

Findings from the descriptive analysis, probit model and Heckman selection model underscore the significant role of education, training and institutional support in enhancing farmers' income and welfare. FPO membership, which offers access to training, technology, financial resources and agricultural support, provides clear benefits, especially in improving income. The probit model reveals that factors such as gender, education and training have a positive impact on income, highlighting the importance of capacity-building initiatives. The Heckman model further confirms that FPO training and input provision are crucial drivers of income growth, while factors like farm size also play a role. However, challenges such as high dependency ratios and reliance on hired labor negatively affect income, indicating the need for targeted interventions to address household dynamics and reduce labor costs. Given these results, policies should focus on expanding access to FPOs, strengthening training programs, improving land access and addressing household dependency issues. Additionally, enhancing infrastructure and financial services through FPOs could further empower farmers, reduce income disparities and contribute to sustainable rural development.

Conclusion

This study evaluates the impact of Farmer Producer Organizations (FPOs) on the economic and social welfare of smallholder farmers in Tamil Nadu's southern districts including Thanjavur, Trichy, Pudukottai, Madurai, Sivagangai of 600 sample farmers (FPO members -400, non-members-200). The findings underscore the transformative potential of FPOs in enhancing income levels and reducing inequalities between member and non-member farmers. Specifically, the analysis reveals that factors such as farm size, training by FPOs and the provision of inputs through FPOs significantly contribute to improved income outcomes. The result showed that FPO training leads to a 19-unit increase in income per unit of participation, while the provision of inputs boosts income by 14 units. However, constraints such as a high dependency ratio and increased use of hired labor appear to negatively impact income, highlighting areas that require further policy attention. The study suggests that targeted interventions focused on expanding FPO access, enhancing training programs and reducing dependency ratios could help maximize the benefits for smallholder farmers. Policymakers should also consider providing support to FPOs in terms of better infrastructure, financial services, and market access to strengthen their role as a critical institutional platform for smallholder empowerment. To address these barriers and increase FPO adoption, policymakers can implement targeted strategies such as providing financial incentives for farmers to join FPOs, including subsidies for membership fees or offering tax breaks for organizations that support smallholder farmers. Training programs tailored to both members and non-members can raise awareness of FPO benefits, improve agricultural practices and equip farmers with the skills to better navigate credit systems. Additionally, subsidies for essential agricultural inputs, such as seeds, equipment and technology, can make joining an FPO more attractive and economically feasible. Collaborating with NGOs can help reach marginalized communities and raise awareness about FPOs, while institutions like agricultural universities and extension services can offer technical support and capacity-building. Lastly, establishing monitoring and evaluation systems will ensure the effective implementation of these policies, track progress and help identify areas for improvement. By reducing financial, informational and institutional barriers, these strategies can scale up FPO adoption, ensuring that more farmers benefit from collective bargaining, access to markets, credit and training.

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Authors' contributions

AY designed the study framework and drafted the manuscript. AM participated in the article data collection, contributed to the analysis of the results and assisted in drafting the manuscript. RM provided insights into the Farmer producer organisation and helped with the literature review. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interest to declare.

Ethical issues: None

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