



## An innovation system perspective of two dairy value chains in Kerala

V SREERAM<sup>1</sup> and JANCY GUPTA<sup>2</sup>

Centre for Research on Innovation and Science Policy, Hyderabad, Telangana 500 034 India

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### ABSTRACT

Although recognized that collaborative performance of the diverse actors are crucial for the success of a value chain, there have been few efforts to understand their dynamics of linkages and interactions in context of dairying. This study fills the gap by analysing the convergence among various actors of 2 dairy value chains (SBCMSS and PDDP) with an innovation system focus. Key informant interviews supplemented with household level survey among the livestock rearers were conducted to collect data. Snowball sampling was followed to identify diverse actors of value chains followed by simple random sampling for mapping the innovation system. Data were analysed using Social Network Analysis (SNA). Results indicate that dairy farmers hold the key influential position in the ego network of SBCMSS and the private dairy firm in case of PDDP. However, the network members of SBCMSS were more likely to access various resources and services than that of PDDP. Besides, there is a considerable scope for enhancing the linkages among the actors for better interaction. Higher centrality measures for the farmers in terms of information brokerage and proximity to the other actors were desirable results for the future extension and technology dissemination interventions. Policy makers could focus on fixing the gaps in linkages between the actors and reconfiguring the interactions to strengthen the central actors to improve the performance of innovation system.

**Key words:** Convergence, Ego networks, Kerala, Linkages, Social network analysis

In Kerala, the dairy sector is of great importance to the livelihood of poor farmers, as majority of them are marginal farmers (90%), who own more than two third of the total cattle population (Agricultural Development Policy 2013). Though the sector in the state is technologically advanced it has not achieved its full potential, as evident from the negligible contribution (2.14%) of milk towards the national production (BAH&FS 2015). Further, variability (27–21 lakh tonnes) in milk production for the last two decades (CLPR 2014), due to decline in the overall cattle population and poor value addition of milk, pushed the sector to a subsistence level. Though the Kerala Cooperative Milk Marketing Federation (KCMMF) is playing the lead role in milk procurement and accounts for 64% of the total milk procured under organized sector, only 17% of the total milk produced is handled by the organized sector including the private dairy firms and traditional milk cooperatives (Anonymous 2017). On the other hand, the weak extension infrastructure and knowledge gap particularly in the livestock sector (National Livestock Policy 2013) poses another set of challenges to the sector. Hence there is an urgent need to bring, institutional and policy interventions so as to rejuvenate the dairy sector through innovative value

chain (DVC) models to organize the producers. In this context, the Agricultural Innovation System (AIS) would be a better framework to analyse the performance of DVCs as articulated by many of the previous researchers (Methu *et al.* 2013, Anandajayasekeram and Gebremedhin 2009). In this study, we looked into the alignment of various actors (farmers, input and service agencies, market players etc.) with respect to two evolving DVCs. This is important because innovation in the DVCs is driven by new information, knowledge, practices, and technologies, and involves engaging different actors with complementary skills along the value chain (Hilary *et al.* 2017, Ayele *et al.* 2012). Hence in this study, we tried to analyse two unique DVCs in Kerala coming under different domains, through an innovation system lens. We were particularly interested in knowing about the actor diversity, level of integration of the core actors into the value chain by identifying the linkages and interaction. Besides we tried to explore how the functional innovation system supports the livestock farmers in their networks (Davis *et al.* 2006) by going beyond their traditional unit of analysis, i.e. the individual household.

*Evolution of Sulthan Bathery Cooperative Milk Supply Society Ltd., Sulthan Bathery, Wayanad, Kerala*

The SBCMS Society, the single largest primary milk cooperative society in the state, started its functioning in

Present address: <sup>1</sup>Research Officer (srieram@gmail.com), <sup>2</sup>Principal Scientist (jancygupta@gmail.com), Division of Dairy Extension, ICAR-National Dairy Research Institute, Karnal, Haryana.

1963. Though the milk procurement is limited to 3 adjoining villages, viz. Noolpuza, Bathery and Nenmeni in Wayanad district, the cooperative firm has 6,464 farmers, as its active members under its fold. Till 2007, the society was working in the Anand pattern of cooperative model (APCOS) by procuring and supplying milk to Milma with the retail selling of limited quantity of milk, locally. When the differences cropped up with Milma with respect to local sale of milk, the society established its own cold storage and processing logistics and started selling own branded milk and dairy products. The society raised the required finance, by sourcing credit from the member farmers' share amount. Today it has a daily procurement of around 27,000 litres of milk with a local sale of milk around 5,000 litres/day through its local outlets. With the other value added dairy products like curd, ghee, peda etc. besides the pasteurized milk SBCMSS has a strong market presence in Wayanad and nearby districts. SBCMSS had also implemented a range of initiatives like the establishment of milk ATM and dairy information kiosk with the support of Dairy Development Department (DDD), dairy based Joint Liability Groups (JLG), to facilitate bank linkage for its members. According to its official records, around 600 farmers were organized into 120 JLGs, promoting the dairying activities in the locality. The cooperative firm also have plans like free medicare for the animals of member farmers and own veterinary hospital.

#### *Evolution of Peoples' Dairy Development Project, Ernakulam, Kerala*

The PDDP was the first dairy development project started in the state, in 1973 as an extension of Welfare services, the organization responsible for the promotion of welfare activities in the Ernakulam district. Initially the project was conceptualized to provide basic agricultural services to the farmers of the locality particularly during the period of Green Revolution. Dairying was identified as a potent tool to encourage cooperative action and mobilization of the poor for their inclusive development by the organization. Initially there were 10 dairy cooperative societies under PDDP. Once Government Dairy of Kerala signed a contract with the project to procure the milk from its societies, it became the first established milk procurement route in the state. Though the state's own Milk Cooperative, KCMMF (brand Milma) was established in 1980 with the organization of its own network of dairy cooperative societies, the milk procurement from PDDP societies continued till 1983. Subsequently, PDDP started own marketing of the branded milk and other dairy products and expanded its reach to more districts for procuring milk. Today it has an extended network with 200 milk societies sprawling across 9 zones in 4 districts (Ernakulam, Kottayam, Idukki and Thrissur) and two processing plants one each in Kerala and Tamil Nadu. Also it diversified its market by producing range of dairy products under the brand name *People*. The average/day milk sale stands at 60,000 litres with a network of 200 societies and 30,000

member farmers. There are some unique features with respect to the milk procurement by PDDP. In contrast to the other dairies, measurement of procured milk is in kilograms rather than litres in the PDDP societies to benefit the farmers as it would fetch more price/unit quantity of milk for them (as 1 litre is equivalent to 1.03 kg). Other member welfare schemes of PDDP include free veterinary service delivery and AI service on doorstep on nominal charges, insurance schemes, cattle feed subsidy, milk production incentives etc. Each PDDP society has a 7 member elected committee to look after the day today activities. A director board comprising 9 members representing the different zones is constituted at the top level for its governance (PDDP 2000).

#### MATERIALS AND METHODS

The 2 DVCs were selected from different domains for the purpose of this study. The study sampled various actors of each of these value chains, which included the public sector actors (Line departments, dairy research and development organizations), independent actors (NGOs and other producer associations), cooperative actors as well as the private players (input and service providers). Data were primarily drawn from the semi-structured interviews conducted with the key informants representing various organizations as well as the 75 dairy farmers each, linked to PDDP as well as SBCMSS, during June to September 2016. An ego centric approach was followed (Orchard *et al.* 2015) to identify and map the actors of both the DVCs. Key informants were identified by following snowball sampling by starting from the officials of both the DVCs. Interviews focused on the evolution of the DVC, actors and their roles and responsibilities, linkages and interactions. Social Network Analysis (SNA) is a proven method to analyse the system dynamics particularly in exploring the multiple interactions and functional linkages (Mariam *et al.* 2016, Thuo *et al.* 2013, Spielman *et al.* 2007). The ego networks of the dairy value chains were drawn to depict the functional linkages among the actors. Also this revealed the influence of the farmers, the core actors of the agricultural innovation system on the other actors (Chindime *et al.* 2016). These visual maps were then supplemented with quantitative network measures, following Mariam *et al.* (2016). Various network parameters like network size, reach efficiency, pairs, *betweenness* and network centralization were used to analyse the ego networks (For further details including the mathematical expression of these parameters, please refer Hanneman and Riddle, 2005).

For studying how the functional innovation system support the farmers, livestock rearers of each DVC were randomly selected from the list of members maintained by the respective milk societies. Face to face interviews were conducted at the household level, with an already set sampling boundary of 75 respondents for each DVC. Data were elicited from these farmers on the key dairy information and service providers as considered by them.

The question asked was “Who are your key information and service providers with respect to dairying?”. As farmers’ innovate capacity is shaped by a wide range of actors who provide information and technology as well as the underlying context (Davis *et al.* 2006), we found that such an approach deemed relevant. Again SNA was used to depict the operational innovation system based on the collected data. The results were interpreted based on the various centrality measures as given by Hanneman and Riddle (2005). Network maps were drawn using open source software, viz. Gephi (Bastian *et al.* 2009). For quantitative analysis, Ucinet®6 for Windows (Borgatti *et al.* 2002) was used. Besides, various descriptive measures like mean and standard deviation were also used to analyse the data.

RESULTS AND DISCUSSION

Various actors connected to the 2 DVCs of focus were identified and mapped in the ego network. The ego network of farmers of SBCMSS is presented in Fig. 1. From a visual inspection of this diagram, it is evident that dairy farmers were linked with the line departments, veterinary university as well as some of the important independent organizations like Wayanad Farmer’s Association (WYDA) and Brahmagiri Development Society (BDS). WYDA is a farmer’s collective, supplying brewery waste and other local cattle feeds to the farmers of that locality. BDS, an independent organization is working for the rural development and actively promotes dairying in that locality. It organizes training for the farmers as well as supplies inputs like fodder seeds. The line departments (Agriculture and Dairy) often contract BDS to supply the fodder stubble

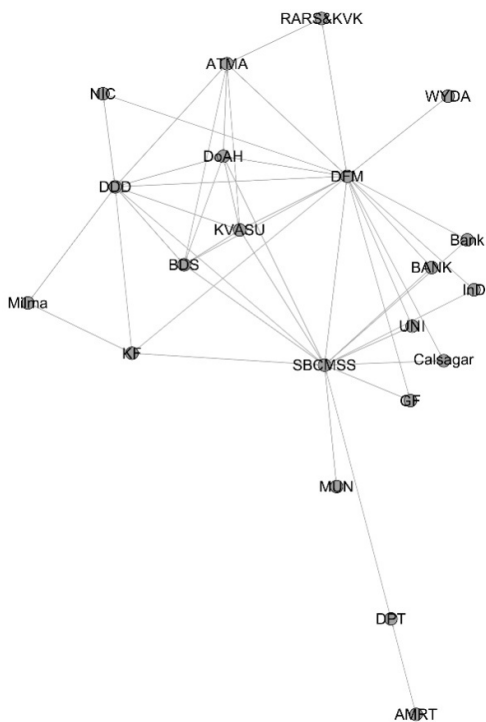


Fig. 1. Ego network of the dairy farmers of SBCMSS.

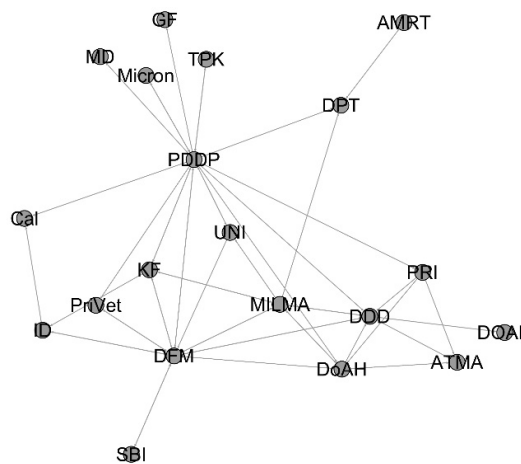


Fig. 2. Ego network of the dairy farmers of PDDP.

and seeds for their departmental fodder promotion programmes. The farmers were getting a strong knowledge support from 2 research institutions, viz. the Kerala Veterinary and Animal Sciences University (KVASU) as well as the Regional Agricultural Research Station & KrishiVigyan Kendra (RARS&KVK) of Kerala Agricultural University. KVASU also had established an animal feed quality checking lab for the benefit of dairy farmers. SBCMSS procures milk from 3 adjoining villages in Wayanad. It is the sole procurer of milk in these villages and there was no alternate milk buyers like Milma in that locality. Therefore the important link between farmers and Milma was missing as evident from the network. This link, if operational, would have given more leverage to farmers to sell their produce based on the milk price. Otherwise, farmers in the network were well connected with various public knowledge and service providers (DDD, DoAH, NIC, KVASU, RARS&KVK, UNI), input providers (Input dealers and WYDA), market linkers (SBCMSS), finance related institutions (Bank) as well as independent service agencies (BDS).

Both the dairy department and veterinary department were strongly linked and conduct joint activities like farm schools under ATMA as well as other training programmes. Also DDD had collusion with National Informatics Centre (NIC) for delivering technological services. As a result, the daily transactions in most of the milk societies were digitized including that of SBCMSS at Wayanad. Also dairy information kiosk had been established in most of the milk societies, with the financial support of DDD and technological backing of NIC. Coming to the ego network of PDDP (Fig. 2), farmers had connections with alternate milk marketing channels, i.e. the private actor PDDP and the State milk cooperative, KCMMF (Milma). Here in the study locale it was observed that farmers had access to the milk collection centers of both PDDP and Milma. So they have more selling options at their disposal depending on the price and other services rendered by their milk procurers. Also farmers had linkages with other important actors like

Table 1. Ego network parameters of SBCMSS and PDDP

Actor	Size		Ties		Pairs		Density		Reach efficiency		Betweenness Score	
	SBCMSS	PDDP	SBCMSS	PDDP	SBCMSS	PDDP	SBCMSS	PDDP	SBCMSS	PDDP	SBCMSS	PDDP
Amritha Milk Pvt. Ltd. (AMRT)	1	1	0	0	0	0	0	0	0	0	0	0
ATMA (ATMA)	6	4	22	6	30	12	73.33	50	35.56	0.5	2.33	3
State Bank of India	2	3	2	2	100	3	3	3	60.71	3	0	3
Brahmagiri (BDS)	6		26		30		86.67		32.73		0.45	–
Calsagar (Cal)	3	3	2	0	6	6	33.33	0	58.06	1	4	2
Dairy Development	9	6	30	13	72	30	41.67	43.33	0.57	4.83	30	28.62
Dairy farmers (DFM)	15	11	46	26	210	110	21.9	23.64	25.71	30.91	89.23	48.8
Dept. of Animal Dairy product traders	6	6	24	16	30	30	80	53.33	38.64	3.5	32.73	2.03
Godarej Feeds (GF)	3	2	6	0	6	2	100	0	53.13	1	0	1
Input Dealer (InD)	4	4	8	1	12	12	66.67	8.33	51.43	0.92	2	8
Kerala Feeds (KF)	4	4	6	6	12	12	50	50	51.43	48.57	6	3
KV&AS University (KVASU)	6	–	25	–	30		83.33	–	32.73	–	0.7	–
Milma (Milma)	3	7	0	7	6	42	0	16.67	75	0.83	3	15
Municipality (MUN)/ Panchayath (PRI)	1	3	0	3	0	6	0	50	100	0.5	0	0.5
National Informatics Centre (NIC)	2	–	2	–	2	–	100	–	66.67	–	0	–
RARS&KVK	3	–	6	–	6	–	100	–	53.33	–	0	–
SBCMS Society (SBCMSS)	13	–	31	–	156	–	19.87	–	30.16	–	87.75	–
United Insurance	2	2	2	2	2	2	100	100	60.71	70.83	0	0
WYDA (WYDA)	1		0	–	0	–	0	–	100	–	0	–
Media (Md)	–	3	–	3	–	6	–	50	–	0.5	–	0
Micron (Micron)	–	1	–	0	–	0	–	0	–	0	–	0
PDDP (PDDP)	–	13	–	13	–	156	–	8.33	–	0.92	–	118.17
Privet Veterinarians (PriVet)	4	–	6	–	66.67	–	3	–	–	56.67	–	0.5
Tetrapack (Tpk)	–	1	–	0	–	0	–	0	–	0	–	0

\*(Codes used in the ego network are given in the parenthesis)

financial institution (SBI), Input dealers (InD, KF), private veterinarians (Privet) as well as line departments (DDD and DoAH). PDDP had own veterinary hospitals and contracted private veterinarians to deliver better technical services to its farmers. PDDP had linkage with a variety of private logistic service providers (Tetrapack, Micron) as well as input and service providers like United Insurance, Godarej Feeds, Kerala Feeds and Calsagar to benefit its member farmers. Further, various ego network parameters of the DVCs are calculated and compared which is presented in Tables 1 and 2.

Various descriptive measures of the network properties

Table 2. Descriptive measures of ego networks

Measure	SBCMSS	PDDP
Network size (number of nodes)	20	18
Number of ties	80	63
Ego network density	0.211	0.184
Network centralization (%)	44.32	45.06
Closeness centrality (Normalized)	87.08	67.51

of SBCMSS could be summarized as follows. The density (2.1%) and number of ties (296) was relatively higher in the SBCMSS network than the respective measures of PDDP (Table 3). This shows that in the innovation network of SBCMSS, farmers were connected slightly better than that of PDDP. On an average, the actors in the network had 2.46 connections with other actors and a mean brokerage power of 97.3. In other words, each actor in this network was acting as a connecting link to other actors to a higher degree than in the network of PDDP. Also the integration of the actors was also comparatively better in the network with mean closeness score of 1.35 compared to a lesser score obtained for the PDDP network (1.17).

An overview of the network properties of the innovation system actors of SBCMSS revealed similar trend as observed in case of other networks (Table 4). The veterinarian was the chief information/service actor along with an input supplier (Vet1, Vet2, In2). However, in case of PDDP, private veterinarian (Pvet1) was the chief actor than the Government veterinary doctor of the locality. This is because PDDP had contracted many private veterinarians

Table 3. Descriptive measures of the farmer’s network of SBCMSS and PDDP dairy value chains

	In degree centrality							Out degree centrality				Betweenness centrality				In closeness centrality			
	X1	X2	X3	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
SBCMSS	0.021	296	2.46	2.46	2.40	0.0	22	2.46	3.20	0.0	10	97.3	197.5	0.0	934	1.17	0.35	0.83	1.83
PDDP	0.020	216	2.16	2.16	2.83	0.0	23	2.16	1.84	0.0	9.0	25.8	49.7	0.0	233	1.35	0.20	1.00	2.35

X1, Density; X2, no. of ties; X3, average degree; Avg, Mean; SD, standard deviation; Min, minimum; Max, maximum.

Table 4. Innovation network properties of SBCMSS and PDDP dairy value chains

	Degree centrality				Closeness centrality				Betweenness centrality	
	In degree		Out degree		In closeness		Out closeness		Ego (ID)	Score
	Ego (ID)	Score	Ego (ID)	Score	Ego (ID)	Score	Ego (ID)	Score		
SBCMSS	Vet1	22	S70	10	Vet1	1.83	S56	2.23	S37	934
	Vet2	15	S74	9	Vet3	1.77	S74	2.14	S21	865
	In2	13	S63	8	Vet5	1.76	S57	2.13	S4	680
PDDP	Pvet1	23	P16	9	Pvet1	2.35	P59	1.59	P14	233
	P26	9	P14	7	Vet2	1.72	P65	1.48	P1	221
	P61	8	P27	6	Pd1	1.66	P57	1.46	P11	208

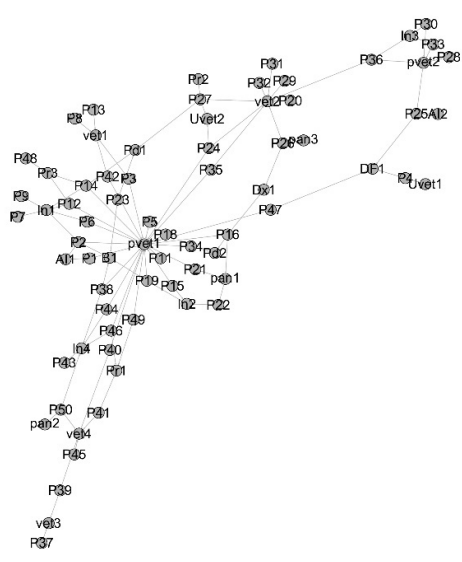
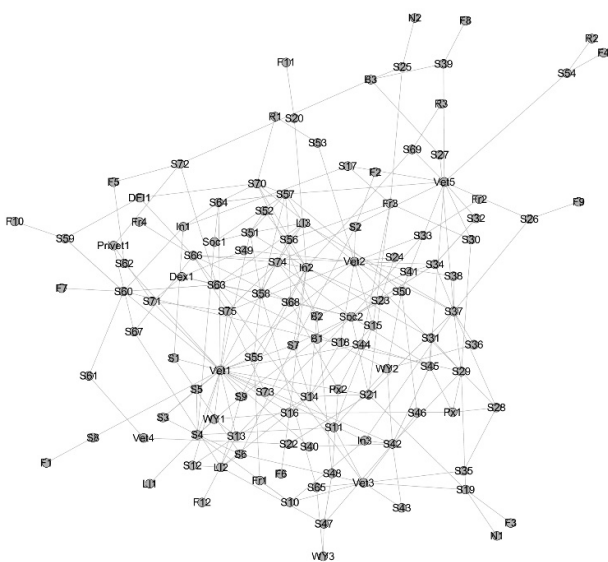


Fig. 3. Innovation system network of SBCMSS. S1-S75, Dairy farmers; B, Beer waste trader; P Vet, Private veterinary doctor; Vet, Govt. veterinarian; Nb, Neighbour farmer; R, Relative farmer; In, Input agent; F, Family members; Pan, Municipality official; Wy, WYDA official; Soc, Official of milk cooperative society; Pr, Progressive farmer; Px, Official of Brahmagiri.

Fig. 4. Innovation system network of PDDP. P1-P75, Dairy farmers; B, Beer waste trader; PVet, PDDP Veterinary doctor Uvet, Govt. veterinarian; Nb, Neighbour farmer; R, Relative farmer; In, Input agent; F, Family members; Pan, Panchayath official; Pd, PDDP cooperative official Dx, Milk vendor of Cooperative society; Pr, Progressive farmer.

for offering services to its members. So farmers connected to PDDP found it more convenient to contact them as their availability was better than the Government veterinarian. In this manner, farmers of this network were having a diverse authentic information source which is a desirable scenario. In terms of *out degree centrality* and *betweenness centrality* farmers was dominant in both the networks, implying their higher information seeking behaviour and brokerage power respectively (Matuschke 2008). Hence any proposed information interventions should make the benefit

of these farmers by making them vital part of the information campaigns so as to derive maximum output. The same trend was also observed with respect to the in closeness measures which revealed the higher level of integration of actors to the networks and their relatively higher access to various information and services. However, actors with higher *out closeness* measures were not well receiving the access to dairy related information and service and they demanded special attention.

This nascent field of investigation was primarily aimed

at exploring the innovation system of 2 unique DVCs. From the study many important findings have emerged. At first, it became apparent that farmers are the major drivers of the innovation system of SBCMSS while it is the private dairy PDDP itself, in the other case. Farmer driven value chains are highly desirable as it would be more focused on the demand driven services and resource provisions. In terms of the configuration of the ego network, the advantage is tilted towards the members of SBCMSS as indicated by the density and dominant position of the farmers. The higher centralization measure for PDDP in its network may likely to fasten the flow of resources and put the private firm in a commanding power. Besides the study also identified the key players in both the DVCs based on their centrality measures. As the result indicates while the public veterinary doctor remains the most important actor in the innovation network of SBCMSS, it is the private veterinary doctor in the case of PDDP. This demonstrates that farmers in both the networks were connected to authentic information and service providers. However as the network density measure indicates that, many of the potential links among the farmers were still not established which could be promoted for better networking and interaction among the actors. The *betweenness* and *in closeness* measures indicates that, farmers were the major information brokers and more integrated actors in the networks. These results are encouraging for the policy makers while planning for any extension interventions for knowledge/technology transfer. Caution is warranted in designing the training programmes to include the actors with high *betweenness* score as they are the potential gatekeepers of information to more other actors.

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