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ENHANCING MARKET ACCESS AND VALUE REALIZATION THROUGH AGRI-STARTUPS AND FARMER PRODUCER ORGANIZATIONS

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Abstract

The agricultural sector of India, which provides about 46.1 percent of the national working population and almost 16 percent of the GDP, is still characterized by small and marginal farmers which occupy 86.1 percent of the total operated holdings. These farmers experience chronic threats of disjointed farmlands, low access to the market, increasing costs of inputs, as well as information asymmetry, which reduced their income and bargaining power. This paper will be seeking to explore how agri-startups and Farmer Producer Organizations (FPOs) can synergize to promote better market access and value realization by the smallholder farmers in India. The study aims at determining the growth pattern and performance of FPOs and agri-startups and also determining the effect of these on the market integration and income improvement of farmers. Descriptive-analytical research design was followed and secondary data were used, such as NABARD, SFAC, Ministry of Agriculture, and published research. The hypothesis states that joint working of FPOs and agri-startups would greatly enhance the market participation and price realization of farmers. Findings show that the membership of FPOs has a positive effect on the net returns, and electronic platforms such as e-NAM have incorporated more than 1.78 crore farmers into the transparent market system. The paper finds that, institutional empowerment of FPOs through technology-based interventions of agri-startups can form a sound ecosystem in empowering smallholders and in marketing sustainable agricultural produce.

Keywords: *Farmer Producer Organizations[1], Agri-startups[2], Market Access[3], Value Realization[4], Smallholder Farmers[5].*

1. Introduction

India is among the largest agricultural economies of the world but the irony of high production and high levels of distress amongst farmers remains a puzzle to policymakers and development agents. The agricultural sector is a source of livelihood to 46.1 percent of the entire workforce and contributes about 16 percent to the national GDP (Economic Survey, 2023). Nonetheless, structural deficiencies are typical of the sector in form of highly fragmented land tenure with 86.1 percent of operational land tenures being owned by small and marginal farmers with a land tenure of less than two hectares (Agricultural Census, 2015-16). The survey of NABARD All India Rural Financial Inclusion Survey (NAFIS) 2021-22 shows that the average landholding dropped by about 31 percent as it declined to 0.74 hectares in 2021-22 compared to 1.08 hectares in 2016-17 (NABARD, 2022). This disaggregation essentially diminishes the economies of scale, raises the costs of a unit operation and

the bargaining power of a single cultivator within the input and output market. This is hindered by limited access to formal credit, insufficient storage and cold chain facilities, reliance on intermediaries, information asymmetry about current market prices and the inability to satisfy quality standards that are required by modern retail and export markets (Meemken&Bellemare, 2020; Srinatha et al., 2024). Market reforms were highlighted in the Dalwai Committee Report on Doubling Farmers Income as the key to agricultural incomes improvement, which recommends collective institutions and online marketplaces (GOI, 2018). Farmer Producer Organizations (FPOs) have also been developed by stakeholders in reaction to this and these institutional innovations are meant to pool small farmers, realize economies of scale, and market integration (Trebbin&Hassler, 2012; Kumar et al., 2025). In February 2020 with a 2020-2020 budget of 6,865 crore, the Government of India became the first policy to have its largest commitment to collectivization with the Central Sector Scheme of Formation and Promotion of 10,000 FPOs (PIB, 2020).

At the same time, the agri-startup ecosystem has experienced a multiplied growth with the number of agriculture startups reaching over 7,000 in 2024, with technologies like artificial intelligence, Internet of Things, blockchain and digital marketplaces helping to eliminate supply chain inefficiencies (FAIFA, 2024; Nirmal Ravi Kumar et al., 2024). India agritech market is estimated to be USD 815 million in 2024, and agrifoodtech venture capital investments were USD 4.6 billion in FY2022 and then slowed to USD 2.4 billion in 2023 (AgFunder, 2023). In spite of this growth, penetration of smallholders is still low because of the affordability of technology, digital literacy, and accessibility challenges because of the last mile. A synergistic approach in which the agri-startups work together with the FPOs that use the grassroots networks and trust capital of the FPOs and the technological solutions of the startup provide a revolutionary route (Kumar et al., 2025). This paper discusses this collaborative ecosystem, and empirical evidence is used to evaluate the role of agri-startups and FPOs that collaboratively increase market access and value creation to the smallholder farming population of India.

2. Literature Review

The academic explanation of agricultural collectivization and the market of accessibility led by technology in the developing economies has grown tremendously in the last ten years. Basing on the theories of collective action and theory of new institutional economics, scholars have been able to develop the idea that producer organizations have internalized market coordination functions, such as aggregation, standardization of quality and collective bargain; hence cutting down the transaction costs and enhancing the integration of farmers into the value chain (Markelova et al., 2009; Olson, 1965). As Bijman et al. (2016) proved, properly operating producer organizations help to improve market access because a well-organized collective of smallholders allows the latter to negotiate with buyers not as atomized individuals, but as a well-organized collective of smallholders that might be much stronger. Trebbin and Hassler (2012) have reported that within the Indian environment, Farmer Producer Companies take into account the principles of collective ownership coupled with commercial flexibility, which resulted in a hybrid type of organization, which is in contrast with traditional cooperatives that had a negative experience with political interference and poor management. Singh (2023) reviewed FPOs in various states and discovered that some FPOs were more successful in integrating its members into the market, but organizations that failed to provide professional management and capitalization failed to become financially sustainable. In a case study of Sahyadri Farmers Producer Company in Maharashtra, Lalitha et al. (2024) proved that the FPOs that are privately initiated and have both backward and forward market connections enhanced by a long way farmer incomes and decreased post-harvest losses. Gurung et al. (2024) established that FPO membership has positive, significant effects on net returns, the profit on investment, and profit margins, but non-member farmers located near one also enjoyed spillover effects. Surendran-Padmaja and Ojha (2025) also warned that, the policy focus on numerical goals of 10,000 FPOs could undermine the quality of the organization, where only 43-49 percent of FPOs remain in operation after the government assistance has ended, according to the analysis of Tata-Cornell Institute of Cornell University.

Market access in the agri-start up dimension is a field that has gained increased academic interest. Nirmal Ravi Kumar et al. (2024) examined the situation with agri-startup in India and discovered that agri-startup plays a vital role in the SDGs pertaining to food security, poverty reduction, and environmental sustainability, but difficulties such as the lack of access to capital and regulatory issues complicate its growth. The NITI Aayog has approximated that an agritech ecosystem, fully developed could raise the income of the Indian farmers by 25-35 percent and add USD 95 billion to the GDP by lowering the input costs, increasing productivity, and improving price realization. Muniyoor and Pandey (2024) revealed that the market-oriented FPOs have better business competencies and profitability than that of production-oriented FPOs, implying that the market linkages facilitated by technology are key determinants of successful organizations. The authors of Pallavi et al. (2024) defined FPOs as agents of sustainable transitions, in which case they can support systemic change in agricultural value chains when used in conjunction with agritech innovation. The e-NAM platform is a major policy intervention connecting the physical and the digital market infrastructure, and research has demonstrated better price transparency and less reliance on intermediaries between registered users (Parmar& Bansal, 2025). Although such evidence is increasingly growing, few studies specifically look at the synergistic model in which agri-startups and FPOs work together to enhance market access results among smallholder farmersa gap this study aims to fill.

3. Objectives

1. To assess the growth, penetration, and performance of Farmer Producer Organizations and agri-startups in enhancing market access for smallholder farmers in India.
2. To evaluate the impact of FPO-agri-startup synergies on value realization, price transparency, and income enhancement of farmers through digital market platforms and collective marketing.

4. Methodology

The current research design was the descriptive-analytical research design based on the analysis of the secondary data in order to investigate how agri-startups and Farmer Producer Organizations contribute to the increased access to markets and value realization. The study adopted a longitudinal method, whereby it analyzed the data collected between 2016-2024 to reflect the growth pattern, level of performance, and the level of market integration between FPOs and start-up agri-related enterprises. It used data that are obtained in official publications of the National Bank of Agriculture and Rural Development (NABARD), the Small Farmers Agri-Business Consortium (SFAC), Government of Agriculture and Farmer Welfare, Tata-Cornell Institute (TCI), National Association of Farmer Producer Organization (NAFPO), press information bureau (PIB), and published peer-review articles in Google scholar database, Scopus database, and Web of Science database. The sampling design was the whole national ecosystem of FPOs and agri-startups, where the target population was captured by government registries and industry reports instead of sample surveys which guaranteed that it was extensive. The analytical software that was used consisted of computing the compound annual growth rate (CAGR), percentage analysis and trend analysis in tabular form. It was used in constructing six tables that provide information on FPO growth and registration, integration of e-NAM platform stakeholders, investment trends in agritech, financial performance of FPOs, geographical distribution, and comparison of income of the FPO-member and non-member households. Each table was statistically interpreted by use of descriptive analysis in order to find out the trends, growth patterns and differentials in performance. The content analysis method was used to bring together the results of already available empirical research and policy reports. The study limitations are that it uses secondary sources and these sources can lead to reporting lags as well as the fact that no strong causality can be established between FPO-startup interventions and the outcomes of farmer income. Nevertheless, multi-source triangulation method enhances validity and reliability of findings presented.

5. Results

Table 1: Growth of FPO Registration under the Central Sector Scheme (2020-2024)

Year	FPOs Registered (Cumulative)	Shareholder Farmers (Cumulative)	Equity Grant Released (₹ Crore)
2020-21	2,200	4,85,000	14.05
2021-22	4,028	8,92,000	65.33
2022-23	6,150	13,50,000	125.40
2023-24	7,597	16,85,000	175.80
2024 (June)	8,875	19,68,868	210.10

Source: PIB (2022, 2024); Ministry of Agriculture & Farmers' Welfare, Government of India.

Table 1 shows the cumulative increase in the number of FPOs funded by the Central Sector Scheme of the Government of India since 2020 to June 2024. The data indicates a steady upward trend with a growth in FPO registrations of 2,200 in 2020-21 to 8,875 in June 2024, which is estimated to have a CAGR of about 41.7 percent. At the same time, the shareholder farmers had grown to 19.69 lakh as compared to 4.85 lakh, showing the growth of the farmer enrollment in the collective enterprises. The equity grant issued increased 14.05 crore to 210.10 crore which shows that the government is contributing more financially. Such a fast institutionalization is an indication of the policy focus on collectivization as a route to market integration, but the sustainability of newly established FPO operations is an urgent issue (Surendran-Padmaja&Ojha, 2025).

Table 2: e-NAM Platform Stakeholder Registration and Trade Performance (2016-2024)

Parameter	2016-17	2018-19	2020-21	2022-23	2024 (Oct)
Mandis Integrated	250	585	1,000	1,260	1,389
Farmers Registered (Crore)	0.46	0.91	1.17	1.59	1.78
Traders Registered (Lakh)	0.62	1.14	1.49	2.19	2.62
FPOs Registered	340	975	1,520	2,870	4,250
Trade Value (₹ Lakh Crore)	0.23	0.89	1.48	2.57	3.79

Source: PIB (2024); SFAC, Ministry of Agriculture & Farmers' Welfare, Government of India.

Table 2 demonstrates how stakeholders will be gradually integrated into the e-NAM platform between 2016-17 and October 2024. The mandis has also been integrated to 1,389 in 23 states and 4 Union territories compared to 250, and the number of farmers registered has increased to 1.78 crore compared to 0.46 crore, which indicates a high level of penetration into the digital market. It is important to note that FPOs registered on the e-NAM have multiplied between 340 and 4,250 which means that they are becoming more and more organized trading organizations on the digital platform. The cumulative value of the trade amounted to a 3.79 lakh crore and it indicates that the market transactions have occurred in a transparent electronic environment. These numbers validate the fact that e-NAM has significantly lowered information asymmetry and dependence on intermediaries, which allows farmers and FPOs to have access to real-time discoveries of prices (Parmar& Bansal, 2025).

Table 3: Agritech Startup Ecosystem Growth in India (2016-2024)

Year	Agri-Startups (Cumulative)	VC Funding (USD Billion)	Startups Assisted under RKVY	Government Fund Allocation (₹ Crore)
2016	~450	0.28	182	25.0
2018	~1,300	0.52	548	53.5
2020	~3,000	0.30	946	82.0
2022	~5,200	4.60	1,380	107.0
2024	~7,000	1.60	1,708	122.5

Source: FAIFA (2024); DPIIT; Tracxn Database; Ministry of Agriculture & Farmers' Welfare.

In Table 3, the author shows the agritech startup ecosystem growth in India since 2016 through 2024. AgrI startups have grown tremendously with around 450 startups in 2016 and more than 7000 startups in 2024. The highest amount of venture capital funding was recorded in 2022 at USD 4.6 billion followed by USD 1.6 billion in 2024 due to world investment recalibration. Through the RKVY Innovation and Agri-Entrepreneurship Development programme 1,708 startups were supported at a cost of 122.5 crore paid out through incubators and knowledge partners. The data indicates that the structural pipeline of agritech innovation, even though it is cyclically funded, is stable and startups are filling such critical supply chain gaps as access to inputs, precision farming, post-harvest management, and digital marketplaces (Nirmal Ravi Kumar et al., 2024).

Table 4: Financial Performance Indicators of FPOs in India (2022-2024)

Performance Indicator	Small FPOs (<300 members)	Medium FPOs (300-1000 members)	Large FPOs (>1000 members)
Average Annual Turnover (₹ Lakh)	12.5	48.3	185.7
Average Paid-up Capital (₹ Lakh)	2.8	7.1	18.4
Average Working Capital (₹ Lakh)	2.4	8.5	32.6
Profitability (% Profitable)	32%	51%	68%
Access to Formal Credit (%)	28%	45%	71%

Source: TCI, Cornell University FPO Database (2024); NABARD Annual Report 2023-24.

A comparative analysis of the financial performance in the FPOs based on the membership size is done in Table 4. The information indicates a positive correlation that is evident between the scale of organizations and financial viability. FPOs with more than 1,000 members show much better average annual turnover (₹185.7 lakh) than small FPOs (₹12.5 lakh). The rates of profitability are higher in small FPOs (32 percent) compared to large organizations (68 percent). More importantly, scale increases access to formal credit by a factor of 28-percent to 71-percent so that it could be used to invest in value addition and market infrastructure. These results support the idea that the size of organizations, their capitalization, and professional management are the major predictors of the success of FPOs (Muniyoor& Pandey, 2024; TCI, 2024).

Table 5: State-wise Distribution of FPOs and Agri-Startups (Top 10 States, 2024)

State	FPOs Registered	Agri-Startups	e-NAM Mandis	FPO Turnover (₹ Crore, Avg.)
Maharashtra	1,285	1,363	118	3.42
Uttar Pradesh	1,120	425	125	1.85
Madhya Pradesh	890	380	80	2.10
Karnataka	785	621	65	2.75
Tamil Nadu	720	310	213	2.95
Rajasthan	685	290	144	1.92
Gujarat	620	700	122	2.48
Odisha	540	165	42	1.35
West Bengal	485	145	18	1.28
Andhra Pradesh	460	278	33	2.15

Source: NABARD (2024); DPIIT Startup India; SFAC e-NAM Portal; NAFPO State Reports.

Table 5 has given the state-wise distribution of FPOs, agri-startups, and e-NAM integrated mandis in the top ten states. Maharashtra also ranks on the top in terms of its FPO registrations (1,285) and agri-startup concentration (1,363) with an e-NAM mandi of 125 and 1,120 FPOs respectively. An interesting trend can be observed: the higher the density of agri-startups in a state, the higher the average turnover of FPO, which can be explained by positive spillover effects of the availability of technologies on the collective marketing results. Tamil Nadu has the highest level of digital market infrastructure with the highest number of e-NAM mandi integrated (213) in terms of FPO numbers (5 th). The geographical disparity highlights the necessity of the policy support that is different in the first place in the eastern states, where the FPO density and startup penetration have been relatively lower (Agarwal &Goyal, 2022).

Table 6: Income and Market Access Comparison: FPO Members vs. Non-Members

Parameter	FPO Members	Non-Members	Difference (%)
Average Monthly Household Income (₹)	14,850	10,220	+45.3%
Price Realization (% above MSP)	8-15%	2-5%	Significant
Post-harvest Loss (%)	8.5%	18.2%	-53.3%
Access to Institutional Credit (%)	62%	31%	+100%
Market Channels Used (Average)	3.2	1.4	+128.6%
Adoption of Grading/Sorting (%)	71%	23%	+208.7%

Source: Gurung et al. (2024); NABARD NAFIS (2022); Lalitha et al. (2024); Singh (2023).

As shown in Table 6, the income and market access indicators are compared between FPO member and non-member farming households. According to the data, the average household income of the members of FPO is about 45.3 percent higher than that of non-members (3.49 v. 10.31). The realizations of FPO members are 8-15 percent higher than the premiums that are received by non-members, which is considerably high at 2-5 percent higher than MSP. The number of post-harvest losses are reduced significantly (8.5% vs. 18.2%), and FPO members use an average of 3.2 market channels versus 1.4 channels used by non-members, which indicates a higher level of diversification of the market. Among FPO members, the application of both grading and sorting is markedly larger at 71 per cent, which allows the former to obtain the requested quality standards by

institutional buyers and modern retail, which results in improved prices (Gurung et al., 2024; Lalitha et al., 2024).

6. Discussion

The results of this article provide strong grounds to believe that Farmer Producer Organizations/agri-startups convergence is a radical institutional tool that can be used to improve market access and value realization among Indian smallholder farmers. Consistent with the first objectivewhich measures the growth and penetration of FPOs and agri-startups, the data shows an exemplary institutional growth. Indian agriculture has been manifesting unprecedented collectivization with registration of 8,875 FPOs under the Central Sector Scheme taking in almost 19.69 lakh shareholder farmers. Such growth is especially high considering the fact that the Tata-Cornell Institute projects that there have been about 44460 FPOs established throughout the country during 2003-2024, and 26938 of them continue to be registered with the Ministry of Corporate Affairs (TCI, 2024). But the most serious note is that in 2023, 57 percent of registered FPOs had already filed their financial statements, which is something to be concerned in the compliance of governance and the transparency of operations. This observation is reminiscent of the Surendran-Padmaja and Ojha (2025) findings that numerical scaling of FPOs without institutional beefing up is prone to the formation of hollow organizations that cannot generate permanent benefits to the members in the market.

The solution by the agritech startup ecosystem has been complementing institutional collectivization by technology-based solutions in the market. The increase in the number of fewer than 50 agri-startups prior to 2014-15 to more than 7,000 in 2024 symbolizes a change in how agriculture is delivered in terms of structure. DeHaat, Ninjacart, AgroStar, and CropIn are examples of platforms that have shown that technology allows addressing the information and logistics gaps that have traditionally marginalized smallholders to remunerative markets. FPO networks A converged strategy that agri-startups deliver last-mile technology through FPO networks, proposed by Kumar et al. (2025) in their Full-Stack Farm-to-Fork Model, is one of the most promising convergence strategies. This synergy will overcome the main weakness that Nirmal Ravi Kumar et al. (2024) find that only startups deal with the challenge of farmer trust and adoption barriers, whereas FPOs are not technologically advanced. Concerning the second goal that tests the effects on the value creation and price disclosure the e-NAM data offer significant evidence of an enhanced market performance. The digital platform has established unprecedented price transparency across geographical borders with 1,389 mandis integrated and trade worth 3.79 lakh crore. The fact that the household incomes and 8-15 percent premium over MSP of FPO members are 45.3 percent higher and 8-15 percent higher than non-members is a direct confirmation of the hypothesis that cooperative interaction between FPOs and technology platforms have significant positive effects on market participation and price realization by farmers. This result is consistent with Gurung et al. (2024), who established that FPO membership has a positive effect on net returns and profit margins. The 18.2 percent to 8.5 percent post-harvest losses become much less in the members of FPO, which again shows the value chain efficiency benefits that may be attained by collectively investing in the infrastructure storage, transportation, and processing.

The analysis of financial performance (Table 4) indicates that there is a significant structural issue: the positive correlation between FPO size and profitability is quite high (32% in case of small FPO and 68% in case of large FPO) that means that most of the newly established FPOs with their small memberships and poor capitalization are also associated with serious viability problems. This challenge is emphasized in the TCI assessment that reveals that not even 43-49 percent of FPOs continue to exist after the state assistance. The solution to these gaps can be found in agri-startups that can provide Farming-as-a-Service (FaaS), digital lending solutions via agri-fintech and market linkage platforms, which allow smaller FPOs to share the fixed costs that they cannot absorb on an individual basis. The fact that a well-developed agritech ecosystem would, based on the estimation

of the NITI Aayog, increase farmer incomes by 25-35 percent can be used to provide a quantitative estimate of the possible effect of these synergies. The analysis of the state-wise variation in Table 5 shows that state with co-located FPO and density of startups have high collective turnovers, which indicates that regional ecosystems are important. The policy should then go beyond the scheme-based promotion to the development of enabling environments to see FPOs, agri-startups, financial institutions and digital infrastructure interact to establish self-sustaining market ecologies that provide quantifiable value to the farming community.

7. Conclusion

This research paper confirms that the symbiotic ecosystem of Farmer Producer Organizations and agri-startups is a fundamental institutional channel of improving market access and value maximization of the smallholder farming population in India. The empirical data show that FPOs are effective in lifting up the farmer incomes by about 45 percent, post-harvest losses by more than 50 percent and diversification of the market channels and price realizations. The e-NAM platform has been able to establish a digital marketplace to connect more than 1.78 crore farmers and 4250 FPOs and trade valued at 3.79 lakh crore. Nonetheless, the sustainability issue is also important where close to half of FPOs do not last beyond the government sponsored periods. The paper finds that a systemic synergistic full-stack model combining FPO grassroots networks and agri-startup technological solutions to precision farming, market connections, fintech, and supply chain management is the most promising course of sustainable farmer empowerment. Among the policy recommendations are compulsory technology adoption in FPO business plans, specific agri-start-up incubation linked to FPO clusters, better credit guarantee schemes to small FPOs and rural communities investments in digital literacy.

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