Interplay between Farmers Producers' Organization (FPO's) Membership and Modern Farm Management Practices Adoption

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Abstract

The continuous increasing population, concern of environmental sustainability and exploitation in market force the farmers to adopt modern agricultural practices and take collective actions. Farmers Producers Organizations (FPO) is expected viable solution to overcome the majority of the farmers issue across the value chain. The present study analyze the adoption of modern agricultural practices in term of input and crop management practices, crop nutrition water management practices and farm financial and record management practices. In addition, farmers profiles mapped across the member and non-member of FPO. Simple statistical techniques such as chi-square test and ANOVA has used to analyze the survey data. Findings of the study reveal a significant association between farmer profile and FPO membership. Further, ANOVA indicates that members of FPO are significantly more adopters of modern agricultural practices. The study offers important policy implications for agricultural economist, promoters of FPO and modern farm practices.

Keywords: Modern agriculture, FPO, crop management, collective action.

Introduction

The agricultural sector of India is now at a crossroad of increasing food demand due to growing population and food security risk due to climate change (Farah et al., 2025 and Hilmi et al., 2024). Traditional farm practices are no longer relevant at this moment. It is crucial time to innovate for agricultural sustainability (Zarkua et al., 2025). Modern farm management practices significantly influence productivity. Digital advancements are also essential for effective management practices; precision agriculture leverages the benefits of technologies like GPS and IoT sensors (Bekee et al., 2024). This helps in allocating resources efficiently and thereby reducing wastage and increasing crop yields (Mgendi, 2024). The increasing penetration of digital methods are changing traditional farming across the world (Raj & Prahadeeswaran, 2025). Precision agriculture is leading this change. This approach boosts

efficient resource allocation and reduces the adverse effects to environment. For example, AI and sensors allow more control over water and chemical application on field. This reduces waste and avoids the excessive use of fertilizers and pesticides. In addition to output, modern farming assures long-term sustainability, realizes positive environmental health and reduces chemical hazards. Practices such as using green manure enhance soil organic matter content and keep pests under control. Integrated farming systems also help with soil conservation and reduce greenhouse gas emissions. For effective management of a farm, farmers typically requires entrepreneurial skills and especially financial proficiency (Gadanakis, 2024; Nieuwoudt et al.,2017). Farmers must maintain budgets effectively and control costs strategically. Marketing skills are also important for the proper use of digital platform and for the reach of broader markets. Effective financial management depends on maintaining records of costs and profitability. Farmers are shifting from traditional paper record maintaining to modern digital record keeping. Digital tools like Farm Management Information Systems (FMISs) process large amounts of farm data. Integrating mandatory Farm Financial Accounts (FFAs) with technical FMIS data reduces administrative tasks (Poppe et al., 2023).

Farmer organizations, like cooperatives and Farmers Producers Organization (FPOs) drives development in farming community (Harrington et al., 2024 and Chintala, & Mani, 2022). This group effort help support the conservation of crop diversity. These organizations allow for distributed decision making over management of resources. In addition, these organizations play an important role in promoting innovation and knowledge among farmers. They serve as a platform for sharing practical farming skills and scientific knowledge. Group activities engage community involvement and togetherness. These shared practices enhance productivity and skills within the agricultural sector, this collaboration leads to solutions that recognize local challenges(Patil et al., 2025 and Tumwebaze et al., 2025). Groups like these encourage adoption of new techniques, practices and technologies. This includes the usage of modern tools adapted for traditional methods.

Particularly, Farmers' organizations (FPOs) are producer group, they are essential to modern agriculture as they have ability of members to modernize. FPO are created a new organizational framework for farmers. Farmers join FPO as member to build network strongly. FPO helps in addressing low production diversity and inadequate farming coordination. FPO seek to strengthen farmers economic conditions and resolve the difficulties in operations generally by providing latest resources (Kumar et al., 2023). In addition, the bargaining power of farmers to get higher market price of their produce also increased (Prabhavathi et al.,2024), further it provides access to essential infrastructure, including transportation and storage facilities Many farmers lack appropriate support and access to scientific techniques. They require support and guidance in learning and understanding about the modern technologies. Training sessions teaches the members to know about better resource management techniques and sustainable farming practices. Implementation of innovations at the farm level increases the utilization of current technology and resources (Parikoglou et al.,2024). Digital intelligence applications and smart farming systems are involved in the modern methods. Digital tools ensure better decision-making and aid in farm management. To determine the best times for irrigation and harvesting, farmers use data analytics. For further adoption, information regarding new techniques and crop varieties must be consistently accessible. Innovation and general resilience in farming are boosted by effective adoption of new technologies.

Studies expresses that farmer producers' organizations (FPOs) play a crucial role on agricultural and livelihood development but not categorically explain the role of FPO in the adoption of modern agricultural practices (Suresh et al.,,2024; a Kumari, et al., 2022). Numerous studies explore all aspects of agricultural modernization but with respect to FPO are the subject of further research (Harrington et al., 2024 and Agarwal, et al., 2022). However, the existing publication lacks an accurate reference. The impact of joining an FPO on a farmer's decision about implementing modern approaches has not been thoroughly studied. There is a significant lack of research on this important overlap—how FPO membership fosters farm-level

innovation. Understanding this relationship is important for supporting sustainable agricultural advancement. Therefore, it is imperative to understand the interplay between FPO membership and adoption of modern farm practices. This study has contributed the literature by providing the understanding on FPO role in modern farm practices adoption. Which may be a basis for future research. In addition, study have some practical implications. This study may help the policymakers, agricultural economist and sustainable farming promotors. It will help the government to design proper policy for modern agricultural practices promotion.

Literature Review and Hypothesis Development

Farmers Producers Organization Membership and Farmer Empowerment

Farmer organizations strengthen farm business operations and drive modernization. These groups empower members by increasing access to resources, sharing knowledge, and improving market presence. Collective structures are necessary to support sustainable agriculture and rural prosperity.

Hazell and Johnson (2002) argued that small and marginal farmers need collective action to be successful, because collectively they gain better market access for their output and buy necessary input smoothly. Wynne-Jones (2017) point out cooperation among farmers are beneficial and facilitate the collective action. Huttunen (2019) expressed that grouping of farmers enable underprivilege farmers to access necessary costly input such as machinery and services. Bucci et al. (2018) suggested that sustainable agricultural practices such precision farming needed strong support structures. They recommended that collaboration of various stakeholders such as farmers, agricultural extension officers, scientist and private sector determined that innovation adoption by farmers, FPO provides platform to bring together all the stakeholders. Sekhar et al., (2024) discussed the role of farmers organization, emphasis that these types of organizations are essential to adopt modern integrated farming adoption (IFS), further these organizations help to disseminate sustainable and smart agriculture practices. Gadanakis (2024 presented that farmers in a group can better realize the price and over the marketing issue and competition. Farmers in collective way can better negotiate in with counterparts. Further they emphasise the importance of training of these groups. For organized smallholders in China, Zheng et al. (2023) revealed that the famers having access to digital finance are mre adopters of sustainable agricultural practices. Wynne-Jones (2017) argued that collaboration is essential for sustainable rural growth. Regularly meeting of farmers groups are bring new knowledge and develop new farming practices

For governing seed and varieties, Sievers-Glotzbach and Christinck (2021) argued that it is necessary to have innovative organizational structures to grow and allocate new plant varieties. Mainly, a decentralized seed distribution system dependent on farmer organizations, which played a crucial role in the entire process of distribution. Zheng et al. (2023) explored how organized smallholder farmers in rural China benefited from using digital finance. They showed that being a part of or a member of a farmer group gives them access to digital credit platforms. Thus, this financial access empower farmers and boost their confidence. Additionally, it also allows them to adopt eco-friendly practices. Xu et al. (2024) analyzed future trends in agricultural digitization, found a significant role of collective action in the adoption of advance technology. According to the research, it has been established that forming a digital agricultural community helps farmers adopt reenergized technology. That means the communities play a key role in assisting farmers to learn and use modern tools. The research also highlights the crucial role of social groups for shaping farmers' behavior towards technology.

Mixed Findings and Implementation Challenges

Bucci et al. (2018) found the pattern of Precision Agriculture (PA) technology adoption. they demonstrated that the successful adoption of precision agriculture requires strong support structures. On the other hand, it also claimed that the wider acceptance of precision agriculture demands a strong collaboration among farmers, farmer

organizations, researchers, and private companies. The primary goal of this collaboration is to reduce uncertainty and make it hassle-free for members to learn new technologies. The studies also cited that small and medium farms have low adoption rates towards new technologies due to the high initial costs, small farm size, farmer age, and lack of technology awareness.

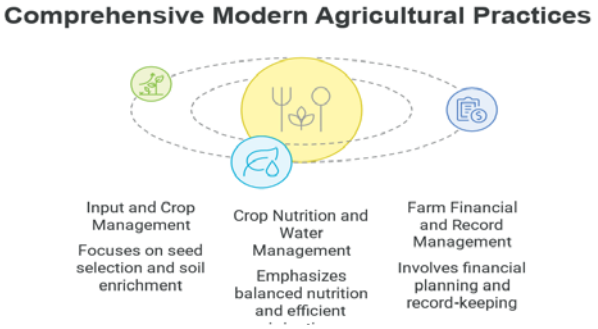
Poppe et al. (2023) developed a conceptual framework for sustainability reporting utilizing digital farm management information systems (FMIS). But the authors identified multiple barriers that primarily restrict the successful integration and adoption of these modern data systems. Overall, the authors stated that overlooking the farmer's role prevents the data from being practically applied in daily farm management decisions. On the other hand, the research material shows that FPO participation is a clear enabler. The booming modernization depends on addressing technological complexity and gaps in organizational support. It is essential that policy actively supports these organized communities to ensure that farmers fully adopt modern practices. The literature review also focuses on the specific interplay between innovation outcomes at the farm level and membership benefits. It is noticeable that modern agriculture aims for efficiency and sustainability. Farmer-Producer Organizations (FPOs) are widely recognized as essential structures for rural development.

For rural growth, many studies focus only on general agricultural modernization like using modern tools of digital intelligence or Precision Agriculture. Other studies focus on the internal structure and benefits of FPOs, such as their role in governing seed varieties or fostering collective knowledge. There is very limited research that point out the exploration of how joining an organized group directly influences a farmer's decision to adopt modern practices across distinct management domains. Still, very few studies have found that FPO membership is linked to organizational influence across multiple areas. As a result, it improves access to finance, quality inputs, and technical advice. Understanding this "relationship" is critical for advancing agricultural development policy in a better shape. Based on above studies, basic conceptual framework has been developed. The modern agricultural practices are divided into three categories namely (1) Input and Crop Management Practices (2) Crop nutrition Water Management Practices and (3) Farm Financial and Record Management Practices. Considering these modern agricultural practices, the following hypotheses has been formulated to achieve the research objectives.

H01: There is no difference in farmers characteristics across members and non-members of FPO.

H02: There is no difference in adoption of modern agricultural practices across members and non-members of FPO.

H03: There is no difference in adoption of modern agricultural practices across members and non-members of FPO with respect to operation holding.



Methodology

Data collection and Sample Size

The study is mainly based on the primary data of farmers. The primary data has been collected from both the types of farmers viz; members of FPO and control group who are not a member of FPO from same location. Data has been collected from the states of Uttar Pradesh and Madhya Pradesh. They are major producing states of several agricultural commodities. From Uttar Pradesh, data has been collected from Aligarh, Rampur and Mathura while from Madhya Pradesh, data has taken from Bhopal, Shore and Dindori districts. Data has been collected from 444 farmers, comprising 293 FPO members and 151 non-FPO members. Primary data collection occurred between January 2023 and May 2023, while the secondary data utilized in this study covers a time span of the previous 30 years.

Survey Instruments and Variables Description

Primary data has been collected through the structured questionnaire. Structured questionnaires have questions related to socio-economic profile of the farmers; their consumption pattern and other variables related to standard of living. Further, questionnaire has consisted of questions related to modern agricultural practices such as use genetically modified seeds, cultivation with new varieties of seed, use green manure, adoption of crop nutrition management, irrigation of crops based on water requirement, bank loan to increase farm investment and record keeping of agricultural income expenditure. The farmer's perception has recorded on 5-point Likert type scale. Where 1 shows the extremely disagree while 5 indicates extremely agree. The modern agricultural practices are divided into three categories namely (1) input and crop management practices (2) crop nutrition water management practices and (3) farm financial and record management practices. Further, variables are taken into these practices. Under input and crop management practices, 4 practices are taken namely use of certified seeds, use genetically modified seeds, cultivation with new varieties of seed, use green manure. While in crop nutrition water management practices, two practices adoption of crop nutrition management and irrigation of crops based on water requirement are adopted. Further in third category, farm financial and record management practices, bank loan to increase farm investment and record keeping of agricultural income expenditure are taken for analysis.

Analytical Approach

The broad objective of the study is to analyze the role of FPO in adoption of modern agricultural practices. Therefore, comparative analysis has been done to explore the difference in adoption of modern agricultural practices across FPO and non-FPO member. In addition, farmers characteristics also explore across the FPO and non FPO members. As the data of farmers characteristics on nominal and ordinal scale, therefore, chi-square test has been analyzed to assess the association between adoption and firm characteristics. Further, perception on adoption of various modern agricultural techniques has been recorded on five-point liker type scale. Therefore, analysis of variance has been applied to assess the difference in adoption between FPO and non- FPO farmers.

Data Analysis

Results and Discussion

These FPOs play an instrumental role in promoting agricultural knowledge and better farms practices. They provide platform to farmers for sharing understanding of agriculture and scientific knowledge. It sensitizes group-based activities which lead to innovation, collaboration and address the local level issues faced by farmers. Chi-square test has been applied to explore the association between farmers profile and FPO membership. Analysis shows there is a significant association between farmers profile in terms of operation holding, age of the farmers and family annual income. The $\chi 2$ test shows a statistically significant association between operation holding and getting membership of farmers' producers' organization ($\chi 2$= 11.983, P=0.002). Farmers with large landholdings are significantly more likely to be a member of FPO. In a member category, 29.7 percent are medium and large farmers while in non-members category only 20.5 percent in this category. It may be due to the fact that farmers with larger landholding generally produce for commercial purpose and seek efficiency profitability and market access. Analysis reveals a significant association between age and FPO membership ($\chi 2$= 11.716, P=0.003). Famers above 50 years of age are higher adopter of FPO membership as compare to younger farmers. Old farmers are experience and understand marketing obstacles and benefits the collective action. They understand the market failure and exploitation of middleman. Therefore, older farmers join the FPO. There is statistically significant association has been found between income and membership of FPO ($\chi 2$= 16.711, P=0.001). It is significant 1 percent level of significance. Higher income group farmers are much aware of agricultural extension services that enable them to understand the model of FPO. Hence, hypotheses which assume there is no difference in farmers characteristics across members and non-members of FPO is rejected.

Table 1. Farmers profile across the FPO membership

	Member of FPO		Member of non-FPO		Total				
Operation Holding	N	%	N	%	N	%	Chi-Square	df	P-value
Marginal	73	24.9	61	40.4	134	30.2	11.983	2	0.002
Small	133	45.4	59	39.1	192	43.2			
Medium and Large	87	29.7	31	20.5	118	26.6			
Age Category									
upto25	11	4	14	10.9	25	6.2	11.716	2	0.003
26-50	186	67.4	93	72.1	279	68.9			
51-75	79	28.6	22	17.1	101	24.9			
Education									
Illiterate	20	7	6	4	26	6	3.605	4	0.462
Higher secondary or less	40	13.9	22	14.8	62	14.2			
High School	71	24.7	29	19.5	100	22.9			
Intermediate	69	24	41	27.5	110	25.2			
Graduate and above	87	30.3	51	34.2	138	31.7			
Family Annual Income									
LessthanRs.20,000	18	6.2	16	10.6	34	7.7	16.711	3	0.001
Rs.50,000-1,00,000	38	13.1	29	19.2	67	15.2			
Rs.1,00,000-2,00,000	124	42.6	76	50.3	200	45.2			
Above Rs. 4,00,000	111	38.1	30	19.9	141	31.9			

Adoption of modern agricultural practices in terms of Input and Crop Management Practices, Crop nutrition Water Management Practices and Farm Financial and Record Management Practices across the members and non-members of FPO are presented in table 2. Analysis of variance has been used to explore the significant difference between members and non-members of FPO for modern agricultural practices. Higher mean value shows the higher degree of agreement. Ther is significant difference between member and non-members of FPO on use of certified seeds adoption (F=6.081, P=0.014). The mean value indicates that members of FPO are more user of certified seeds. Generally, FPO procure agri-input including seeds in bulk from reliable suppliers, In addition FPO have access to technical guidance from expert to use certified seeds. Therefore, members farmers are more user of certified seeds. The mean value of cultivation with new varieties of seeds is 4.04 while for non-members mean value is 3.91, adoption of cultivation with new varieties of seeds is significantly higher in member category (F=4.257, P=0.040). About crop nutrition and water management practices, Analysis of Variance indicates a statistically significant difference across the member and non-member of FPO (F= 3.896, P=0.049). The mean value reveals that members farmers are more adopters of crop nutrition management practice as compare to non-member of FPO. Another category of modern agricultural practices is farming financial and record management practices, F-test shows that members of FPO are significantly more adopter of farm financial and record management practices (F=13.503, P=0.000). Mean value is more for Members of FPO, it indicates that members of FPO more adopters of bank loan to increase farm investment a compare to non-members. Bank considers member of FPO are low risk borrowers and FPO act a guarantors, therefore member of FPO get easy credit from bank.Similarly, ANOVA analysis member of FPO are significantly more adopters of record keeping of agricultural income expenditure practices

(F=20.208, P=0.000). Hence, hypothesis (H02) which assume there is no difference in adoption of modern agricultural practices across members and non-members of FPO is partially rejected.

Table 2. Adoption of modern agricultural practices

FPO Member	Member of FPO		Member of non-FPO		ANOVA	
	Mean	S.D	Mean	S.D	F	Sig.
Input and Crop Management Practices						
Use of certified seeds	4.28	0.53	4.15	0.6	6.081	0.014
Use genetically modified seeds	4.02	0.62	3.95	0.59	1.585	0.209
Cultivation with new varieties of seed	4.04	0.61	3.91	0.63	4.257	0.040
Use Green Manure	3.85	0.85	3.86	0.71	0.028	0.867
Crop nutrition Water Management Practices						
Adoption of crop nutrition management	4.08	0.5	3.97	0.63	3.896	0.049
Irrigation of crops based on water requirement	4.28	3.08	4.06	0.6	0.75	0.387
Farm Financial and Record Management Practices						
Bank loan to increase farm investment	3.92	0.61	3.66	0.88	13.503	0.000
Record keeping of agricultural income expenditure	4.2	0.55	3.91	0.83	20.208	0.000

Table 3 shows the adoption of input and crop management practices across the operation holdings, ANOVA reveals that significant difference in member and non-member of FPO for use of certified seeds. For marginal and small farmers, means value is higher for members, it indicates that members of FPO belong to marginal and small farmers are more adopters of certified seeds. Similarly, use of genetically modified seeds and Cultivation with new varieties of seed is higher in members of FPO across the all type of operation holding categories. For the green manure use, analysis shows that for marginal and small farmers, non-members are more user of green manure while among medium and large farmers category, mean value shows that members FPO are using green manure. Because marginal and small non-members use green manure as a low-cost, locally available alternative to chemical fertilizers, while large member farmers adopt it as part of scientific soil health and sustainability practices promoted through FPO training and support. For crop nutrition and water management practices, for marginal and small farmers adoption of crop nutrition management is higher. Marginal and small farmers belong to FPO are considers Bank loan to increase farm investment and emphasis on record keeping of agricultural income expenditure. Hence, hypothesis There is no difference in adoption of modern agricultural practices across members and non-members of FPO with respect to operation holding is rejected.

Table 3. Adoption of modern agricultural practices across operation holding categories

	Marginal		Small		Medium			
FPO Member	**FPO**	**Non FPO member**	**FPO**	**Non FPO member**	**FPO**	**Non FPO member**	**F**	**Sig.**
Input and Crop Management Practices								
Use of certified seeds	4.25	3.97	4.29	4.22	4.31	4.35	4.66	0.010
Use genetically modified seeds	3.92	3.78	4.04	4.05	4.09	4.06	5.33	0.005
Cultivation with new varieties of seed	3.95	3.72	3.99	4.02	4.21	4.10	9.59	0.000
Use Green Manure	3.63	3.73	3.80	3.90	4.10	4.03	8.39	0.000

	Marginal		Small		Medium			
FPO Member	**FPO**	**Non FPO member**	**FPO**	**Non FPO member**	**FPO**	**Non FPO member**	**F**	**Sig.**
Crop nutrition Water Management Practices								
Adoption of crop nutrition management	3.95	3.80	4.13	4.02	4.13	4.23	9.40	0.000
Irrigation of crops based on water requirement	4.68	3.87	4.13	4.19	4.17	4.19	0.19	0.830
Farm Financial and Record Management Practices								
Bank loan to increase farm investment	3.77	3.25	3.95	3.90	4.00	4.00	17.78	0.000
Record keeping of agricultural income expenditure	4.14	3.68	4.25	3.95	4.20	4.26	6.55	0.002

Conclusion and Policy Implications

Indian agriculture at the juncture of feeding highly increasing population on one hand while follow sustainable agriculture at another hand to conserve the environment. Moreover, farmers are facing the issue of market the produce and realize the good price. From the literature, it has been found that solution of these problem lies in adoption of modern agricultural practices and collective action. Therefore, there is need to study the role of FPO in adoption of modern agricultural practices. The present study analyses the role of FPO in adoption of modern agricultural practices in term of input and crop management practices, crop nutrition water management practices and farm financial and record management practices. The study shows that farmers profile is significantly associated with adoption of FPO membership. The finding of the study shows that farmers with higher landholdings and older in age become the members of FPO. In addition, higher level of literacy and income is significantly associated with FPP membership. Further, analysis of variance (ANOVA) indicates that members of FPO are significantly more adopter of input and crop management practices, crop nutrition and water management practices, and farm financial and record management practices. Members of FPO are more user of certified seed, genetically modified seeds, cultivates new varieties of seeds, more adopter of crop nutrition management, bank loan for farm investment, keep proper records of agricultural income.

The study have significant policy implications for agricultural economist, FPO promoters and policymakers based on farmers profile and FPO membership, difference in adoption of modern agricultural practices across the members and non-members of FPO. The association between farmers profile and FPO membership provides understanding for promotion of FPO among farming community based on farmers characteristic. Based on findings, it is recommended suggested that FPO should be promoted among small and marginal, low income group and young farmers. Analysis shows that adoption of modern agricultural practices among Farmers Producers Organization (FPO), provides a clear understanding that FPO should adopt the inclusive approach which emphases all type of farmers to be a members of FPOs. It helps to promotes modern agricultural practices among farmers. There are few limitations of the study, it is based only two states of India, which restrict the generalize the findings of the study for whole country. In addition, modern agricultural practices are taken under three broad categories, Future research may be design a comprehensive study by including the stages of complete agricultural supply chain.

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