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Enhancing livelihood security of dairy farmers through farmers' producer company: a diagnostic study of Bundelkhand region

Anirban Mukherjee[1*], Premlata Singh[2], Satyapriya[2], Aniruddha Maity[3], Kumari Shubha[1] and Rajarshi Roy Burman[2]
[1]ICAR-Research Complex for Eastern Region, Patna-800014, India
[2]ICAR-Indian Agricultural Research Institute, New Delhi-110012, India
[3]ICAR- Indian Grassland and Fodder Research Institute, Jhansi-284003, India
*Corresponding author e-mail: anirbanmukjiari@gmail.com
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Abstract
Farmers'producer organization has been envisaged as a potential driving force for enhancing livelihood security in Bundelkhand. To diagnose the effect of joining farmers' producer company (FPC) on livelihood enhancement of dairy farmers, Hardol Milk Producer Company Limited (HMPC) was selected for the study. Difference in difference research design was used to record the effect of joining HMPC on enhancing sustainable livelihood dimensions of dairy farmers. For measuring that a sustainable livelihood index was developed which includes six different capital dimensions *viz.,* natural, physical, economic, human, social and political capitals. Equal weightage method of livelihood index formulation was adopted to study the changes in livelihood capitals over time between the treatment and the control group under study. The members and non-member dairy farmers were also compared based on eleven different socio-personal, socio-psychological variables and fifteen management practices related to dairy farming. It revealed that joining HMPC helped farmers to enhance their annual income from milk sale, social participation, extension agency contact, urban contact significantly. A significant difference in different livelihood dimensions was recorded between the HPMC members and control group which indicated joining the dairy based producer company enhanced member farmers' livelihood security, particularly in social capital (0.385) human capital (0.375) economic capital (0.232) and political capital (0.225).

Keywords: Capital dimensions, Dairy farmers, Livelihood sustainability index, Producer organization

Introduction

Farm-based livelihoods play a vital role in rural development planning, predominantly in the developing countries like India where a majority of workforce depends on agriculture and allied sector. Livelihood security has been focused much in recent decades with the increasing risks due to climate change. Livelihoods are secured when farmers possess secure ownership of, or access to resources and income earning activities, including reserves and assets, to offset risks, ease shocks and meet contingencies (Chambers, 1989). The Bundelkhand region is a drought prone area where the impact of changing climatic condition is notably visible. Half-hearted government interferences have been taken place at times to improve the livelihood of Bundelkhand farmers. Unexplained socio-economic and political stigmas have always been limiting factors in that region for upgrading the farm income, which has become worse with climatic irregularities. Besides the regular agricultural setbacks, lack of organized extension network and easy access to market has been a chronic problem in Bundelkhand region. In this scenario the solution is possible through exploring innovative market led extension models in order to integrate the farmers, especially the small farmers; with the value chain so that the remuneration is enough to hold the farmers in dairy farming. Several institutional models have been tried in India to integrate farmers with production and value chain like Self Help Groups, Farmers Interest Groups, and Farmers' Cooperatives etc. The recent model, Farmers Producers' Company, enables farmers to organize themselves as collective, provides them a business outlook to agriculture and links them to market (Mukherjee *et al.,* 2018a). The cooperative experience in India has not been a very pleasant one, as cooperatives have largely been state promoted, with a focus on welfare rather than business on commercial lines (Dabas, 2003). Even though numbers of states have introduced parallel cooperative laws, and the union laws too, have been made more liberal, the pace of reform has been far too slow. Several states have resisted all efforts at reforms (Singh *et al.,* 2012). There appears to be a growing awareness among policy makers that supply side

solutions to dairy must be balanced with investment on the demand side *i.e*., in the capacity of dairy farmers to build and manage institutions of their own, which can then develop locally relevant strategies to address problems and challenges.

Farmers producer companies (FPCs) have emerged as one class of institutions that hold tremendous promise in fulfilling this role. It was introduced in 2002 as new part IX A into the Companies Act 1956 under the chairmanship of renowned economist, Y. K. Alagh (Singh, 2008; Mukherjee *et al*., 2018b). Since then Indian farmers got a new opportunity to start expedition towards livelihood sustainability through FPC (Mukherjee *et al.,* 2018a). The main objectives of a FPC are: procurement of inputs, production, harvesting, grading, pooling, handling, storage, marketing, selling or exporting the primary produce of the company members or import of goods or services for them in addition to processing of produce of members, manufacturing, sale or supply of machinery, consumables, conducting training and awareness programme, insurance of crop and livestock and providing guidance for efficient natural resource management etc.(ASA, 2010; Chauhan, 2015; Mukherjee *et al.,* 2018a). There is a rising hope that the farmers producer company can act as a potential driving force for agricultural and rural development. The dairy farmers of Bundelkhand are facing tremendous climatic and economic challenges. Is this market led model secure livelihood for small dairy farmers? The present study was conducted to assess the outcome of joining Farmers Producer Company in terms of enhancing livelihood security of small dairy farmers.

Materials and Methods

***Study area and sampling*:** The study was conducted on Hardol Milk Producer Company Limited (HMPC) in Bundelkhand region of Madhya Pradesh state of India. The data was collected from 45 randomly selected member dairy farmers of the producer company and 30 nonmember dairy farmers from the same locale (as control group). In-depth interviews were conducted with key informants to ensure the triangulation of data. Proper care was also taken to make the respondents comfortable and unbiased recording of the data.

***Survey instrument*:** For the study, an interview schedule was prepared which consisted of eleven different socio-personal and socio-psychological variables, and fifteen management practices related to dairy farming. For measuring livelihood sustainability, a Livelihood sustai-nability index was constructed by following the standard protocol to measure the changes in livelihood parameters of the dairy farmers due to joining HMPC. The sustainable livelihood is a conceptual approach for a better understanding about the integral complexities of poverty and thereby assessing the dimensions, factors and opportunities of people's livelihood strategies (Wang *et al.,* 2016). There were six different dimensions in the index *viz*., natural capital, physical capital, economic capital, human capital, social and political capital. The natural capital included two indicators purchased new land and improved existing land. The physical capital dimension included 15 indicators such as possession of dairy cattle, *pakka* cattle shed, permanent house, fresh drinking water supply, main house, electricity, separate bathing shelter, separate kitchen, separate latrine, irrigation water pump, television, internet access, mobile phone, two wheelers, and four wheelers. The next dimension economic capital consisted of 5 indicators *viz.* having round the year income generating activity, bank account, investment in agri-business, increased savings and repaid old loans. Human capital dimension included trained in income generating activity, business planning, personal development, providing nutritional food and sending children to school. Social capital included 4 indicators such as live in more social groups, member in other groups, face no domestic violence, increase in contacts with other progressive farmers.The sixth and last dimension is political capital and that included indicators like becoming committee member, participation in project planning, project implementation, monitoring and evaluation, and participation in different village development activity. The data were recorded in binomial mode (yes=1, no=0). As the basic intension of the study was not to classify different groups/ states according to livelihood index score but to study the changes in livelihood capitals over time and compare between the treatment and the control group, equal weightage method of livelihood index formulation was adopted (Singh and Hiremath, 2008; Kamaruddin and Samsuddin, 2014).

***Research design*:** In the present study, a difference in difference (DiD) research design was used for estimating the effects of joining dairy based FPC on enhancing livelihood wellbeing. In the quasi experimental setting controlling confounding variables were important. It was calculated as-

$$= E\left(LW_1^T - LW_0^T | T_1 = 1\right) - E\left(LW_1^C - LW_0^C | T_1 = 0\right)$$

Where, LW_t^T and LW_t^C respectively denoted the livelihood wellbeing outcome response for members of HMPC and control group at period t=0, 1, where the time period t=0 corresponded to the period before the establishment of HPMC *i.e*. year 2011 and t=1 corresponded to the year 2018 during the survey. Further T_1 =1 represented for the membership of HPMC at the time t=1 T_1=0 means non-membership. The first term in the equation represented the average difference between before and after for the members and non-members of HPMC. It was calculated by the difference in livelihood wellbeing outcome (index score) of HPMC member group during between the time frame 2011 and 2018. It was further subtracted with the livelihood wellbeing index score of control group during between the time frame 2011 and 2018 following the method used in Heckman and Hotz (1989).

Statistical analysis: The comparison studies were done through nonparametric tests *viz.* Mann-Whitney U, Wilcoxon W, as the sample did not follow normal distribution. For the statistical analysis, the data were analyzed using MS Excel and SPSS 20 software.

Results and Discussion

***Operational and functional mechanisms of HMPC*:** The HMPC follows individual ownership model of farmers producer company in which farmers are directly forming company and the company is governed by Board of Directors (BODs) helped by Chief executive officer (CEO) and his office staff for functioning like procurement of milk, processing and marketing activities and administrative works (Fig 1).

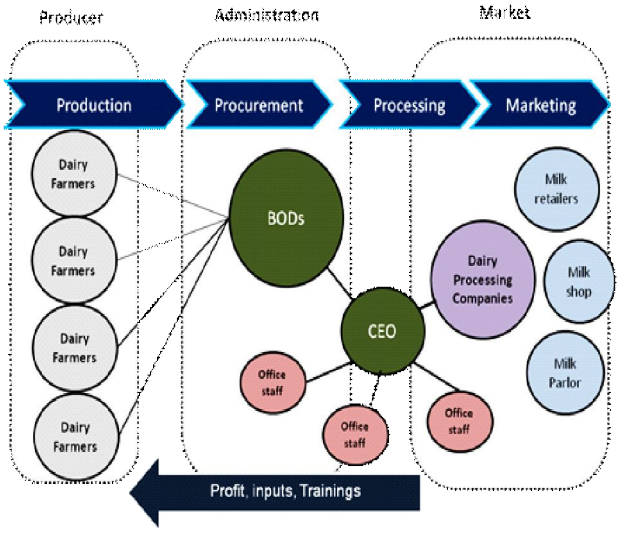

Fig 1. Operational and functional mechanisms of HMPC

The company has collaboration with Madhya Pradesh State Cooperative Dairy Federation Limited (Sanchi), Sterling Agro Industries Ltd's (NOVA), and PARAS Dairy. It helps the milk growers to provide services like artificial insemination with quality semen, providing balanced feeds to the milk growers (Sudana), cattle medical camps and trainings for the milk growers. The average livestock population of the member farmers is two buffaloes and one cow. With this livestock they supply 5-6 liters of milk to the collection center every day. The pricing of the milk varies from Rs. 34 to 38. The price paid for milk is based on the value of protein, fat and lactose.

***Comparison in socio-personal and psychological characteristics*:** A comparison of members of Hardol Milk Producer Company with non-member dairy farmers (control group) was done in the study by applying Mann-Whitney U test. In case of socio-personal variables like age, gender, education, education level, and family size there was no significant differences found as the selection of the control group was done with due care from the same locality and considering the similarity of the respondents (Table 1). Seven important socio psychological variables such as social participation, extension agency contact, urban contact, training experience, members of other group, progressiveness and attitude towards the milk producer company where also assessed in this study. It was found that member of farmers in majority were highly social participant (82.2%) in different programs organized in villages (Table 1). As per extension agency contact about 60% of the respondent member dairy farmers were exhibited high extension agency contact, while in case of non-member farmers only 20% of them were maintaining high extension agency contact. Regarding urban contact a similar kind of result was found. It showed near about 55.6% of the member farmers were maintaining a high urban contact as compared to the nonmember farmers (16.7%). Social participation, extension agency contact and urban contact are the variables indicated the degree of people's involvement in society and linkages with the agency working for agriculture (Dutta Das, 1995). The member dairy farmers scored significantly higher in all these variables, which indicated that the persons had more interaction and involvement in society once they joined the FPO. Regarding training experience, a big difference in training experiences was found as maximum of the member farmers were undergone at least one training (51.5%) or two or more trainings (48.9%) on dairy farming. It might be due to the membership program of the producer company which encouraged the members

Table 1. Comparison of socio-personal, and psychological characteristics of HMPC members and non-members

SN	Characteristics	Members F POfrequency (percentage) n=45	Non-member farmers frequency (percentage) n=30	Mann-Whitney U	Probability score and significance (2-tailed)
1	**Age**				
a	Young (18-35 years)	14 (31.1)	13 (43.3)	569.50	.250
b	Middle aged (36-50 years)	13 (29.9)	8 (26.7)		
c	Old (51-80 years)	18 (40.0)	9 (30.0)		
2	**Gender**				
a	Male	28 (62.2)	21(70.0)	622.50	.491
b	Female	17 (37.8)	9 (30.0)		
3	**Education level**				
a	Middle schooling	23 (51.1)	20 (66.7)	573.00	.237
b	Higher secondary	20 (44.5)	10 (33.3)		
c	Graduate	2 (4.4)	0 (0.0)		
4	**Family size**				
a	Nuclear (up to 5)	9 (20.0)	13 (43.3)	582.50	.308
b	Joint family (6 and above)	36 (80.0)	17 (56.7)		
5	**Social participation**				
a	high	37 (82.2)	7 (23.3)	277.50	.000**
b	low	8 (17.8)	23 (76.7)		
6	**Extension agency contact**				
a	high	27 (60.0)	6 (20.0)	405.00	.001**
b	low	18 (40.0)	24 (80.0)		
7	**Urban contact**				
a	high	25 (55.6)	5 (16.7)	412.50	.001**
b	low	20 (44.4)	25 (83.3)		
8	**Training experience**				
a	never	0 (0.0)	3 (10.0)	378.00	.000**
b	once	23 (51.1)	24 (80)		
c	two and more	22 (48.9)	3 (10.0)		
9	**Members of other group**				
a	No	16 (35.6)	20 (66.7)	465.00	.009**
b	Yes	29 (64.4)	10 (33.3)		
10	**Progressiveness**				
a	less	0 (0.0)	14 (46.7)	26.50	.000**
b	moderate	0 (0.0)	16 (53.3)		
c	high	38 (84.4)	0 (0.0)		
d	very high	7 (15.6)	0 (0.0)		
11	**Attitude towards FPC**				
a	Positive	41 (91.1)	17 (56.6)	1.500	.000**
b	Negative	1 (2.2)	8 (26.7)		
c	Neutral	3 (6.7)	5 (16.7)		

*(P<0.05); **(P<0.01); Figures in parenthesis indicate percentage

to take trainings time to time in the area of livestock production management, animal health management, feed and nutrition management etc. Majority of the member dairy farmers (64.4%) were also found as member of other groups like SHG, Joint Liability Group, Dairy Farmers clubs etc., whereas majority of non-member dairy farmers (66.7%) did not belonging to any such groups. Progressiveness is an important character of farmers and was studied by utilizing progressiveness scale (Mukherjee, 2018). As per the study, the member

farmers were high (84.4%) to very highly (15.6%) progressive, while the non-member neighbours were less (46.7%) to moderate progressive (53.3%). It indicated that progressiveness was probably associated with farmers' producer company membership. Attitude towards Farmers Producer Company was also assessed. It was found the majority of the member exhibited positive attitude (91.1%) when compared to non-member farmers (56.6%), rather 26.7% of the non-member farmer had negative attitude towards farmers producer company. In all these socio-psychological variables, the HMPC members were significantly differed from their non-member neighbours.

***Comparison in livestock management practices*:** The variables related to dairy farming management were also studied (Table 2) to understand the differences in dairy management practices followed by the HMPC members and non-members. Regarding frequency of feeding, the majority of the member farmers (55.6%) were following feeding of cattle 3 times a day, whereas majority of the non-member dairy farmer (83.3%) were feeding two times a day. it was observed that about 95.6% of the member dairy farmers were providing the concentrate feeds to animals as compare to only 46.7% of non-member dairy farmer. In case of mineral mixture feeding, it was found that 80% of the member dairy farmers were providing mineral mixture to animals, while it was 16.7% for non-member dairy farmers. Majority of the member farmers (71.1%) were feeding special ration to milking animals for increasing milk yield, whereas only 40% of the nonmember farmers were following it. Fat content is an important parameter for deciding milk price. It was found that 46.7% of member farmers were feeding special ration for increasing fat content in milk, whereas only 13.3% of non-member former was doing the same. Thus member farmers were found significantly more concerned. The reason might be periodic awareness and knowledge camps organized by the producer company for encouraging farmers to adopt improved management practices for enhancing dairy business at individual and collective level. Availability of the green fodder is important constraining factor for dairy farmers in Bundelkhand region. It was found that majority of member farmers (53.3%) use mixture of all green fodder available, whereas 37.8% of the farmer found cultivating green fodders in their field like maize (*Zea mays*), bajra (*Pennisetum glaucum*), berseem (*Trifolium alexandrinum*), sorghum (*Sorghum bicolor*), mapier (*Pennisetum purpureum*) etc. Majority of the member farmers were found dependent on the available grasses from cultivated fields and when grasses were not available they generally leave their animal free for grazing. Near about 20% of the non-member dairy farmers were using fodder tree leaves for animals. During the November to June the farmer faces tremendous problem of fodder. During the dry season tree fodder are mostly preferred by dairy farmers as fodder sources (Mukherjee *et al*., 2018c). Wheat straw was major source of dry fodder for majority of member and non-member farmers, followed by wheat and paddy straws. Some of the farmers were also using maize and jowar stovers. In case of the socio-personal variables like experience in dairy and annual income of respondents were significantly differed from each other. Majority (40%) of the dairy farmers had more than 20 years of experience. It indicated that age was not a factor in case of taking membership of producer company. The experienced people were more likely to take participation in producer company. Another interesting fact was that in spite of non-significant difference in herd size, annual income of the member farmers was found significantly different from the non-members dairy farmers. It indicated that there might be some other management factors, which were responsible for income enhancement of neighbour member farmers.

***Changes in livelihood sustainability*:** The differences in difference among the average scores in the six livelihood dimensions and respective indicators were recorded in the present study (Table 3). In case of natural capital much differences was not visible among the two groups as purchasing new land and improving the existing land requires a huge amount of money. In case of the second parameter physical capital there were 15 indicators and interestingly negative differences were observed in case of having fresh drinking water supply (-0.04), separate bathing shelter (-0.132), separate kitchen (-0.092) and separate latrine (-0.267). A considerable difference was found in access of internet (0.459), possession of dairy cattle (0.419), *pakka* cattle shed (0.216) and two wheelers (0.235). It might be due to the contribution of FPC, which allowed members to be aware about different knowledge management platforms in internet. The trainings and profitability gain in dairy business might influence the member farmers to purchase more dairy cattle, construct *pakka* cattle shed and possess two wheelers for carrying milk to the collection center. Study also indicated that income generating activities were increased over the year since 2011, but it was more for non-member groups rather than the members of HPMC (0.622) which revealed that nonmembers were involved in more diverse income

Table 2. Comparison of members and non-members dairy farmers of HMPC in respect to livestock management practices

SN	Characteristics	Members F POfrequency (percentage) n=45	Non-member farmers frequency (percentage) n=30	Mann-Whitney U	Probability score and significance (2-tailed)
i	**Heard size (in number)**	13 (28.9)	9 (30.0)	586.00	.324
a	2-3	25 (55.5)	21 (70.0)		
b	4-6	7 (15.6)	0 (0.0)		
c	7 and above				
ii	**Experience in dairy**	16 (35.6)	27 (90.0)	203.50	.000**
a	up to 10 year	11 (24.4)	2 (6.7)		
b	11-20 year	18 (40.0)	1 (3.3)		
c	21-30 years				
iii	**Annual income (in lakh Rs/year)**	23 (51.1)	24 (80.0)	406.00	.004**
a	up to 1.5	19 (42.2)	6 (20.0)		
b	1.51-3	3 (6.7)	0 (0.0)		
c	above 3				
iv	**Distance from milk. market**	21 (46.7)	2 (6.6)	130.00	.000**
a	0-4 km	24 (53.3)	14 (46.7)		
b	5-7 km	0 (0.0)	14 (46.7)		
c	above 7 km				
v	**Milk production (lit/day)**	31 (68.9)	28 (93.3)	246.50	.000**
a	up to 10 lit	13 (28.9)	2 (6.7)		
b	11-20 lit	1(2.2)	0 (0.0)		
c	above 21				
vi	**Household milk consumption (lit/day)**	38 (84.4)	22 (73.3)	558.50	.175
a	up to 2	7 (15.6)	8 (26.7)		
b	more than 2				
vii	**Milk sale (lit/day)**	35 (77.8)	29 (96.7)	258.50	.000**
a	up to 10	9 (20.0)	1 (3.3)		
b	11-20	1(2.2)	0 (0.0)		
c	above 21				
viii	**Feeding method followed**	8 (17.8)	7 (23.3)	637.50	.558
a	1	37 (82.2)	23 (76.7)		
b	2				
ix	**Frequency of feeding**	20 (44.4)	25 (83.3)	410.00	.001**
a	2 times a day	25 (55.6)	5 (16.7)		
b	3 times a day				
x	**Frequency of watering**	5 (11.1)	5 (16.7)	514.50	.067
a	2 times a day	22 (48.9)	7 (23.3)		
b	3 times a day	16 (35.6)	9 (30.0)		
c	4 times a day	2 (4.4)	9 (30.0)		
d	5 times a day				
xi	**Concentrate feeding**	43 (95.6)	14 (46.7)	345.00	.000**
a	Yes	2 (4.4)	16 (53.3)		
b	No				
xii	**Mineral mixture feeding**	36 (80.0)	5 (16.7)	247.50	.000**
a	Yes	9 (20.0)	25 (83.3)		
b	No				

SN	Characteristics	Members F POfrequency (percentage) n=45	Non-member farmers frequency (percentage) n=30	Mann-Whitney U	Probability score and significance (2-tailed)
xiii	**Feeding special ration to milking animals for increasing milk yield**				
a	Yes	32 (71.1)	12 (40.0)	465.00	.008**
b	No	13 (28.9)	18 (60.0)		
xiv	**Feeding special ration for increasing fat content in milk**				
a	Yes	21 (46.7)	4 (13.3)	450.00	.003**
b	No	24 (53.3)	26 (86.7)		
xv	**Sources of green fodder**				
a	Grasses available in cultivated field	3 (6.7)	14 (46.7)	474.00	.021*
b	Cultivated green fodder	17 (37.8)	0 (0.0)		
c	Leaves of fodder trees	1 (2.2)	6 (20.0)		
d	Mixture of all green fodder available in the season	24 (53.3)	10 (33.3)		
xvi	**Source of dry fodder**				
a	Wheat straw/*bhusa* only	28 (62.2)	26 (86.7)	512.00	.025*
b	Wheat straw + gram/lentil straw	3 (6.7)	0 (0.0)		
c	Wheat straw + paddy straw	12 (26.7)	4 (13.3)		
d	Wheat straw + paddy straw + maize /*jowar* straw (stover)	2 (4.4)	0 (0.0)		

*(P<0.05); **(P<0.01); Figures in parenthesis indicate percentage

generating activities than members (-0.045). Income diversification is a good sign towards livelihood security as it reduces the risk (Pandey *et al*., 2017; Gautam and Andersen, 2016). In case of member farmers, the value was less since they were focused on HPMC dairy business. A wide difference (0.597) was recorded in investment in agribusiness ventures, which might be due to joining HPMC and contributing to seed capital providing the investment option with calculated risk. For non-members investment in other agribusiness ventures were risky due to adverse climatic condition in Bundelkhand region. Good differences in increase in savings were also recorded (0.182). The changes in social capital was significantly diverge (0.385). The HPMC members took membership of other groups (0.573) and they were getting better recognition in family and friends (0.216), involved in less conflicts with neighbours (-0.144) and had better contact with progressive farmers (0.706). All these were probably due to joining HPMC, which flourished the social dimension of the farmers. They might have realized that business is a process of networking. Human capital is one of the important dimensions of livelihood wellbeing in which a significant difference between the member and non-member farmers were measured (0.373). The HMPC member farmers were trained in income generating activities (0.44), dairy business planning and management (0.44), personal development (0.546), intake of nutritional foods (0.44) and sending children to school. Joining in FPC, knowledge about the rights, working in different team position, voting power might have influence the member farmers to make better score in political capital. That was visible with wide difference in indicators scores: participation in project planning (0.195), project implementation (0.138), monitoring and evaluation (0.047), worked as committee member (0.568) and participate in different developmental activities in village (0.178).

The difference in changes of livelihood score over time (2011 to 2018) was recorded (Table 4). The highest difference was found in in social capital (0.385) followed by human capital (0.375), economic capital (0.232) and political capital (0.225). Except natural capital, there were significant differences between the members and non-members group with respect to all other dimensions.

Table 3. Changes in livelihood sustainability dimensions of members of HPMC and non-members during the year 2011 to 2018

SN	Dimensions and respective indicators	a	b	(b-a)	c	d	(d-c)	(d-c)-(b-a)
		Before 2011	After 2018	Difference of control group	Before joining HPMC 2011	After joining HPMC 2018	Difference of member group	Difference in difference
1	***Natural capital***							
N1	Purchase of new land	0.000	0.067	0.067	0.000	0.108	0.108	0.041
N2	Improvement of existing land	0.000	0.200	0.200	0.081	0.324	0.243	0.043
	Average score	**0.000**	**0.133**	**0.133**	**0.041**	**0.216**	**0.176**	**0.043**
2	***Physical capital***							
P1	Have Dairy cattle	0.000	0.067	0.067	0.054	0.541	0.486	0.419
P2	Have *pakka* cattle shed	0.000	0.000	0.000	0.027	0.243	0.216	0.216
P3	Have permanent house	1.000	1.000	0.000	0.865	1.000	0.135	0.135
P4	Have fresh drinking	0.933	1.000	0.067	0.946	0.973	0.027	-0.04
P5	water supply							
	Have main house	0.000	0.000	0.000	0.297	0.378	0.081	0.081
P6	Have electricity	1.000	1.000	0.000	1.000	1.000	0.000	0
P7	Have separate bathing shelter	0.133	0.400	0.267	0.405	0.541	0.135	-0.132
P8	Have separate kitchen	0.000	0.200	0.200	0.270	0.378	0.108	-0.092
P9	Have separate latrine	0.133	0.400	0.267	0.405	0.405	0.000	-0.267
P10	Have irrigation water pump	0.000	0.400	0.400	0.216	0.757	0.541	0.141
P11	Have television	0.867	1.000	0.133	0.622	0.838	0.216	0.083
P12	Have access of internet	0.000	0.000	0.000	0.081	0.541	0.459	0.459
P13	Have mobile phone	0.000	0.000	0.000	0.405	0.432	0.027	0.027
P14	Have two wheeler	0.000	0.333	0.333	0.135	0.703	0.568	0.235
P15	Have four wheeler	0.000	0.000	0.000	0.000	0.108	0.108	0.108
	Average score	**0.271**	**0.387**	**0.116**	**0.382**	**0.589**	**0.207**	**0.091**
3	***Economic capital***							
E1	Have income generating activity	0.000	0.667	0.667	0.270	0.892	0.622	-0.045
E2	Have bank account	0.400	0.800	0.400	0.378	0.973	0.595	0.195
E3	Investment in agri-business	0.000	0.133	0.133	0.108	0.838	0.730	0.597
E4	Increased savings	0.000	0.467	0.467	0.189	0.838	0.649	0.182
	Average score	**0.100**	**0.517**	**0.417**	**0.236**	**0.885**	**0.649**	**0.232**
4	***Human capital***							
H1	Trained in income generating activity	0.000	0.533	0.533	0.027	0.973	0.946	0.413
H2	Trained in dairy business planning and management	0.000	0.533	0.533	0.000	0.973	0.973	0.44
H3	Trained in personal development	0.000	0.400	0.400	0.027	0.973	0.946	0.546
H4	Intake of nutritional food	0.000	0.533	0.533	0.000	0.973	0.973	0.44
H5	Sending children to school	0.400	0.667	0.267	0.676	0.973	0.297	0.03
	Average score	**0.08**	**0.5332**	**0.4532**	**0.146**	**0.973**	**0.827**	**0.3738**
5	***Social capital***							
S1	Live in more social groups	0.000	0.400	0.400	0.000	0.973	0.973	0.573
S2	Member in other groups	0.000	0.400	0.400	0.000	0.973	0.973	0.573

SN	Dimensions and respective indicators	a	b	(b-a)	c	d	(d-c)	(d-c)-(b-a)
		Before 2011	After 2018	Difference of control group	Before joining HPMC 2011	After joining HPMC 2018	Difference of member group	Difference in difference
S3	Recognition in family and friends	0.000	0.000	0.000	0.243	0.459	0.216	0.216
S4	Conflicts with neighbours	0.067	0.400	0.333	0.378	0.568	0.189	-0.144
S5	Contact with other progressive farmers increased	0.000	0.267	0.267	0.000	0.973	0.973	0.706
	Average score	**0.013**	**0.293**	**0.280**	**0.124**	**0.789**	**0.665**	**0.385**
5	***Political capital***							
Po1	Committee member	0.000	0.000	0.000	0.054	0.622	0.568	0.568
Po2	Participate in project planning	0.000	0.400	0.400	0.000	0.595	0.595	0.195
Po3	Participate in project implementation	0.067	0.333	0.267	0.054	0.459	0.405	0.138
Po4	Participate in project monitoring and evaluation	0.000	0.467	0.467	0.000	0.514	0.514	0.047
Po5	Participate in village development activity	0.067	0.267	0.200	0.054	0.432	0.378	0.178
	Average score	**0.027**	**0.293**	**0.267**	**0.032**	**0.524**	**0.492**	**0.225**

Table 4. Significance of difference in changes of livelihood dimensions

Dimensions	Difference in difference(d-c)-(b-a)	Mann-Whitney U	Wilcoxon W	Asymptotic significance (2-tailed) P value
Natural capital	0.043	630.000	1095.000	.514
Physical capital	0.091**	259.000	724.000	.000
Economic capital	0.232**	360.000	825.000	.000
Human capital	0.375**	521.500	986.500	.000
Social capital	0.385**	132.000	597.000	.000
Political capital	0.225**	392.000	857.000	.002

**(P<0.01)

Farmers' producer organizations are working in different sectors of agriculture and allied activities (Trebbin, 2016; Mukherjee *et al.,* 2018a) for enhancing prosperity of rural livelihood. The FPCs provides services like supply of raw material, training and human resource development, value chain management, marketing, financial assistance, technology backstopping and social securities (Trebbin and Hassler, 2012; Trebbin, 2016; Mukherjee *et al*., 2019). The present study was done to identify outcomes of joining Farmers Producer Company in terms of enhancing livelihood security of dairy farmers particularly in Bundelkhand region. Choice of livelihood strategy was mainly dependent on the types of livelihood capitals majorly possessed by the households (Pour *et al.,* 2018). In this study for the dairy farmers who joined the HPMC in 2011 was found high in human capital (0.973), followed by economic capital (0.885), and social capital (0.789) as most important three dimensions during the survey, whereas for the control group the most important three dimensions were human capital (0.533), economic capital (0.517) and physical capital (0.387). Human and economic capitals were found common in both the cases, which were commonly found in case of non-farm households (Hua *et al.,* 2017). Farm based households possesses majorly natural, physical and social capitals (Hua *et al.,* 2017). In this case the dairy farmers' major incomes were from dairy sector and thus the results were similar to non-farm households.

In 2011, physical and economic capitals were higher than the other livelihood dimensions for both the cases of HPMC members (0.382, 0.236) and non-members (0.271, 0.10) groups, respectively. The member farmers were in better position in both the capitals. Financial assets play a significant role in helping farmers to take risk and join HPMC. One possible reason was that joining HPMC requires funds for seed capitals of company which was similar with the findings of Chen *et al*. (2014) in

case of adoption of agricultural engineering technology. Richer farmers are more likely to take adaptation measures to enhance livelihood security in vulnerable climatic conditions like Bundelkhand (Deressa *et al.*, 2009; García De Jalon *et al.,* 2018).

In order to have a clear picture about the possible outcome of joining HPMC it was seen that there were significant changes found in social capital (0.385), human capital (0.375), economic capital (0.232) and political capital (0.225). The reason behind that was the principles and practices followed in farmers producer company. Farmers producer company provided a platform for farmers to join together, involve together and work with groups. This enhanced farmer's interaction with different progressive farmers working in dairy sector. The result was revalidated with the significant difference in social participation which was recorded during the survey (Table 1). Improvements in social capital could help farmers overcome their cognitive, normative and institutional barriers (Jones and Boyd, 2011; García De Jalon *et al.,* 2018).

In HPMC, the member farmers were involved in several awareness camps, short training programme in dairy and animal health management. These continuous training and skill upgradation programs might have enhanced the scores in human capital. Farmers with better human capital are more likely to have sustainable livelihood strategies (Alam *et al.,* 2016; Ochieng *et al.,* 2017). There were significant differences found in training experiences, extension agency contact, progressiveness and attitude towards HPMC (Table 1). All these indicated about the development of human capital as a result of joining HMPC. The development of human capital helped to enhance the farmers' knowledge and facilitate them to be better aware of their livelihood risks while also improving their ability to access and use information to better deal with their livelihood risks (Li *et al.,* 2017). Farmers with poor economic capital face livelihood risks (Ochieng *et al.*, 2017) and that make them more likely to be exposed to risks and lead to livelihood vulnerabilities. For the dairy farmers, HPMCs constant support and training programs helped to enhance their knowledge in commercial dairy farming. The results was recorded as significant difference in different dairy management practices like milk production, frequency of feeding, concentrate feeding, mineral mixture feeding, providing special ration to dairy cattle during stress period (Table 2). Market plays an important role in securing assured income and thereby livelihood sustainability. Proximity to market centers is a major influencing factor for the adoption of high returning livelihood strategies (Khatiwada *et al.*, 2017). The distance from milk market for the HPMC members group were found significantly closer than the control group and this was due to the milk collection center of HPMC at the villages where the members lives. It also reduced the transportation cost and thus further savings. Political capital describes about the involvement of member group in different political activities, village development activities. It also implies about the political empowerment of the member group. Joining FPC provided an environment for the members to work in different leadership positions like Board of Directors, heads of village groups/ self-help groups etc.

Conclusion

Study revealed that joining HMPC helped farmers to enhance their income from milk sale. Joining dairy based farmers producer company exhibited significant changes in social capital, human capital, economic capital and political capital of the dairy farmers group. Changes in social capital (0.385) was found as highest followed by human capital (0.375) and economic capital (0.232) among the most important three dimensions. Farmers producer company provided a platform for farmers to join and work together in groups, organize several awareness camps, short training programme in dairy and animal health management and economic support for the members dairy farmers. Thus it contributed in livelihood security of dairy farmers of Bundelkhand region.

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