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Comparative Impact Assessment of Diverse Farmers Producers Organizations (FPOs) in Bihar: An Inter-FPO Variation Analysis using Post Hoc Tukey's HSD Test

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ABSTRACT: Farmers are principal members of Farmers Producers Organizations (FPOs), a specific class of POs that pact with the production, marketing, and value addition of agricultural products. The primary mission of FPO is to mobilize farmers into member-owned producer companies for enhancing the negotiation power of marginal and small farmers through developing a judicious economy of scale at farm gate. It is an important tool for shifting the focus of farmer from mere production to marketing of produce i.e., transforming agriculture to agri-business management (ABM) and to realise farmers that 'agriculture is more than just cows and plows'. The study was performed in the Samastipur and Muzaffarpur district of Bihar state with an objective to analyse the impact of Farmer Producer Organisations (FPOs) on its member farmers. 5 FPOs were selected purposely since each FPO deal with different agricultural commodity. A total of 250 members (having at least 5 years of experiences in FPOs) were randomly selected for the study from each five FPOs at the rate of 50. The main challenge in the study was to compare the impact of all 5 FPOs together through suitable statistical method. This comparison of impact was analysed through Post Hoc Tukey's Honestly Significant Difference (HSD) test. The results concluded that Samarpan Jeevika Mahila Kisan Producer Company Limited ($\bar{x}$ =0.7470) was the most impactful FPO trailed by Jan Nayak Farmer producer company limited ($\bar{x}$ =0.7465), Pusa Seed Producer Company Limited ($\bar{x}$ =0.6291), Tirhut Honey Farmers Producer Company Limited ($\bar{x}$ =0.6201) and Maurya Farmer Producer Company Limited ($\bar{x}$ =0.5897). Subsequently, overall mean impact of FPOs was $\bar{x}$ =0.6664. Hypothesis testing was done though Post Hoc Tukey's Honestly Significant Difference test. From Tukey's HSD test it was inferred that when Maurya Farmer Producer Company Limited (4) was chosen as a reference category then it has maximum number of asterisk and significant difference with all 4 FPOs i.e. significant at 1% level. From this it can be deducted that Maurya Farmer Producer Company Limited was the least impactful FPO among all 5 selected FPOs for the study.

Keywords: Agri-business management, economy of scale, FPO, farmer producer organization, honestly significant difference (HSD), Impact Assessment, Post Hoc test.

INTRODUCTION

There is no doubt that India relies heavily on agriculture for economic advancement, as do many other developing nations. Over half of India's labour force depends directly or indirectly on agriculture for its livelihood and spends most of his expenditure on food (GOI, 2013; GOI, 2021). In India 86.2% farmers have marginal and small land holding (Agriculture Census, 2016). These landless, marginal, and small farmers face various challenges from production to marketing phase of their produce, since they produced in isolation or as part of unstructured groups (such as local cooperatives or community associations) which itself lacked the formal organization and business structure necessary to engage effectively in larger markets (Lal *et al.*, 2015). To cater these issues a number of innovative institution models have emerged across the time, some have got success while majority have not for numbers of reasons. To provide further momentum to the farmers organisations, government put forward a new idea of collectivization in the form of Farmer Producer Company (FPC) on the recommendation of committee chaired by renowned economists Y. K. Alagh in 2002 (NABARD, 2017; NABARD, 2020; NABCONS, 2011;

NABCONS, 2019). A Farmer Producer Company (FPC) represents a unique blend of cooperative societies and private limited companies. It aims to harness the advantages of a corporate structure while preserving the ethos of traditional cooperatives. FPCs embody an organization that is created and operated by farmers (CIKS & FWWB 2017) with their interests at its core. In India, entities like the Small Farmers' Agribusiness Consortium (SFAC), the National Bank for Agriculture and Rural Development (NABARD), and other supporting agencies play a pivotal role in fostering and facilitating the growth of FPCs. FPOs have potential to solve major agriculture problem because it relies on concept of 'Unity is strength' (Neti & Govil 2022). This model of collectivization of farmers has all capacity to make Indian agriculture independent from subsidy- culture and make our farmer self- resilience. So, it is imperative to study the impact of FPO with the study entitled Comparative Impact Assessment of Diverse Farmers Producers Organizations (FPOs) in Bihar: An Inter-FPO Variation Analysis Using Post Hoc Tukey's HSD Test.

MATERIALS AND METHODS

The study had been performed in northern region of Bihar state in two districts Samastipur and Muzaffarpur. An ex-post facto research design was followed in study (Kumar *et al.*, 2022; Shukla *et al.*, 2022b; Srivastava *et al.*, 2021; Srivastava *et al.*, 2023). In total 250 member farmers from each five FPOs at the rate of fifty were randomly selected. These 5 FPOs were chosen purposely since each FPO deal with different agricultural commodity. The selected members were essentially having 5 years of experience in particular FPOs. Data on perceived impact of FPOs on socio-economic conditions of the farmers along with members' perceptions about FPOs' impact on market linkage, participation, technological and food security were collected using a scientifically validated interview schedule. The main challenge in the study was to compare the impact of all 5 FPOs together through suitable statistical method. This comparison of impact was analysed through Post Hoc Tukey's Honestly Significant Difference (HSD) test (Schlegel, 2018; Lal *et al*., 2019; Lal *et al.*, 2023). These 5 FPOs selected were Samarpan Jeevika Mahila Kisan Producer Company Limited, Pusa Seed Producer Company Limited, Tirhut Honey Farmers Producer Company Limited, Maurya Farmer Producer Company Limited and Jan Nayak Farmer Producer Company limited dealing in commodity Fruits, Seed, Honey, Cereals & Pulses and Spices (Turmeric) respectively. The collected data were scored, compiled, tabulated, and analyzed by SPSS software version 27.0.1.0 using set of appropriate statistical tools, i.e., mean, standard errors, standard deviation, frequencies, one-way ANOVA, and Post-hoc Tukey's HSD test. Post-Hoc Tukey's HSD test is recognized to be the best method in a wide variety of cases (Schlegel, 2018; Lal *et al.*, 2019; Lal *et al.*, 2023).

RESULTS AND DISCUSSION

Descriptive statistics is a summary statistic to provide the basic structure and insight of the data set. Sinha *et al.* (2018) quantified descriptive statistics viz., mean, standard deviation, minimum, maximum, range, percentiles {25th 50th (Median) 75th} to compute nonparametric Wilcoxon Signed paired Rank test.

Table 1: Descriptive Statistics of Impact of FPOs.

		N	Mean	SD	SE	95% CI for $\bar{x}$		Min.	Max.	BCV
						LB	UB			
1.00		50	.7470	.0261	.0037	.7395	.7544	.6944	.7932	
2.00		50	0.629	.0407	.0057	.6174	.6406	.5283	.6880	
3.00		50	0.620	.0277	.0039	.6122	.6280	.5607	.6735	
4.00		50	.5897	.0293	.0041	.5813	.5980	.5313	.6626	
5.00		50	.7465	.0289	.0040	.7382	.7547	.6545	.7886	
Total		250	.6664	.0737	.0046	.6573	.6756	.5283	.7932	
Model	FE			.0310	.0019	.6626	.6703			
	RE				.0334	.5737	.7592			.0055

Acronyms & coding elucidation: 1=Samarpan Jeevika Mahila Kisan Producer Company Limited; 2= Pusa Seed Producer Company Limited; 3=Tirhut Honey Farmers Producer Company Limited; 4= Maurya Farmer Producer Company Limited; 5= Jan Nayak Farmer producer company limited. CI= Confidence Interval; x̄=Mean; LB=Lower Bound; UB= Upper Bound; BCV=Between- Component Variance; FE= Fixed Effects; RE= Random Effects

From Table 1, it is evident that Samarpan Jeevika Mahila Kisan Producer Company Limited ($\bar{x}$ =0.7470) was the most impactful FPO trailed by Jan Nayak Farmer producer company limited ($\bar{x}$ =0.7465), Pusa Seed Producer Company Limited ($\bar{x}$ =0.6291), Tirhut Honey Farmers Producer Company Limited ($\bar{x}$ =0.6201) and Maurya Farmer Producer Company Limited ($\bar{x}$ =0.5897). Subsequently, overall mean impact of FPOs was $\bar{x}$ =0.6664. The graphical depiction of mean value of impact is shown in Fig. 1.

From Table 2, depicted the result of Test of Homogeneity of Variances, it is clear that all the test statistic values for homogeneity of variances are non-significant (at both 1% and 5% level of significance) which shows that variances for all the study variables are homogeneous.

Table 3 denoted the result of Analysis of Variance (ANOVA); it is obvious that test statistic for ANOVA test is significant (at both 1% and 5% level of significance) which shows that effects of all the studied variables are significantly different (Shukla *et al.*, 2022; Chithra *et al.*, 2023).

From Robust tests of Equality of means, it is clear that test values are asymptotically significant which show variable means are significantly different (Table 4).

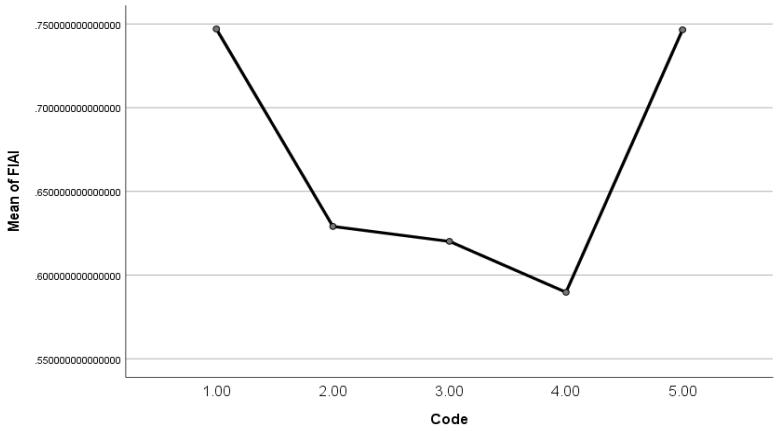

Fig. 1. The mean value of studied FPOs impact assessment Index (FIAI).

Table 2: Test of Homogeneity of Variance.

	Levene Statistic	df1	df2	Significance
Based on $\bar{x}$	1.980	4	245	.098
Based on Medium	1.180	4	245	.320
Based on Median and with adjusted df	1.180	4	183.259	.321
Based on trimmed $\bar{x}$	1.723	4	245	.146

Table 3: ANOVA value representing the appropriateness of regression model.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.117	4	.279	289.681	.000
Within Groups	.236	245	.001		
Total	1.353	249			

Table 4: Robust Tests of Equality of Means.

	Statistic*	df1	df2	Sig.
Welch	335.223	4	122.012	0.000
Brown-Forsythe	289.681	4	215.940	0.000
*. Asymptotically F distributed				

Table 5: Inferential Statistics Impact comparison among FPOs through Multiple Comparisons Tukey's Honestly Significant Difference test.

(I) Code	(J) Code	Mean Difference (I-J)	SE	Sig.	95% CI	
					LB	UB
1.00	2.00	.1179*	.0062	.000	.1008	.1350
	3.00	.1268*	.0062	.000	.1098	.1439
	4.00	.1572*	.0062	.000	.1402	.1743
	5.00	.0004	.0062	1.000	-.0165	.0175
2.00	1.00	-.1179*	.0062	.000	-.1350	-.1008
	3.00	.0089	.0062	.603	-.0081	.0259
	4.00	.0393*	.0062	.000	.0222	.0563
	5.00	-.1174*	.0062	.000	-.1345	-.1004
3.00	1.00	-.1268*	.0062	.000	-.1439	-.1098
	2.00	-.0089	.0062	.603	-.0259	.0081
	4.00	.0303*	.0062	.000	.0133	.0474
	5.00	-.1263*	.0062	.000	-.1434	-.1093
4.00	1.00	-.1572*	.0062	.000	-.1743	-.1402
	2.00	-.0393*	.0062	.000	-.0563	-.0222
	3.00	-.0303*	.0062	.000	-.0474	-.0133
	5.00	-.1567*	.0062	.000	-.1738	-.1397
5.00	1.00	-.0004	.0062	1.000	-.0175	.0165
	2.00	.1174*	.0062	.000	.1004	.1345
	3.00	.1263*	.0062	.000	.1093	.1434
	4.00	.1567*	.0062	.000	.1397	.1738
*. The mean difference is significant at the 0.05 level. CI=Confidence Interval						

In order to apply Tukey's HSD test, initially all the 5 FPOs were coded from 1 to 5. Then reference code was denoted as (I) Code, and the comparison one was denoted by (J) Code. Samarpan Jeevika Mahila Kisan Producer Company Limited (1) was compared to Pusa Seed Producer Company Limited (2), and mean

difference (I-J) {0.7470 -0.6290 =0.1179)} was found to be significant at a 1% level. From this, it can be inferred that Samarpan Jeevika Mahila Kisan Producer Company Limited was ranked 1st and Pusa Seed Producer Company Limited was ranked 3rd in terms of impact on members farmers, even then, there was a significant difference between these 2 FPOs (Table 5).

From Table 5, it is obvious that when Samarpan Jeevika Mahila Kisan Producer Company Limited (1) was compared to Tirhut Honey Farmers Producer Company Limited (3), and it was also found significant at 5% level and when Samarpan Jeevika Mahila Kisan Producer Company Limited (1) was compared to Maurya Farmer Producer Company Limited (4) it was highly significant at a 5% level but weakly significant when comparing it with Jan Nayak Farmer producer company limited which was coded as 5.

If one picks Maurya Farmer Producer Company Limited (4) as a reference category then it has maximum number of asterisk and significant difference with all other 4 FPOs *viz.*, significant at 1% level. From this it can be deducted that Maurya Farmer Producer Company Limited was the least impactful FPO.

CONCLUSIONS

In India, where 86.2% of farmers grapple with marginal land holdings, the government, inspired by economist Y. K. Alagh's committee, introduced Farmer Producer Companies (FPCs) to address challenges from production to marketing. For this five FPCs of Samastipur and Muzaffarpur districts in Bihar were investigated. Findings of the study, brought by using SPSS software, revealed that Samarpan Jeevika had the highest impact, with Maurya Farmer Producer Company Limited being the least impactful among them. The overall mean impact of FPOs was $\bar{x}$ =0.6664. This concise study underscores the significant role of FPCs in the agricultural landscape, aiming to empower small and marginal farmers for sustainable development.

FUTURE SCOPE

The study's findings on Farmer Producer Companies (FPCs) in Bihar highlight varying impacts among them. Future research could delve deeper into factors influencing these differences, examining successful FPC strategies, government policies' role, and long-term socio-economic effects. Analysing the sustainability and inclusive growth potential of FPC interventions would provide a comprehensive framework for enhancing their effectiveness in empowering small and marginal farmers.

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Conflict of Interest. None.

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