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ORIGINAL ARTICLE

How sustainable are the farmer producer companies (FPCs) in India?—Unravelling the determinants of farmers' perceptions through multivariate analyses

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Abstract

Agriculture is predominantly driven by smallholder farmers; majority are in Asian countries like China and India. Recognizing the need for commercializing smallholder farms and increasing their revenue, farmer producer companies (FPCs), a subset of farmer producer organizations, have emerged as smallholder farmers' collectives in India. Present research examined how member-farmers perceive the sustainability of FPCs and identified key factors influencing it. A random sample of the eight FPCs of varying duration and functions in the eastern Indian state of Bihar, where about 97% of farmers are smallholders, were assessed through an interview schedule survey of 320 member-farmers in terms of their demographic, economic and socio-behavioural attributes. Organizational factors, such as functional efficiency, member satisfaction, empowerment and group dynamics of the FPCs, were assessed using Likert-type scales. Sustainability of the FPCs is indexed based on members' perceptions on growth, business planning and outlook, management and governance, value and credibility, brand and

promotion and collaboration and innovation. Multivariate analyses, including multiple regression and path analysis, revealed that older and more diversified FPCs were perceived as more sustainable, with higher levels of functional efficiency, satisfaction, empowerment and group cohesion. Functional efficiency, member satisfaction and group dynamics had a direct positive impact on sustainability, whereas empowerment and progressive attitudes showed indirect effects. These findings suggest that strengthening internal dynamics and organizational performance of FPCs can enhance their sustainability and make smallholders' agricultural production system remunerative.

KEYWORDS
farmer producer companies (FPCs), farmers' satisfaction, functional efficiency, group dynamics, members' attributes, smallholders, sustainability

JEL CLASSIFICATION
D22, D63, D71, M13, M14, O13, Q13

1 | INTRODUCTION

Smallholder farms dominate global agriculture, accounting for an estimated 500 million of the world's 570 million farms. Asia is home to over 74% of these farms, with China and India accounting for 35% and 24%, respectively (Deka et al., 2020). In India, smallholders operate 86.21% of all agricultural land (GOI, 2019: Agriculture Census, 2015–16). These small farms, despite being under 2 ha in size, employ over two billion people and produce nearly 80% of the food consumed in Asia and Africa (Abraham et al., 2022; Lowder et al., 2016), playing a pivotal role in the agricultural economy and food systems of the developing world (Altieri et al., 2012; Diwakar et al., 2023). However, smallholders face numerous structural and institutional challenges, which include marginalization, imperfect access to inputs and product markets, high resource acquisition costs, low returns on produce, inadequate access to credit, technology and information, weak bargaining power and high transportation and storage costs (Abraham et al., 2022; Nikam et al., 2023; Singh, 2023; Trebbin, 2014). In response, several studies suggest collective action and aggregation could provide a solution by enabling smallholders to pool resources, enhance market access and reduce transaction costs (Abraham et al., 2022; Bizikova et al., 2020; Hu & Zhang, 2024; Mwambi et al., 2020; Markelova et al., 2009; Roy et al., 2020; Singh, 2023). Globally, different aggregation models have been implemented where smallholders jointly access credit, manage resources and engage with markets, reducing transaction costs while benefiting from economies of scale (Abraham et al., 2022; Bizikova et al., 2020; Markelova et al., 2009; Trebbin & Hassler, 2012).

In sub-Saharan Africa and India, the second wave of reforms in farmer aggregation models emerged in the early 2000s (Abraham et al., 2022). In India, the government introduced farmer producer organizations (FPOs) to empower smallholders by improving their access to markets and bargaining power (Nikam et al., 2019; Department of Agriculture and Cooperation, GOI, 2013). FPOs can be registered under various legal structures, including the Cooperative Societies Act, Autonomous or Mutually Aided Cooperative Societies Act, Multi-State Cooperative Society Act, Companies Act or Public Trusts (Singh et al., 2021). As a subset of FPOs, (farmer) producer companies (FPCs) are registered under the Companies Act, with specific provisions outlined in Part IXA of the 1956 Act, carried forward by the Companies Act, 2013 and monitored by the Registrar of Companies, not by the Registrar of Cooperative Societies (Singh, 2023). These offer a suitable framework for the producers themselves to own the company because farmers, or the producers, are its equity holders. About 84% of the FPOs are the FPCs, which distinguish themselves through professional management, profit-orientation and member-centric governance, which facilitates aggregation, value addition and better marketing of produce (Krishnan et al., 2021; Nikam et al., 2019; Singh, 2023); thus, these traits promote both efficiency of the corporate structure and alignment with cooperative values like producer ownership and engagement (Bhunia & Singh, 2025; Sharma, 2022; Singh, 2023).

The Indian government has recognized FPCs as a crucial legal-institutional innovation to address market challenges faced by small-scale farmers (Singh, 2022; Suresh & Sreejith, 2024). Yet, their performance is uneven—although some are thriving, many fade after 3–5 years once external assistance ceases (Prasad, 2021; Singh, 2022). Though external support in terms of finance and capacity-building is vital for initial success, it raises concerns over long-term sustainability (Markelova et al., 2009; Singh, 2022). Moreover, not all FPCs successfully achieve economies of scale, creating a debate about their objective of inclusivity versus competitiveness (Lutz & Tadesse, 2017; Mwambi et al., 2020). The farmers' organizations that receive assistance from the business environment remain active, whereas others experience socio-economic and political vulnerabilities and either fully shut down or become inoperative (Suresh & Sreejith, 2024). The differential performance (Bhanot et al., 2021; Manaswi et al., 2020; Mukherjee et al., 2022; Roy et al., 2020; Singh, 2023; Verma, 2020), lack of infrastructure (Deka et al., 2020), below-par financial efficiency and profitability positions (Kakati & Roy, 2019) and uneven growth and distribution of FPCs in Indian states, as well as the fact that only roughly 60% of the FPCs are operational (TCI, 2024), and bulk of the FPCs dealing with field crops and a particular activity (Nikam et al., 2023) raises the key research questions like (i) How the farmer-members perceive the sustainability of their FPCs across the developmental stages as well as product and functional diversity? (ii) What are the factors influencing FPCs' sustainability as perceived by their members?

Although prior research has examined the strengths, weaknesses and challenges faced by FPCs in India (Gorai et al., 2022; Manaswi et al., 2020; Nikam et al., 2023) and aspects like FPC effectiveness (Joshi & Choudhary, 2018; Mukherjee, 2018; Pabba & Ponnusamy, 2024), social stability (Gorai et al., 2022), financial management (Hadawale & Sinha, 2024; Kakati & Roy, 2019; Singh & Singh, 2014), performance and impact (Singh et al., 2021; Singh, 2023), fewer studies have delved into the multidimensional concept of sustainability (Suresh & Sreejith, 2024), indicating the research gap with respect to the sustainability measures of the FPCs. It is critical to be aware of sustainability issues and solutions to build functional FPCs rather than simply increasing the number of FPCs (Suresh et al., 2024). Given the reliance on governmental initiatives, financial incentives and external support, it is crucial to understand the members' perceptions on the sustainability of the FPCs beyond their initial establishment (Singh, 2022).

It is not adequately researched whether the sociodemographic variables influence the perceived sustainability of the FPCs (Suresh & Sreejith, 2024; TCI, 2024). In this backdrop, the present investigation was undertaken with the specific objectives (i) to assess the sustainability of the FPCs across their different developmental stages as perceived by their members and (ii) to reveal the demographic, economic, socio-behavioural and organizational variables influencing the FPCs' sustainability. The novelty of this study lies in visualizing FPC sustainability as a trajectory for resilient smallholder farming systems. By analysing organizational and sustainability parameters, this study adds to the literature on collective action theory. Its findings will offer evidence-based insights for policy advocacy to strengthen FPCs as viable and sustainable farmer institutions. This, in turn, will enhance smallholders' agricultural productivity and profitability, aligning with the Sustainable Development Goals (SDGs) of zero hunger and improved farm incomes.

Following this introduction, the paper presents a literature review on progress, challenges and sustainability concerns of FPCs and the research gap, followed by the theoretical structure of the study. The methodology section details the study area, sampling, data collection and analytical framework. The results and discussion cover characteristics of FPCs and their members, including demographic, economic, socio-behavioural and organizational variables, sustainability of FPCs as perceived by their members and its influencing factors. The paper concludes with the policy recommendations.

2 | LITERATURE REVIEW

2.1 | Progress of FPCs in India

The institutionalization of FPCs in India can be traced to the 2002 amendments to the Companies Act of 1956, introducing the Producer Company (PC) model—a hybrid structure combining cooperative values with corporate governance mechanisms (Krishnan et al., 2021; Singh & Singh, 2014). This policy innovation aimed to overcome the inefficiencies of traditional cooperatives and empower primary producers through legally recognized entities. However, the distribution of FPCs remains skewed towards a few agriculturally advanced states like Maharashtra, Uttar Pradesh and Madhya Pradesh (Balamatti, 2023; TCI, 2024), revealing regional disparities. Maharashtra has a dominant share largely due to the state's established history of agricultural cooperatives and marketing reforms (TCI, 2024), and many are organically evolved with farmers taking the lead and coming together (Roy et al., 2020). States like Bihar have witnessed substantial growth in FPC numbers since 2019, driven by favourable government's promotional policies and targeted financial allocations (Anand et al., 2023a; Roy et al., 2020). Although some states' (like Uttar Pradesh and Madhya Pradesh) high concentration of FPCs is due to a combination of favourable environmental conditions and innovative farmers who have been encouraged and nurtured through group efforts (TCI, 2024). This distribution may also be impacted by other variables, such as the local crop, market accessibility or export opportunities outside of those offered by FPCs (Suresh & Sreejith, 2024). The dominance of government-promoted models, reliance on external consultants for facilitation (Singh, 2022) and compliance uncertainties highlight the fragile institutional landscape in which FPCs operate (Nikam et al., 2023). The rapid expansion has not been matched by a corresponding strengthening of organizational capacity or market integration, leading to concerns about long-term sustainability.

2.2 | Successes and challenges faced by farmers' organizations

Despite the widespread evolution of farmers organizations, their success across the world has shown mixed results (Markelova et al., 2009; Poulton et al., 2010; Suresh & Sreejith, 2024). Farmer organizations globally have demonstrated varying degrees of success. Although cooperatives dominate the agricultural landscape in the EU (Bijman et al., 2014; Bijman and Iliopoulos, 2014), and producer organizations in Africa have evolved from collective bargaining towards value-addition activities (Mwambi et al., 2020), many initiatives face challenges balancing enterprise growth with democratic member participation. India is the second Asian nation to introduce PCs after Sri Lanka, where they largely failed due to lack of government support (Singh, 2016). This shift from traditional cooperatives to PCs with the government's assistance is regarded as a significant shift in India's cooperative sector (Gireesan, 2023). Nevertheless, FPCs frequently suffer from low member engagement, elite capture by large landholders (Singh et al., 2021) and gender exclusion. The overdependence on state or consultancy support often results in a hollow organizational base, where many FPCs struggle once initial handholding ceases (Singh, 2022). Moreover, studies have indicated that only 30% of FPCs are operating successfully, but 20% are still struggling to survive, and the remaining 50% are still in their initial phase of 1–3 years (Nayaji & Dixit, 2021). Financial constraints remain acute: Most FPCs have a very low paid-up capital, limiting their operational scope (Govil et al., 2020). Operational challenges, including inadequate infrastructure, poor governance practices, limited access to markets and weak inter-FPC networks (Singh & Singh, 2014), further exacerbate their vulnerabilities.

2.3 | Conceptualizing sustainability of FPCs

Sustainability in the context of FPCs extends beyond financial survival to encompass economic resilience, institutional robustness, social inclusiveness and environmental adaptability (Kumar et al., 2022; Pallavi et al., 2024; Suresh & Sreejith, 2024). Economic sustainability demands diversification of crops and revenue streams, access to value-added markets and resilient financial systems (Das & Mondal, 2021; Renuka & Singh, 2021; Singh, 2023). However, evidence suggests that many FPCs continue to focus narrowly on traditional crop trading, thereby exposing themselves to market risks (Nikam et al., 2023). Social sustainability requires fostering trust, cooperation and participatory decision-making among members (Bikkina et al., 2018; Lalitha et al., 2022). Yet, weak internal governance, inequitable benefit-sharing and low women's participation remain persistent hurdles. Infrastructure development, access to modern technology and capacity-building initiatives are vital for productivity and competitiveness (Kumar et al., 2022; Suresh & Sreejith, 2024). Institutional sustainability, linked to robust governance structures and enabling policy environments, is crucial but often overlooked. Moreover, integrating environmental stewardship into FPC strategies remains an emerging but largely neglected dimension. Thus, the sustainability of FPCs is a multifaceted endeavour, which was considered in the present study while developing an index to measure the sustainability of FPCs based on the perception of members.

2.4 | Research gap

Although substantial research highlights FPCs' role in addressing market failures and improving smallholder incomes (Bizikova et al., 2020), few studies engage critically with their long-term

sustainability. The disproportionate focus on formation metrics—number of FPCs created, members enrolled—obscures organizational health indicators such as profitability, governance quality and survival beyond donor support periods (Nikam et al., 2023; Govil et al., 2020). There is a notable lack of studies investigating organizational life cycles, transitions from grant dependency to self-sufficiency and the role of member perceptions and motivations. Addressing these gaps calls for integrating multi-method research designs, drawing from organizational theory, behavioural economics and rural sociology. Methodologically, the tendency towards quantitative assessments overlooks the subjective and relational dimensions of sustainability. A qualitative, context-sensitive exploration—capturing farmers' lived experiences and perceptions—emerges as a methodological imperative (Suresh & Sreejith, 2024).

2.5 | Theoretical underpinnings

The sustainability of FPCs must be understood through a multidimensional theoretical lens. Stakeholder Theory (Freeman, 2010) underscores the importance of inclusive engagement across diverse interest groups to build resilient and responsive organizations. Resilience theory (Holling, 1973) emphasizes adaptive capacities to external shocks, essential in volatile agrarian contexts. Field theory (Lewin, 1951) draws attention to the internal forces shaping group behaviour, whereas institutional theory (North, 1990) highlights the role of formal rules and informal norms in shaping organizational trajectories. Perception theory (Gibson, 1979) reminds that member experiences and cognitive frames significantly affect engagement, ownership and loyalty (Österberg & Nilsson, 2009).

Sustainability of FPCs is influenced by multiple demographics, economic, psychological and organizational factors. Demographic factors play a crucial role in decision-making and adaptability (Kolb, 1984; Lester et al., 2003). Economic factors, including farm income and cultivable land, determine financial stability, which enables investments in infrastructure, technology and market expansion, reinforcing sustainability (Pfeffer & Salancik, 1978). Behavioural dimensions such as trust, satisfaction and empowerment emerge as critical mediators of FPC sustainability (Dyer & Singh, 1998; Nahapiet & Ghoshal, 1998). Organizational aspects like functional efficiency, satisfaction and empowerment play a critical role in shaping participation and governance within FPCs. Functional efficiency, which includes transparency in operations, effective leadership and streamlined decision-making, enhances members' trust and long-term commitment, reducing the risks of organizational failure (Dyer & Singh, 1998). Member satisfaction, driven by equitable benefit-sharing, access to markets and institutional support, significantly influences retention and active participation, as dissatisfaction often leads to disengagement and fragmentation within the organization (Barney, 2018). Empowerment, both economic and social, strengthens members' agency in decision-making, improving collective action and fostering a sense of ownership, which aligns with the principles of participatory governance (Alsos et al., 2016). Farmers' economic motivations for continued association are relevant drivers of pro-active participation of members in FOs (Cechin et al., 2013). Thus, FPC sustainability is neither purely economic nor organizational, but a complex interaction of economic, social, psychological and institutional forces. Based on these theoretical insights, the constructs and variables adopted in the present study aim to capture a holistic understanding of FPC sustainability, ensuring conceptual rigour and field relevance. Conceptual framework of the present study is given in Figure 1.

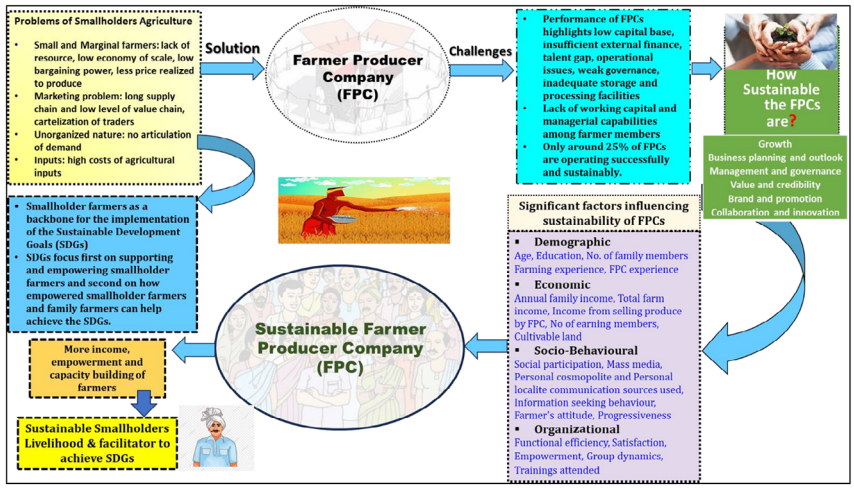

FIGURE 1 Sustainability of farmer producer company (FPC): key aspects and influencing factors. [Colour figure can be viewed at wileyonlinelibrary.com]

3 | METHODOLOGY

3.1 | Study area, sampling and data collection

The present investigation was conducted across eight FPCs in eastern Indian state of Bihar, a state with a unique agrarian structure where small and marginal farmers account for 97% of landholdings and cultivate 76% of the farmland, with an average holding of just 0.39 ha—far below the national average of 1.08 ha (Nayaji & Dixit, 2021; Roy et al., 2020). Bihar presents a critical case for FPC sustainability, having seen rapid growth in its FPC ecosystem: A total of 791 FPCs were formed between 2019 and 2022, making up 75% of the state's total 1062 registered FPCs by October 2022 (MSC, 2022). As of 2024, Bihar leads eastern India with 1731 FPOs and ranks sixth nationally (TCI, 2024). Unlike states like Maharashtra, where some FPOs emerged organically, Bihar's FPOs are largely promoted and dependent on external support for 3–5 years (Roy et al., 2020). This reliance highlights the importance of examining their sustainability, especially in regions lacking strong traditions of farmer organization.

Keeping the period of FPCs' existence in mind, the study employed stratified random sampling to classify FPCs based on the operational duration: 1–3 years, >3–6 years, >6 years and >6 years but became inoperative. This approach ensured representation across developmental stages, capturing diverse challenges and performance levels of the FPCs. Although the sample size of eight FPCs may not represent the entire FPC ecosystem, it was designed to balance depth and feasibility under resource constraints. It is often emphasized on the practicality of focused sampling in resource-limited settings, ensuring robust insights without compromising precision (Groves et al., 2009; Lohr, 2010). For the field survey, 40 farmer members were randomly selected from each of the eight FPCs, resulting in a sample of 320 farmers as the respondents representing five districts, 10 blocks and 16 villages. This sample size was sufficient to capture heterogeneity in farmers' experiences and identify patterns in FPCs' performance and sustainability. By focusing on a manageable yet diverse sample, the study provides actionable insights into viability factors, informing policies to strengthen FPCs in Bihar and in similar contexts.

3.2 | Analytical frameworks and estimation strategies

3.2.1 | Attributes of FPCs and their members

Various demographic, economic, social-behavioural and organizational variables pertaining to attributes of FPCs and their members were operationalized to assess their influence on the sustainability of FPCs. Demographic variables included age, education, family size, farming experience and duration of involvement in FPC as a member. Economic variables encompassed annual income, farm earnings, earnings from the selling of produce through FPC, earning members and cultivable land. Social and behavioural variables included social participation, communication, information-seeking behaviour, members' attitude and progressiveness. Organizational variables focused on training, functional efficiency, satisfaction, empowerment and group dynamics. The framework guided the systematic measurement of these variables to ensure clarity and consistency in data collection and analysis.

3.2.2 | Sustainability of FPCs

The sustainability of FPCs is considered a dependent variable and measured with a developed index. A sustainable organization operates efficiently over the long term, contributing to increased human productivity and influencing the endurance of the business. In the present study, sustainability of FPCs was assessed based on six dimensions, namely, (i) growth (G), (ii) business planning and outlook (BPO), (iii) management and governance (MG), (iv) value and credibility (VC), (v) brand and promotion (BP) and (vi) collaboration and innovation (CI). The FPC sustainability index (SI) is developed following stimulus response theory of scale construction and Likert's summated rating technique (1932). In the initial phase, a comprehensive literature review along with the relevant theories led to the identification of six dimensions of FPC sustainability. Under each dimension 8–12 potential statements were drafted based on criteria suggested by Edwards (1957) to assess various facets of FPC sustainability. To ensure adequacy and statement's significance, a panel of experts representing Indian Council Agricultural Research Institutes, Agricultural Universities/Colleges, Krishi Vigyan Kendras (KVKs: Farm Science Centres) and State Line Departments were consulted. Responses were obtained from the 60 such experts in an online survey where they were asked to rate each statement on a 3-point continuum, indicating the level of relevancy (3—most relevant, 2—relevant and 1—least relevant). To ensure the relevance of the statements, item analysis was performed based on the calculation of the mean relevancy score (MRS) of each statement. The statements were screened with MRS > 2.0, and thus a total of 50 statements under the six dimensions were administered to the 60 member-farmers of FPCs of non-sampling regions in Bihar, and their responses were obtained in terms of agreement on a 3-point continuum scale. To categorize the respondents based on their responses, the total summated scores of the statements for each respondent were calculated, and the respondents were ranked in descending order. The top 25% of respondents with the highest scores formed the high group, whereas the bottom 25% with the lowest scores constituted the low group. Each group comprised 15 respondents; *t*-statistics was calculated for each statement considering the mean scores of high and low groups. Thus, four to six statements with higher significant *t*-statistics under each dimension were included, with a total of 30 statements under the six dimensions of FPC SI.

Reliability and validity of the constructs were assessed using robust statistical measures (Table 1). Composite Reliability (CR) was employed to evaluate reliability, as it provides a more

TABLE 1 Reliability and validity of the dimensions of farmer producer company's (FPC's) sustainability.

Dimension of sustainability	Growth	Business planning and outlook	Management and governance	Value and credibility	Brand and promotion	Collaboration and innovation
Growth	**0.874**	0.777	0.780	0.771	0.757	0.878
Business planning and outlook		**0.909**	0.759	0.749	0.718	0.772
Management and governance			**0.873**	0.799	0.800	0.783
Value and credibility				**0.896**	0.805	0.790
Brand and promotion					**0.792**	0.750
Collaboration and innovation						**0.825**
Composite Reliability	0.941	0.959	0.941	0.953	0.908	0.895
Average variance extracted (AVE)	0.763	0.825	0.762	0.804	0.628	0.681

Note: The diagonal bold values indicate the square root of AVE.

accurate estimation than Cronbach's alpha, particularly when dealing with latent variables. For validity assessment, convergent validity was measured using the average variance extracted (AVE), which reflects the extent to which items converge to represent the underlying construct. Discriminant validity was evaluated using the Fornell–Larcker criterion (1981), based on the square root of AVE and inter-construct correlations. All constructs demonstrated excellent internal consistency, with CR values ranging from 0.895 to 0.959, exceeding the recommended threshold of 0.7. The AVE for all constructs was above 0.5, indicating adequate convergent validity.

Discriminant validity was assessed using the Fornell–Larcker criterion. The square root of the AVE for each construct was greater than its correlations with most other constructs, indicating acceptable discriminant validity. However, slight deviations were observed where the correlation between growth and collaboration and innovation (0.878) marginally exceeded the square root of AVE for growth (0.874), and the correlation between brand and promotion and value and credibility (0.805) as well as between brand and promotion and management and governance (0.800) slightly surpassed the square root of AVE for brand and promotion (0.792). Given the negligible differences and considering the inherent variability associated with real-world data collection conditions, these deviations are within an acceptable range. Similar observations have been noted in applied research, where minor discrepancies do not substantially compromise discriminant validity (Henseler et al., 2015). Furthermore, Fornell and Larcker (1981), the original proponents of this criterion, acknowledge that slight deviations can occur without undermining the overall construct validity.

The SI, comprising 30 statements under six dimensions, was perceived by the respondents on a 5-point continuum. The relative weights of each of the six dimensions were worked out following confirmatory factor analysis with the principal component analysis method. Accordingly, FPC SI values were derived by multiplying the mean value of each dimension with the corresponding weight:

$$\mathrm{SI} = \left(\sum (0.170 \times \mathrm{G}_i + 0.172 \times \mathrm{BPO}_i + 0.172 \times \mathrm{MG}_i + 0.172 \times \mathrm{VC}_i + 0.144 \times \mathrm{BP}_i + 0.170 \times \mathrm{CI}_i) / 5.0) \times 100$$

where i indicates the respondents ($i = 1,2, \ldots. n$), who responded to each statement on 5-point continuum; $G_i = \Sigma G_{ij}/\Sigma j$, j (=1,2, …) denotes growth-related statements; $\mathrm{BPO}_i = \Sigma \mathrm{BPO}_{ik}/\Sigma k$, k (=1,2, ….) denotes business planning and outlook–related statements; $\mathrm{MG}_i = \Sigma \mathrm{MG}_{il}/\Sigma l$, l (=1,2, ….) denotes management and governance–related statements; $\mathrm{VC}_i = \Sigma \mathrm{VC}_{im}/\Sigma m$, m (=1,2, ….) denotes value and credibility–related statements; $\mathrm{BP}_i = \Sigma \mathrm{BP}_{ip}/\Sigma p$, p (=1,2, ….) denotes brand and promotion–related statements; and $\mathrm{CI}_i = \Sigma \mathrm{CI}_{iq}/\Sigma q$, q (=1,2, ….) denotes coordination and innovation–related statements.

3.2.3 | Test of significance and multivariate analyses

The analysis of variance (ANOVA) is done to assess the differences in the sustainability among FPCs across three different development stages. Subsequently, on obtaining significant F statistics, post hoc test is performed to determine specific differences between FPCs at three different development stages.

The multivariate analyses are done through multiple regression analyses (stepwise method) and path analysis to delineate the differential effects of the independent variables on the sustainability of FPCs, considered dependent variable.

Multiple linear regression model followed is given below:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \epsilon$$

where Y is the dependent variable—sustainability of FPCs as perceived by their members; $X_1, X_2, \ldots, X_n$ are independent variables (predictors)—various demographic, economic, social-behavioural and organizational variables; β_0 is the intercept; $\beta_1, \beta_2, \ldots, \beta_n$ are regression coefficients; and ϵ (epsilon) is the error term.

Stepwise regression iteratively updates this equation by adding X_i variables based on statistical significance (e.g., p-value < 0.05). It is useful for building a parsimonious model by eliminating redundant or insignificant variables.

Stepwise multiple regression focuses on identifying the best subset of predictor variables for a model, whereas path analysis aims to test and visualize causal relationships between multiple variables, including total, direct, indirect and mediating effects of the independent variables on the dependent variable. Therefore, path analysis was also performed.

The path model with mediation followed these equations:

Direct effect:

$$Y = \beta_1 X + \epsilon_1 Y$$

Indirect effect through mediator (M):

$$M = \beta_2 X + \epsilon_2 M$$
$$Y = \beta_3 M + \beta_4 X + \epsilon_3$$

The path coefficient (β) quantifies the strength and direction of relationships between variables in the model, like regression coefficients.

Direct effect: β_1 (from X to Y)

Indirect effect: $\beta_2 \times \beta_3$ (via mediator M)

Total effect: Sum of direct and indirect effects

The Statistical Package for Social Science (SPSS), Version 26, was used for these analyses.

4 | RESULTS

4.1 | Features of selected FPCs

The present investigation pertains to eight randomly sampled FPCs, two each functioning for a period of 1–3 years (FPC1 and FPC2), >3–6 years (FPC3 and FPC4) and >6 years (FPC5 and FPC6), whereas two FPCs existed for >6 years but became inoperative (FPC7 and FPC8). The salient features of these FPCs are given in Table 2.

4.2 | Attributes of the FPCs' members

The demographic profile indicates that most of the members, selected as respondents in the present study, are middle-aged (mean age ranging from 37 to 48 years), have a primary to

TABLE 2 Attributes of the farmer producer companies (FPOs) selected under the study.

Characteristic	Functional for 1–3 years		Functional for >3–6 years		Functional for >6 years		Non-functional	
	FPC1	FPC2	FPC3	FPC4	FPC5	FPC6	FPC7	FPC8
Year of establishment	2021	2020	2019	2018	2016	2009	2015	2014
Head office	Saraiya, Muzaffarpur	Bareta, Darbhanga	Bareta, Darbhanga	Chiraiya, East Champaran	Laheriasaria, Darbhanga	Subhash Nagar, Purnea	Kewala, Jaynagar, Katihar	Chandawa, Rautara, Katihar
No. of members during establishment	70	190	50	97	50	500	250	100
No. of members (during study)	325	300	400	551	1500	5753	700	220
Equity (USD)	3900	3600	4800	6612	18,000	69,036	8400	2640
No. of villages covered	12	27	10	42	13	354	10	8
No. of BODs in company	5	12	7	11	8	8	6	5
Products (single /multi-commodity)	Maize	Makhana, wheat	Makhana-based product	Wheat, rice, moong	Pickles, *dal bari* (pulse chunk), *channa sattu* (pulse flour), amla candy, other value-added products	Maize, banana, poultry feed (pre starter, starter crump and grower), makhana, inputs, potato, kitchen garden inputs	Potato	Maize
Market landscape	Local and regional markets	Local and National markets	National markets	Local and regional markets	National markets and state market of Bihar	National and international market	Local market	Local market
Turnover (USD)	10,800	2400	24,000	14,400	49,200	650,400	1200*	1200**

(Continues)

TABLE 2 (Continued)

Characteristic	Functional for 1–3 years		Functional for >3–6 years		Functional for >6 years		Non-functional	
	FPC1	FPC2	FPC3	FPC4	FPC5	FPC6	FPC7	FPC8
Service provided	Supply of inputs, training of members and marketing	Supply of inputs, processing of makhana, branding, packaging and marketing	Supply of inputs and processing, value addition of makhana-based products and marketing	Having seed production technology delivery system, processing and marketing	Supply of inputs and training of members. Food processing, packaging and branding. Provides technology for value addition and marketing	Supply of inputs, regular training of members, food processing, packaging and branding, marketing through online platform	Supply of inputs and training of members	Supply of inputs and marketing

Note: 1 Indian Rupee (INR) = 0.012 United States Dollar (USD); last reported turnover on 2021* and 2020**, respectively; thereafter became inoperative.
Abbreviation: FPCs, farmer producer companies.

secondary level of education, come from medium-sized families (on average seven to eight members), and have 10–20 years of farming experience with an average duration of membership of approximately 2–9 years in their respective FPCs. The respondents include both male and female members, with the gender distribution varying across the selected FPCs. Notably, in FPCs such as FPC5 and FPC6, female respondents were predominant, highlighting significant female participation and their crucial role in FPCs.

The economic status of FPC members varies, with average annual family incomes ranging from $657 to $1067 that is largely contributed from farming and other avenues like livestock, wages as agricultural labour and so on. Income from selling farm produce through their FPCs is found meagre, varying from $10 to $115. The members of FPC2 received the average income of $10 from the sale of produce by their FPC in the first year of functioning. It is evident that the members of the FPCs (like FPC6 and FPC3) dealing with diverse produce and commercial crops like makhana and involved in processing and value addition to the produce realized relatively more income from selling of farm produce by their FPCs, albeit contributing only 8%–12% of their income from farming. The average cultivable landholding of the respondents varied from 1.24 to 2.06 ac, thus marginal farmers (<1 ha land) with mostly two earning members in their family of seven to eight members.

Socio-behavioural attributes of the FPCs' members are realized through their social participation, communication, information-seeking behaviour, attitude and progressiveness. Most respondents participated in social organization(s), mostly as a member, exhibiting a medium level of social participation with mean scores varying between 0.75 and 1.05, except for non-functioning FPCs, where social participation was low. The utilization of mass media sources of communication is widespread among the members of all FPCs availing those often; however, there are variations in the average number of sources utilized and the mean utilization score varied from 2.51 to 3.42 out of 4.0, thus at a medium-to-high level. Member-farmers of FPCs are found to be active in contacting extension personnel and utilizing cosmopolitan channels, albeit less than the mass media except in the case of FPC4 and FPC8. However, the FPC members have mostly relied on localized and personal contact channels. Overall communication profile, which encompasses all communication sources, differs across the sources and FPCs with high to very high mean values of utilization (Table 3). According to the information-seeking behaviour, the members of FPC6 showed a strong information-seeking culture with highest mean score (2.75 out of 3.0), whereas the members of other functional FPCs also showed a higher score. However, the members of long-established but non-functional FPCs showed the lower information-seeking behaviour. The member-farmers' favourable attitude towards their FPCs is evident from the higher scores that showed an increase over the duration of FPCs' existence and functioning. Farmers' attitude towards the inoperative FPCs is found at an average level, which warrants a positive change to restore the functioning of these FPCs. The members of all functional FPCs exhibit a high level of progressiveness. Overall socio-behavioural profile of the members, studied based on various parameters, reveals a better position of the FPC6, FPC5 and FPC3, garnering relatively higher overall mean scores, indicating positive behaviour among their members (Table 3).

4.3 | Organizational performance of the FPCs

The organizational performance of the FPCs was studied based on the efficiency in their functioning as perceived by their members, the satisfaction of the members in fulfilling their needs

TABLE 3 Demographic, economic, socio-behavioural and organizational attributes.

Sl. no.	Variables	Operationalized description	Measurement unit	Mean (standard deviation) (n = 40 in each FPC)							
A. Demographic variables				**FPC1**	**FPC2**	**FPC3**	**FPC4**	**FPC5**	**FPC6**	**FPC7**	**FPC8**
1	Age	The time that a person has spent in his/her life	Years	48 (8.52)	42 (7.65)	37 (9.52)	46 (8.25)	43 (6.56)	46 (9.82)	44 (10.25)	45 (12.50
2	Education	Duration of formal education	Years	12.68 (3.50)	3.63 (1.95)	7.88 (3.55)	6.08 (3.45)	9.10 (4.62)	8.58 (4.25)	12.63 (2.75)	5.65 (2.25)
3	No. of family members	Number of persons in the family	Number	6.76 (3.42)	7.22 (3.05)	7.80 (3.49)	9.35 (4.43)	7.82 (3.23)	8.47 (3.75)	7.10 (3.31)	10.72 (4.73)
4	Farming experience	Duration of engaging in farming activities	Years	14.02 (9.04)	12.74 (4.10)	9.85 (5.10)	20.27 (10.83)	13.35 (2.38)	16.30 (3.8)	18.01 (9.9)	20.84 (11.70)
5	FPC experience	Duration of involvement as a member in FPC	Years	1.94 (0.73)	2.05 (0.71)	3.57 (0.50)	3.05 (0.84)	6.00 (1.00)	8.9 (3.5)	4.45 (0.50)	4.52 (0.50)
B. Economic variables											
6	Annual family income	The total amount of money earned each year	USD (1 INR = 0.012 USD)	$714 (120)	$826 (194)	$1031 (292)	$953 (115)	$657 (96)	$1067 (235)	$772 (124)	$704 (184)
7	Total farm income	The total amount of money earned each year from farming	USD	$645 (165)	$617 (206)	$826 (280)	$770 (98)	$546 (88)	$972 (157)	$570 (158)	$654 (124)
8	Income from selling produce by FPC	The total amount of income from the selling of farm produce by FPC	USD	$32 (8.00)	$10 (3.45)	$64 (6.55)	$26 (6.60)	$33 (4.45)	$115 (9.20)	–	–
9	No. of earning members	Number of persons in family who earn an income	Number	3 (1.14)	2 (1.13)	2 (0.95)	3 (1.31)	2 (1.31)	2 (0.99)	2 (1.51)	2 (1.32)
10	Cultivable land	Land that can be used to grow crops by a member	Acres (1 ha = 2.5 ac)	1.29 (0.31)	1.49 (0.21)	1.59 (0.73)	1.37 (0.9)	1.24 (0.62)	2.06 (0.56)	1.40 (0.73)	1.60 (1.27)
C. Socio-behavioural variables											
11	Social participation	The extent of members' participation in any formal/informal social organization	A score of 2 and 1 is given in the case of an office bearer and member in an organization; 0 for non-members	0.75 (0.25)	1.00 (0.05)	0.95 (0.08)	1.05 (0.10)	0.98 (0.08)	0.98 (0.09)	0.38 (0.20)	0.28 (0.15)

(Continues)

TABLE 3 (Continued)

C. Socio-behavioural variables											
12	Mass media communication sources used	Extent to which the member uses different mass media sources (television, radio, newspaper, magazine, ICTs, mobile apps)	Scores of 4, 3, 2 and 1 are assigned for use of each source most often, often, sometimes and rarely, respectively	3.22 (0.45)	3.42 (0.40)	3.21 (0.25)	2.51 (1.37)	2.94 (0.3)	3.27 (0.2)	3.07 (0.31)	2.57 (01.48)
13	Personal cosmopolite communication sources used	Extent to which FPC's members use personal cosmopolite communication sources (village-level worker, assistant director of agriculture, block-level officials, subject matter specialists of KVK, officials of NABARD, SFAC, NGO)	Same as above	2.99 (0.35)	2.88 (0.24)	2.86 (0.35)	3.03 (0.26)	2.82 (0.10)	2.99 (0.21)	2.42 (0.30)	3.01 (0.31)
14	Personal localite communication sources used	Extent to which FPC's members use personal localite communication sources (neighbours, friends, relatives, village-level leaders)	Same as above	3.17 (0.59)	3.55 (0.24)	3.44 (0.21)	3.28 (0.39)	3.42 (0.37)	3.36 (0.10)	3.37 (0.25)	3.25 (0.42)
15	Information-seeking behaviour	Exposure of FPC's members to the informal and formal information sources. An interview schedule comprising eight relevant statements was used to measure it (Anand & Ghosh, 2023)	Responses obtained on 3-point continuum (3-always, 2-sometimes, 1-rarely)	2.49 (0.25)	2.53 (0.21)	2.55 (0.18)	2.53 (0.20)	2.56 (0.16)	2.75 (0.17)	2.15 (0.28)	2.03 (0.37)
16	Farmer's attitude	FPC members' attitude towards their organization on various aspects. It is measured with an attitude scale comprising 12 statements (Mukherjee, 2018)	Responses obtained on a 5-point continuum. The Likert scale ranges from 5 (very high) to 1 (very low)	4.44 (0.25)	4.45 (0.21)	4.51 (0.18)	4.47 (0.20)	4.75 (0.16)	4.82 (0.17)	2.09 (0.28)	1.96 (0.37)

(Continues)

TABLE 3 (Continued)

C. Socio-behavioural variables											
17	Progressiveness	FPC member's thinking and progressive nature is considered. A scale consisting of 10 statements was used for measurement (Mukherjee, 2018)	Same as above measurement	4.30 (0.27)	4.33 (0.16)	4.40 (0.14)	4.32 (0.31)	4.60 (0.18)	4.74 (0.16)	2.85 (0.50)	2.79 (0.61)
D. Organizational variables											
18	Functional efficiency	Functional efficiency is referred to as the ability of FPCs to operate smoothly and achieve their objectives. It is measured on 10 indicators; 4–5 statements under each (Mukherjee, 2018)	Same as above	3.62 (0.14)	3.71 (0.10)	4.41 (0.08)	3.76 (0.09)	4.00 (0.13)	4.08 (0.03)	1.77 (0.40)	1.34 (0.28)
19	Satisfaction	FPC's member's fulfilment of needs and aspirations, which is measured on 15 statements (Mukherjee, 2018)	Same as above	3.97 (0.30)	4.23 (0.21)	3.99 (0.18)	4.51 (0.29)	4.73 (0.19)	4.91 (0.11)	1.32 (0.20)	1.30 (0.18)
20	Empowerment	Refers to various dimensions of socio-economic development and community engagement of the members, which is measured on 14 statements following a scale (Mukherjee, 2018)	Same as above	4.06 (0.33)	4.06 (0.29)	4.41 (0.22)	4.38 (0.21)	4.57 (0.6)	4.84 (0.14)	1.29 (0.16)	1.22 (0.17)
21	Group dynamics	Group dynamics of the FPCs is determined through 10 indicators and 4–5 statements under each (Anand, 2024)	Same as above	3.43 (0.19)	3.52 (0.16)	3.53 (0.13)	3.40 (0.11)	3.71 (0.12)	3.76 (0.09)	2.64 (0.15)	2.49 (0.13)
22	Trainings attended	No. of trainings facilitated by FPC that were attended by their members annually	Average no. of trainings by members	2 (0.50)	2 (0.50)	2 (1.06)	1 (0.45)	3 (0.80)	4 (0.95)	–	–

Abbreviations: FPCs, farmer producer companies; KVK, Krishi Vigyan Kendra.

and aspirations by the FPCs, the empowerment of being members of the FPCs, the dynamics of the FPC as a group and the capacity building of the members through training (Table 3). The functional efficiency, representing the ability of FPCs to operate smoothly and achieve their objectives, shows FPC3 as the top performer, followed closely by FPC6 and FPC5 with a mean perception score of more than 4.0 out of 5.0. However, farmers' satisfaction shows a better position of the FPC6, FPC5 and FPC4, achieving mean satisfaction scores greater than 4.50 on a 5-point continuum. These FPCs excel in delivering quality inputs and services, ensuring timeliness and fostering value addition and marketing opportunities, thereby enhancing overall member satisfaction. Empowerment of the members, encompassing various dimensions of socio-economic development and community engagement, is a key determinant of an organization. It shows an increasing trend over the duration of FPCs' functioning; however, it is found to be poor in the case of inoperative FPCs (FPC7 and FPC8) even after their existence for 8–9 years, and they stopped functioning since 2021 and 2020, respectively. The members of the FPC6 and FPC5 perceived that their involvement as members has effectively enhanced their social status, income, leadership capacity and community engagement. The group dynamics are varied across the FPCs (Table 3). The FPC6 emerged at the top in overall group dynamics (mean score 3.76 out of 5.0), indicating relatively positive perceptions of its members across various domains, closely followed by the FPC5. For the rest of the functional FPCs, the mean group dynamics score varied from 3.40 to 3.53; conversely, non-functional FPCs demonstrated an average level of dynamism, suggesting areas for improvement in group dynamics and member satisfaction. FPCs played an important role in developing the capacities of their members as their members have attended, on average, one to four trainings annually during the past 3 years.

4.4 | Sustainability of FPCs and its domains

The assessment of sustainability of selected FPCs reveals significant disparities across different dimensions, with FPC6, FPC5, FPC3, FPC2, FPC4 and FPC1 found in decreasing order with respect to the overall sustainability as perceived by their members (Table 4). These functional FPCs demonstrate strong performance across multiple dimensions, including growth, business planning and outlook, management and governance, value and credibility, brand and promotion as well as collaboration and innovation. These FPCs exhibit robust growth trajectories, proactive business planning, effective management practices, strong brand presence and a culture of collaboration and innovation. As a result, they achieve high sustainability scores and index percentages, reflecting their comprehensive approach towards fostering sustainable agricultural practices and enhancing member-farmer livelihoods. FPC6 and FPC5 stand out for their exceptional performance in sustainability, with both FPCs scoring notably high across all dimensions. Their emphasis on strategic planning, effective governance, brand building and fostering collaborative partnerships contributes significantly to their overall sustainability and underscores their commitment to long-term growth and prosperity.

On the other hand, FPC7 and FPC8 face challenges in achieving sustainability, as indicated by their lower scores across various dimensions, and became non-functional after 6 years of their existence. These FPCs may need to reassess their strategies and strengthen their focus on areas such as business planning, governance, brand building and collaboration to enhance their sustainability and competitiveness in the agricultural landscape.

TABLE 4 Sustainability of the farmer producer companies (FPCs) as perceived by the respondent-members of the selected FPCs.

Dimensions	Weight	Weighted mean score ($n = 40$ in each FPC)							
		Functional for 1–3 years		Functional for >3–6 years		Functional for >6 years		Non-functional	
		FPC1	FPC2	FPC3	FPC4	FPC5	FPC6	FPC7	FPC8
1. Growth	0.170	0.73	0.73	0.78	0.77	0.82	0.84	0.29	0.26
2. Business planning and outlook	0.172	0.72	0.75	0.79	0.74	0.82	0.84	0.25	0.22
3. Management and governance	0.172	0.80	0.78	0.80	0.74	0.82	0.84	0.21	0.22
4. Value and credibility	0.172	0.77	0.79	0.80	0.74	0.85	0.85	0.22	0.21
5. Brand and promotion	0.144	0.24	0.63	0.66	0.37	0.67	0.70	0.18	0.18
6. Collaboration and innovation	0.170	0.73	0.75	0.77	0.79	0.80	0.82	0.21	0.25
Overall sustainability mean score		3.99	4.43	4.61	4.15	4.77	4.88	1.36	1.35
Overall FPC sustainability index (%)		79.73	88.59	92.19	82.99	95.43	97.70	27.17	26.90

TABLE 5 Analysis of variance (ANOVA) and post hoc test indicating significant differences in sustainability of the farmer producer companies (FPCs) across their growth stages.

ANOVA					
Sustainability	**Sum of squares**	**df**	**Mean square**	***F***	**Sig.**
Between groups	594.957	3	198.319	3597.459	0.000
Within groups	17.420	316	0.055		
Total	612.378	319			

Post hoc						
(I) FPC experience	**(J) FPC experience**	**Mean difference (I − J)**	**Std. error**	**Sig.**	**95% confidence interval**	
					Lower bound	**Upper bound**
1–3 years	>3–6 years	−0.16925*	0.03712	0.000	−0.2651	−0.0734
1–3 years	>6 years	−0.63450*	0.03712	0.000	−0.7304	−0.5386
1–3 years	Non-functional	2.83500*	0.03712	0.000	2.7391	2.9309
>3–6 years	>6 years	−0.46525*	0.03712	0.000	−0.5611	−0.3694
>3–6 years	Non-functional	3.00425*	0.03712	0.000	2.9084	3.1001
>6 years	Non-functional	3.46950*	0.03712	0.000	3.3736	3.5654

*The mean difference is significant at the 0.05 level.

4.5 | Tests of significance of differential sustainability of the selected FPCs

The ANOVA conducted to examine the differences in sustainability among FPCs across various growth stages yielded highly significant results, with a substantial *F*-value of 3597.459 ($p < 0.001$) (Table 5). This indicates statistically significant differences in sustainability among FPCs at different stages of their growth.

Post hoc tests are subsequently conducted to identify specific differences between FPCs at distinct growth stages. When comparing FPCs with 1–3 years of experience to those with over 6 years, a significant mean difference of −0.63450 ($p < 0.001$) was observed, indicating that longer established FPCs tended to have higher perceptions of sustainability compared to newer ones. Similarly, FPCs with 1–3 years of experience showed significant mean differences when compared to non-functional FPCs, with a higher perception of sustainability (mean difference = 2.83500, $p < 0.001$). Moreover, comparing FPCs with 3–6 years of experience to those with over 6 years revealed a significant mean difference of −0.46525 ($p < 0.001$), indicating that the latter group had higher perceptions of sustainability. Additionally, FPCs with 3–6 years of experience also showed significant differences compared to non-functional FPCs, with higher perceptions of sustainability (mean difference = 3.00425, $p < 0.001$). Furthermore, FPCs with over 6 years of experience exhibited significant differences compared to non-functional FPCs, with a higher perception of sustainability (mean difference = 3.46950, $p < 0.001$). Thus, the post hoc test results underscore significant variations in perceptions of sustainability across different growth stages of FPCs. Although longer established FPCs tend to perceive sustainability more positively compared to newer ones, non-functional FPCs also show distinct differences in sustainability perceptions. These findings highlight the importance of considering the developmental stages of FPCs when evaluating and enhancing sustainability within these organizations as depicted in Table 5. Findings of the study highlighted the multi-faceted nature of sustainability in the context of FPCs, encompassing dimensions such as growth, governance, branding and collaboration. FPCs that

TABLE 6 Multiple regression (stepwise) between perceived sustainability of farmer producer companies (FPCs) and demographic, economic, socio-behavioural and organizational variables.

Model summary (stepwise forward selection)

Model	Predictors	*R*	*R* square	Adjusted *R* square	Std. error of the estimate
1	A	0.619	0.383	0.380	15.416
2	a, b	0.746	0.557	0.553	13.083
3	a, b, c	0.785	0.616	0.611	12.204
4	a, b, c, d	0.796	0.634	0.628	11.945
5	a, b, c, d, e	0.806	0.650	0.642	11.706
6	a, b, c, d, e, f	0.812	0.660	0.651	11.571
7	a, b, c, d, e, f, g	0.817	0.668	0.657	11.465
8	a, b, c, d, e, f, g, h	0.821	0.674	0.662	11.378

Coefficients

Model	Predictors	Unstandardized coefficients		Standardized Coefficients	*t*	Sig.
		B	Std. Error	Beta		
8	(Constant)	27.006	3.907		6.912	0.000
	a. Group dynamics	0.221	0.051	0.224	4.305	0.000
	b. Functional efficiency	0.346	0.037	0.405	9.395	0.000
	c. Member-farmers' satisfaction	0.136	0.040	0.193	3.398	0.001
	d. Farming experience	−0.151	0.046	−0.133	−3.295	0.001
	e. FPC experience	0.145	0.051	0.143	2.834	0.005
	f. Social participation	0.129	0.048	0.113	2.659	0.008
	g. Member-farmers' attitude	0.095	0.044	0.102	2.164	0.032
	h. Annual family income	−0.116	0.055	−0.082	−2.092	0.038

excel in these areas are better positioned to achieve long-term sustainability, drive agricultural development and improve the livelihoods of member-farmers.

4.6 | Determinants of FPC sustainability

The determinants of sustainability of the FPCs as perceived by their members were revealed through multivariate analyses like stepwise multiple regression and path analysis: the effects of demographic, economic, socio-behavioural and organizational variables (considered independent variables) on the perceived sustainability of FPCs by their members (dependent variable).

Stepwise regression iteratively examined the statistical significance of each independent variable in a linear regression model. The forward selection approach started with nothing and added each new variable incrementally, testing for statistical significance. Thus, the results of stepwise regression analysis identified the factors influencing the sustainability of the FPCs (Table 6). The model summary of stepwise (forward selection) reveals information on the performance of each step in the stepwise regression process. A total of eight models were generated over eight steps with the incremental addition of one variable in each step. In the final step (eighth step), the model has an *R*-value of 0.821, indicating a strong positive relationship between the eight independent

TABLE 7 Path analysis between perceived sustainability of farmer producer companies (FPCs) and demographic, economic, socio-behavioural and organizational variables.

Independent variables	Total effect	Direct effect	Indirect effect	Highest mediating effect
Age (×1)	−0.109	−0.029	−0.080	−0.062 (×19)
Education (×2)	−0.121	−0.057	−0.064	−0.027(×20)
No of family members (×3)	0.025	−0.045	0.070	0.023 (×20)
Farming experience (×4)	−0.172	−0.078	−0.094	−0.065(×19)
FPC experience (×5)	0.474	0.076	0.398	0.105 (×22)
Trainings attended (×6)	0.386	0.097	0.289	0.081 (×19)
Annual family income (×7)	−0.140	−0.132	−0.008	0.047 (×11)
Total farm income (×8)	−0.133	0.022	−0.155	−0.099 (×7)
No of earning members (×9)	−0.251	−0.071	−0.180	−0.086 (×19)
Cultivable land (×10)	−0.143	−0.063	−0.080	−0.036(×19)
Income from FPC (×11)	0.074	0.087	−0.013	0.075 (×19)
Social participation (×12)	0.385	0.079	0.306	0.081 (×19)
Mass media sources used (×13)	0.081	0.026	0.055	0.027 (×4)
Personal cosmopolite sources used (×14)	−0.080	−0.006	−0.074	−0.043 (×19)
Personal localite sources used (×15)	0.153	0.067	0.086	0.028 (×19)
Information seeking behaviour (×16)	0.298	0.051	0.247	0.061 (×22)
Member-farmers' attitude (×17)	0.488	0.061	0.427	0.105 (×22)
Progressiveness (×18)	0.495	0.087	0.408	0.099 (×22)
Functional efficiency (×19)	0.585	0.325	0.260	0.065 (×22)
Member-farmers' satisfaction (×20)	0.530	0.170	0.361	0.125 (×22)
Member-farmers' empowerment (×21)	0.475	0.028	0.447	0.145 (×19)
Group dynamics (×22)	0.619	0.214	0.405	0.099 (×20)
Residual 0.298				

variables and perceived sustainability of the FPCs. The *R* square value of 0.674 suggests that the independent variables like group dynamics, functional efficiency, members' satisfaction, farming experience, FPC experience, social participation, members' attitude and annual family income account for 67.4% of the variation in FPC sustainability. Among these variables, group dynamics, followed by functional efficiency, determine most of the variation in perceived sustainability of the FPCs by their members, and together they explain more than 55% of the variation. Other variables positively influencing the FPC sustainability, are members' satisfaction, FPC experience and social participation. Conversely, annual family income and farming experience have a negative relationship with perceived sustainability of FPC, as indicated by its negative coefficient and beta value that may be attributed to the fact that the relatively richer and older farmers had an unfavourable perception on their FPC sustainability.

Stepwise regression models have revealed the significant variables based on their incremental direct effects on perceived sustainability of the FPCs. However, to understand the total, direct, indirect and mediating effects of the demographic, economic, socio-behavioural and organizational variables (22 exogenous variables) on the perceived sustainability of the FPCs, the path analysis was done (Table 7). It is evident that functional efficiency had highest direct effect (0.325),

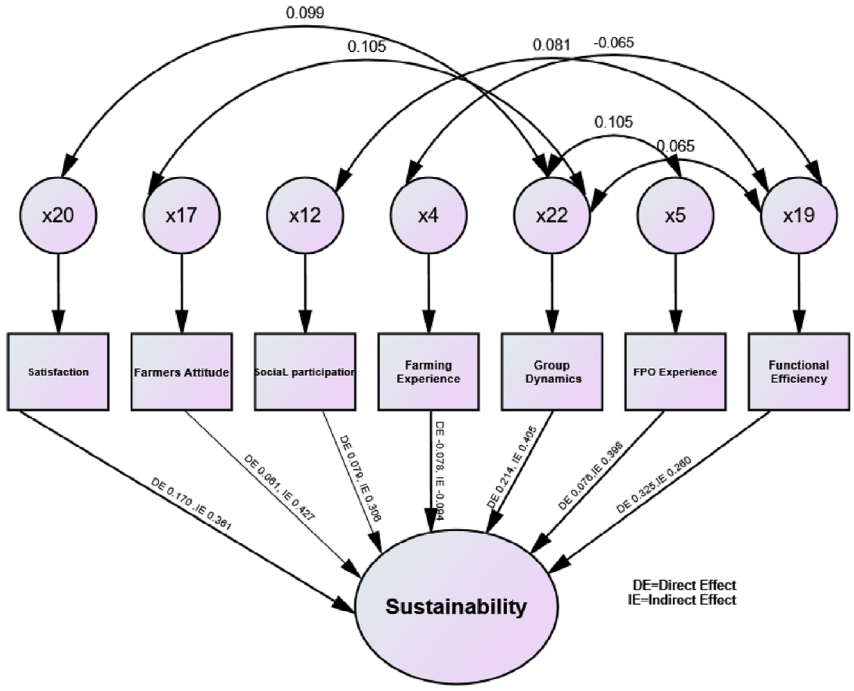

FIGURE 2 Path diagram between attributes of farmer producer company's (FPCs') members and their perceived sustainability. [Colour figure can be viewed at wileyonlinelibrary.com]

followed by group dynamics (0.214) and members' satisfaction (0.170). However, highest indirect effect is found for members' empowerment (0.447), members' attitude (0.427), progressiveness (0.408) and group dynamics (0.405). Moreover, while considering highest mediating indirect effect, functional efficiency had a mediating effect on the maximum number of variables, followed by group dynamics (Figure 2). The residual effect in this path analysis was recorded as 0.298, which indicates 22 independent variables together determined about 70% of FPCs' sustainability as perceived by their members.

Regression analyses underscore functional efficiency, group dynamics and members' satisfaction as significant predictors of the FPC sustainability, indicating their pivotal roles in fostering sustainable practices and outcomes within FPCs. Path analysis delves deeper, uncovering indirect pathways through which factors like members' empowerment, attitude and progressiveness may have an intricate interplay of factors shaping sustainability outcomes. To ensure the sustainability of FPCs, it is essential to focus on internal dynamics, operational efficiency, innovations resulting in members' satisfaction, positive mindsets, abilities and forward-thinking of the member-farmers. By addressing these factors, FPCs can enhance their sustainability metrics and support commercialization, ultimately fostering resilience and long-term viability in smallholder agricultural communities.

5 | DISCUSSION

The FPC ecosystem in eastern Indian state of Bihar has grown rapidly during the period 2019–2022 (MSC, 2022); mostly, the FPCs are promoted, not organically evolved (Roy et al., 2020). Thus, FPCs' dependency on promoting agencies raises the question of their sustainability (Markelova

et al., 2009) beyond the 3- to 5-year support period. The present case study of eight FPCs at their different developmental stages presents the current landscapes of the FPCs being promoted to address the challenges faced by the smallholders in their farming. Like the findings of the present study, the small size of membership in FPCs in another eastern Indian state, West Bengal, has also hindered the equity size, leading to low working capital and weaker market linkages (Singh, 2023). Persistent issues such as limited paid-up capital and small memberships hamper viability (Nikam et al., 2023). Furthermore, even larger memberships, if inactive, can undermine collective action (Mwambi et al., 2020; Roy et al., 2020). Financial sustainability remains a significant concern, with low average turnovers observed across FPCs.

Demographically, most FPC members are middle-aged farmers with limited formal education but substantial farming experience (10–20 years). This suggests that practical knowledge and skills are more critical than formal education for FPC success (Mukherjee, 2018). The majority are marginal farmers (<0.5 ha) with annual family incomes ranging from $700 to $1000, and FPCs currently contribute only modestly to their incomes. Weak market linkages limit members' participation, as many prefer not to market their produce through FPCs due to limited opportunities and poor price realization (Singh, 2022). Strengthening these linkages is crucial for enhancing member engagement and improving income outcomes. If the price realization from marketing of the produce is to be improved, the product differentiation requires to be focused by the FPCs (Verma, 2020). Information exchange predominantly occurs through local networks rather than formal extension systems, a pattern associated with lower-performing FPCs (Gorai et al., 2022). Conversely, FPCs with longer operational histories exhibit greater member progressiveness, stronger information-seeking behaviours and higher openness to innovation (Anand et al., 2023b; Schumpeter, 2013). An optimistic and supportive attitude among members towards FPCs has the potential to enhance the full capabilities of FPCs, and the progressiveness of members contributes to the increased adoption of the innovations by the farmers (Anand & Ghosh, 2023; Singh et al., 2021). Organizational strength—reflected in group dynamics, functional efficiency and empowerment—plays a decisive role in FPC performance. Capacity building through need-based training and fostering inclusive participation emerge as critical drivers for sustainable FPC development (Akbari et al., 2023; Simpson, 2010).

Members' perception on the sustainability of their FPCs is influenced not by the developmental stages of the FPCs, but by critical organizational attributes such as growth, governance quality, business planning, branding, innovation and collaboration. Some older FPCs studied became non-functional due to the lack of these attributes and insufficient support beyond the initial phases (Singh, 2022). The study indicates that perceived sustainability is largely explained (67%) by eight attributes, with group dynamics, functional efficiency and member satisfaction contributing around 62%. These findings highlight the pivotal role of strong internal organizational processes and active member participation (Kumar et al., 2022; Silva et al., 2024). Similarly, functional efficiency is paramount for optimizing resources and improving operational workflows, which aligns with classical management theories emphasizing efficiency and productivity (Taylor, 1911). A positive correlation exists between robust organizational governance, management systems and the functional efficiency of organizations (Ragasa & Golan, 2012). Membership commitment exhibits a strong and positive correlation with performance (Mwambi et al., 2020; Singh, 2023).

A conducive environment for the development of FPCs is important as it encourages the promotion of FPCs, addresses financial needs, removes constraints, offers vital infrastructure and actively raises awareness among farmers (Chakraborty, 2020). Key challenges to sustainability include leadership gaps, limited financial resources, poor infrastructure and inadequate marketing capabilities (Suresh & Sreejith, 2024). Conversely, enablers include strong capacity-building programs, branding initiatives, market intelligence and innovative governance mechanisms.

The results of present study align with established sustainability theories, including the triple bottom line framework (Elkington & Rowlands, 1999) emphasizing economic, social and environmental integration, and the resource-based view (Barney, 2018), which highlights internal capabilities as sources of sustainable competitive advantage. The relevance of social capital in sustaining farmer collectives is reaffirmed (Pretty & Ward, 2001). Strengthened internal governance, enhanced market connections and sustained innovation can position FPCs as key contributors to the SDGs, particularly SDG-2: Zero Hunger, by fostering resilient, remunerative smallholder agriculture (Bhunia & Singh, 2025).

6 | CONCLUSIONS

This study provides an in-depth understanding of the dynamics, performance and sustainability of FPCs as perceived by their members in an eastern Indian state, characterized by smallholder dominance and recent expansion in the number of FPCs. While certain FPCs have demonstrated robust growth—achieving financial viability, increased membership and stronger market linkages—others have struggled with stagnation or eventual dormancy. Notably, FPCs engaged in value addition and branding activities have reported higher turnover and broader market outreach. Challenges such as limited financial capital, inadequate market access and insufficient managerial skills have hindered the growth of less successful FPCs. These findings point to the critical need for strategic interventions aimed at strengthening business planning, enhancing market integration and building internal capacities. The analysis further reveals that while FPC membership provides smallholders—most of whom possess marginal landholdings (<1 ha) and limited formal education—with improved access to services and markets, the direct economic benefits remain modest for many. The findings emphasize the multi-dimensional nature of FPC sustainability, highlighting that longevity alone does not guarantee success. Instead, the performance of FPCs is shaped by organizational attributes such as functional efficiency, group dynamics, member satisfaction, business planning and branding. The analysis reveals that well-functioning FPCs demonstrate high scores across these dimensions, whereas long-established but inactive FPCs fail to sustain due to gaps in governance, planning and market linkages. The disparity in performance between active and non-functional FPCs also suggests that continuous monitoring, governance reforms and member engagement strategies are essential to prevent stagnation and closure.

The perceived sustainability of FPCs by their members is a multidimensional issue, shaped by demographic, socio-behavioural, economic and governance-related factors, with group dynamics, functional efficiency and member satisfaction as the most critical predictors. The present findings also reinforce the role of internal cohesion, empowerment and progressive attitudes in shaping sustainable organizational outcomes. These insights reinforce the broader developmental role that FPCs can play in transforming smallholders' agriculture.

7 | POLICY RECOMMENDATIONS

In light of the study's findings, the following focused policy measures are recommended:

1. Policies must distinguish the needs of FPCs at different growth stages. Early-stage FPCs require incubation, capacity-building and seed capital, whereas mature FPCs benefit from market integration, strategic investment and innovation incentives.

2. Internal governance and group dynamics of the FPCs need to be strengthened by encouraging democratic participation, leadership training and conflict resolution mechanisms. This will improve group cohesion and collective decision-making.
3. FPCs are to be supported to move beyond primary production into value-added processing, branding and niche marketing, improving income generation and resilience.
4. Establishing continuous monitoring and evaluation systems with performance benchmarks that reflect sustainability metrics will help identify and address weaknesses proactively. Involvement of members in this process will capture farmers' practical experience on sustainability parameters.
5. Implementation of the behaviour change communication and training programs that promote progressive attitudes, innovation adoption and leadership skills among FPC members will help in sustainable performance of the FPCs.
6. Promoting agencies must develop structured withdrawal strategies and sustainability handover plans to ensure that FPCs continue functioning after the initial support period.
7. FPCs should be seen as vehicles for inclusive growth and rural transformation by the policymakers and planners.

By adopting these measures, policymakers and stakeholders can enable FPCs to evolve into robust institutions that support the commercialization of smallholder agriculture, enhance rural incomes and contribute to a more resilient and sustainable agri-food system.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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