

VARIABILITY OF EXTENSION CONTACTS AND SOCIAL PARTICIPATION WITH CLIMATE RISK AMONG COASTAL DAIRY FARMERS

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ABSTRACT

Dairy farming in coastal regions faces various challenges due to changing climate, which has to be addressed by ensuring frequent and regular climate and livestock management information. Using Social Network Analysis (SNA), centralities of climate and livestock management information sources, and social participation networks among 120 high-climate risk and low-climate risk farmers from coastal low-lying regions of Kerala were analyzed. Low-risk farmers engaged extensively with extension contacts for information, while high-risk farmers exhibited relatively limited involvement confined to formal sources. Livestock Inspector and Veterinary Hospital showed a higher contact and closeness in the farmer network. Milk co-operative in Kerala, 'Milma' showed high engagement with both groups, whereas Panchayat, Credit Co-operative Society, and NGOs had relatively greater interaction with low-risk farmers. Education, land size and herd size were identified as significantly and positively influencing both extension contact and social participation. Thus, we can observe variations in utilization of extension contacts and social participation networks to address climate change, and to reduce these gaps, improving outreach strategies for different extension contacts and enhancing social participation among high-risk farmers should be emphasized in coastal dairy farming systems.

Keywords: climate change, information sources, social participation, social network analysis

INTRODUCTION

Climate change has been one of the major research areas because of its widespread effects all over the globe, affecting populations and production systems associated with it. Even if global mean temperatures were constant after the twenty-first century, several aspects of the climate system would keep on changing, including increased sea level rise (IPCC, 2018). India, one of the most climate vulnerable regions where a large population depends on climate-sensitive industries like agriculture, fisheries, animal husbandry etc. (Vinaya and Shivamurthy, 2021; Vinaya and Tapan, 2023; Vinaya and Gadde, 2025;), has already been showing signs of severe climate change and is predicted to worsen more (Krishnan *et al.*, 2020). Especially in the dairy sector in India, climate change has been linked to a significant decline not only in milk production but also to reduced feed intake and increased occurrence of many diseases, including Foot and Mouth Disease (FMD) (Lal *et al.*, 1987; Choudhary & Sirohi, 2022; Sirohi & Michaelowa, 2007), affecting overall livelihood of farmers. To cope up with climate change, farmers adopt various adaptation strategies, which are critically related to availability of information sources to build resilience among vulnerable households (Alam *et al.*, 2017; Chovatia *et al.*, 2024; Mallick *et al.*, 2023; Chuadhari

et al., 2023; Jena *et al.*, 2023; Vinaya *et al.*, 2022). Extension contacts were identified as a key determinant in enhancing adoption of climate-resilient practices among farmers (Mishra *et al.*, 2024; Tanti & Jena, 2023). The successful implementation of climate change adaptation among farmers mostly dependent on the operation of local agents and institutions that provide institutional assistance and incentives (Agrawal, 2010). Social engagement was proven to be significantly correlated with dairy farmers' adaptation strategies (Ghasura *et al.*, 2024) and their knowledge level to adopt scientific management practices (Chaudhary *et al.*, 2024). Hence, it is necessary to research how interaction with various extension contacts and social participation differ among respondents with changes in climate so that the insights can be used to formulate suitable adaptation practices for them.

OBJECTIVE

To assess the variability of extension contacts and social participation with climate risk

METHODOLOGY

Multistage sampling was followed in the study. Alappuzha district in Kerala state, was selected purposively

covering 13.9% of Kerala coastal, is the only coastal climate change hotspot in the state and is considered highly vulnerable due to its low-lying geography and exposure to frequent floods and droughts (Irrigation Department 2022; SDMA 2023; IMD 2023). In the district, random sampling was followed to select 15 farmers from each of 8 villages from four coastal low-lying taluks, which together constituted a total of 120 dairy farmers. Exploratory and non experimental study design was followed. Primary data were collected using semi-structured interview schedule. The research followed a cross-sectional time horizon, as data were collected at a single point in time. Statistical analysis was carried out using social network analysis and correlation.

Social Network Analysis (SNA) has been considered as a potential tool for revealing hidden information flow mechanisms among farmers and offering insightful information for devising strategies for disseminating information that can reach even the most isolated and underprivileged farmers (Simon et al., 2021). First, the risk to climate change among coastal dairy farmers was assessed using IPCC 5th Assessment (AR5) (2014) framework, and then they were classified into low and high categories based on the risk index scores. UCINET 6 was used for calculating network measures. Some of the basic social network matrices were used for analysis which are explained and interpreted as follows:

- (1) Degree Centrality (DC): It measures the number of direct connections an actor has in the network, which was converted into 0-1 scale by the software. The higher the value, the more popular or central will be the node (Golbeck, 2015).
- (2) Closeness Centrality (CC) indicates how quickly an actor

can access other actors in the network. A high closeness centrality indicates more closeness with others, thereby being in a position to gain information from others (Spielman et al., 2011)

- (3) Betweenness Centrality (BC) reflects how often an actor comes between the shortest path between two other actors. Actors with high betweenness centrality play an important role by bridging the flow of information, and their removal could significantly disrupt the communication within the network (Hansen et al., 2020)

RESULTS AND DISCUSSION

Here, the risk to climate change was derived as a result of adaptive capacity, sensitivity, exposure and hazard. High risk values may be due to relatively lower adaptive capacity and relatively higher all other components. Adaptive capacity is positively influenced with high information availability and participation in society.

(1) Social network structures and centrality measures of various extension contacts of dairy farmers

A. Extension Contacts for Climate Related Information

Distinct differences can be observed in the use of different extension sources for climate related information between high-risk and low-risk dairy farmers in Kerala’s coastal low-lying regions. Low-risk farmers showed a higher reliance on formal sources like livestock inspectors, with a degree centrality of 0.57 compared to 0.33 for high-risk farmers (Table 1 and Fig.1 and 2). Whereas for high-risk farmers, higher contact was observed for veterinary hospital with the highest degree centrality (0.48). The characteristics of low-risk farmers can be observed as more engagement with a broader range of information sources.

Table 1: 2-Mode centrality measures for various extension contacts of respondents for climate-related information

(n=120)

Sr. No.	Source	Degree Centrality		Closeness Centrality		Betweenness Centrality	
		LR	HR	LR	HR	LR	HR
1	Livestock Inspector (LI)	0.57	0.33	0.88	0.83	0.32	0.16
2	Agriculture Development Office (ADO)	0.00	0.00	0.00	0.00	0.00	0.00
3	Livestock Management Training Center	0.08	0.00	0.52	0.00	0.01	0.00
4	Dairy Development Board (DDB)	0.37	0.17	0.69	0.68	0.14	0.07
5	Veterinary hospital	0.42	0.48	0.73	1.04	0.20	0.30
6	Bank personnel	0.00	0.00	0.00	0.00	0.00	0.00
7	Research personnel	0.00	0.00	0.00	0.00	0.00	0.00
8	Private Agencies	0.12	0.05	0.02	0.60	0.02	0.01

The Dairy Development Board (DDB) shows a higher degree centrality (0.37) for low-risk farmers compared to that of high-risk farmers (0.17). Similarly, the livestock management training centers in the area have more contact

with low-risk farmers (degree centrality of 0.08), whereas with high-risk farmers, it showed no engagement (0.00). LI, Veterinary hospital and DDB act as a closer source of information regarding climate change to both categories of

farmers. Among low-risk farmers, LI act more frequently as intermediaries within their information networks (BC 0.32), facilitating climate-related information, and it has a substantially lower action among high-risk farmers (0.16). Veterinary hospital also act as one of the important bridging actors among high-risk (0.30) and low-risk farmers (0.20).

However, both dairy farmers groups showed no contact with agriculture development offices, bank personnel, and research personnel, which indicates that these sources are either unavailable or not valued for climate-related information by the dairy farmers in the coastal region.

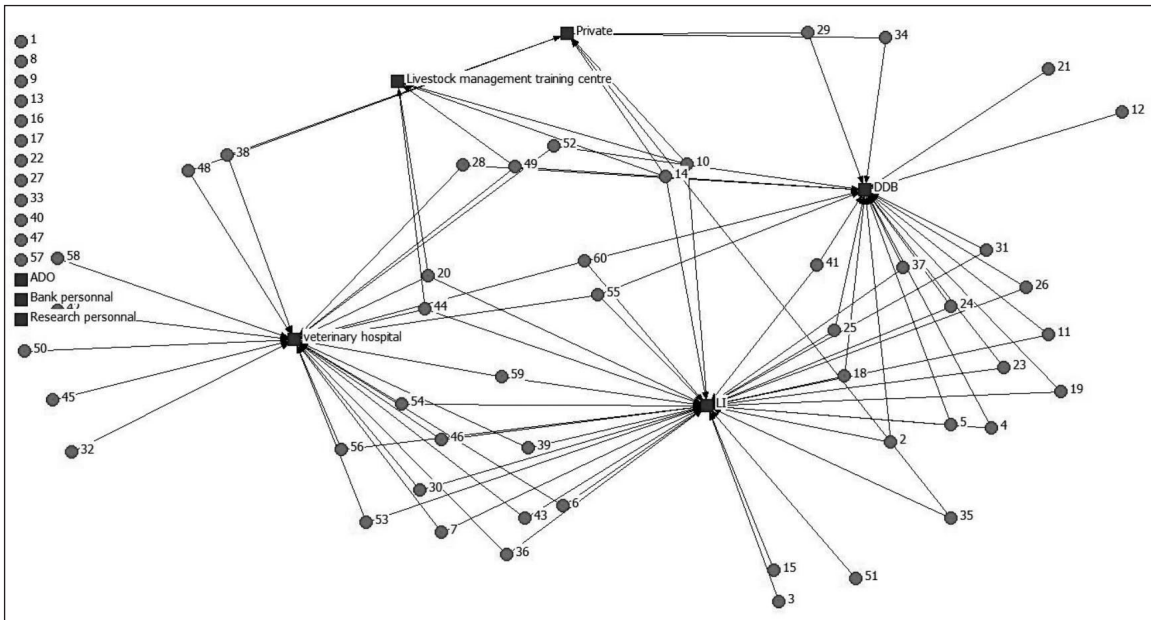


Fig. 1 : Extension contact network for climate information –low risk respondents

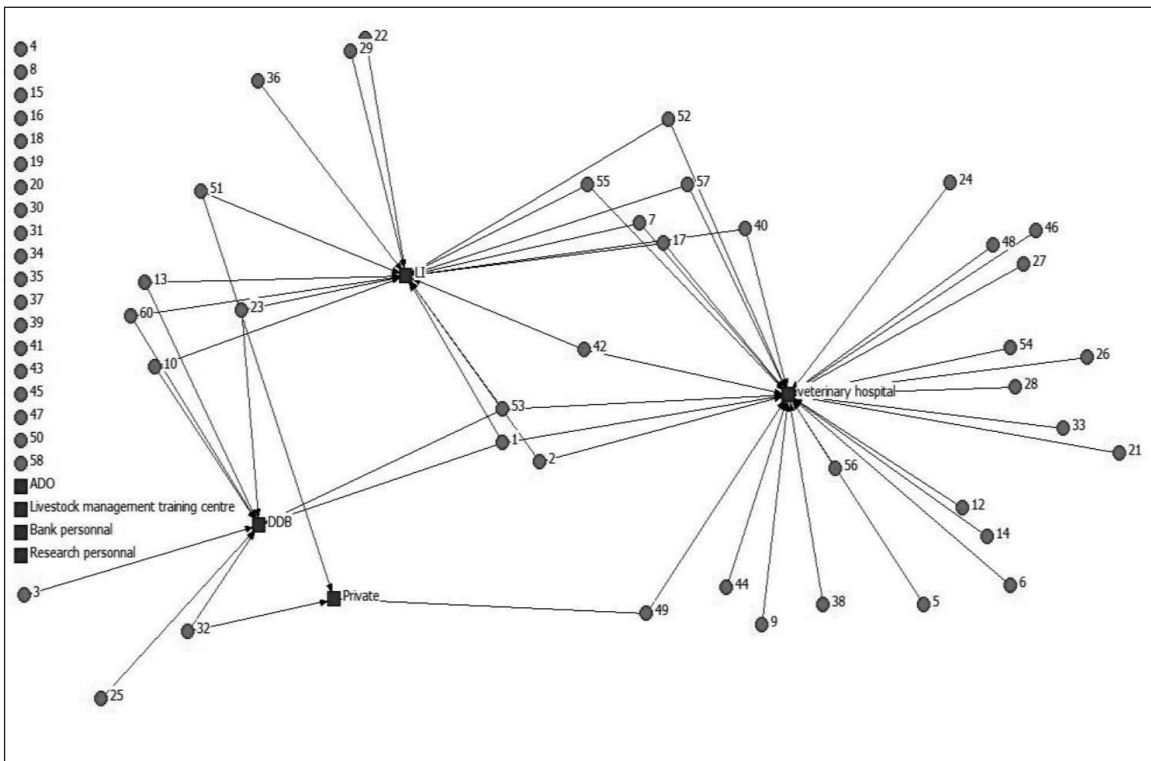


Fig.2 : Extension contact network for climate information – high risk respondents

B. Extension contacts for livestock related information

Table 2: 2-Mode centrality measures for various extension contacts of respondents for livestock-related information (n=120)

Sr. No.	Source	Degree Centrality		Closeness Centrality		Betweenness Centrality	
		Low Risk	High Risk	Low Risk	High Risk	Low Risk	High Risk
1	Livestock Inspector	0.87	0.33	0.86	0.83	0.55	0.16
2	Livestock management training centre	0.08	0.00	0.01	0.00	0.00	0.00
3	Dairy Development Board	0.38	0.17	0.51	0.68	0.08	0.07
4	Veterinary hospital	0.67	0.48	0.57	1.04	0.33	0.30
5	Research personnel	0.03	0.00	0.03	0.00	0.00	0.00
6	Private Agencies	0.13	0.00	0.43	0.01	0.01	0.01

Results of Table 2 illustrates differences in the contacts of extension agencies for livestock-related information among high-risk and low-risk farmers. A study showed that majority of farmers have never been consulted regarding livestock production system for climate adoption practices (Meghwal et al., 2017). High-risk respondents showed relatively limited engagement with Livestock Inspectors (LI) (DC 0.33) and Veterinary Hospitals (DC 0.48) compared to those of low-risk respondents, with degree centrality 0.87 and 0.67 respectively. Similar to the climate-related information sources, LI and veterinary hospital act as a key source for livestock information also, indicated by the higher closeness centrality and betweenness centrality among both groups. In case of DDB, even though low-risk respondents had access more frequently (DC 0.17), it does

not necessarily serve as a key intermediary within their information networks (BC 0.08), compared to high-risk respondents. Moreover, private agencies showed a higher degree of contact with low-risk farmers (DC 0.13) compared to high-risk respondents (DC 0.00). However, both groups exhibit similar and lower closeness and betweenness centrality measures for this source, indicating that private agencies play a less prominent role in the information networks of both category of farmers. Overall, the results emphasis that low-risk respondents had a higher contact with many information sources including formal and informal sources, which might have helped for better cope up with climate change while high-risk respondents engage less frequently, that also more with formal sources only.

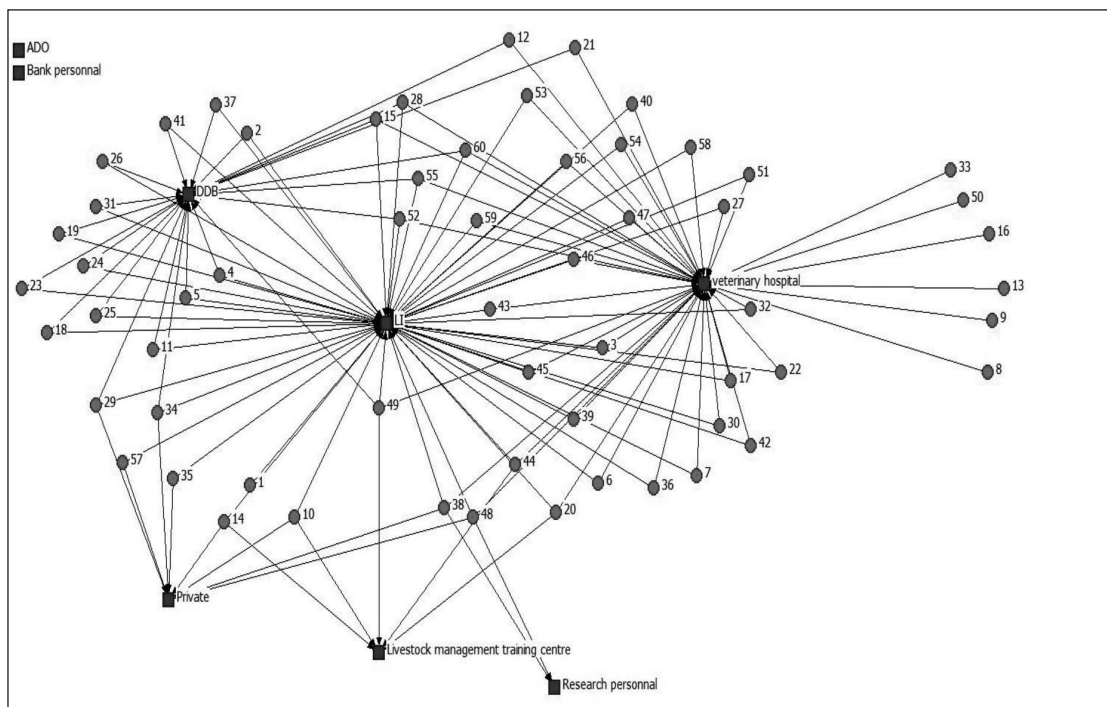


Fig. 3 : Extension contact network for livestock information – low risk respondents

Table 3: 2-Mode centrality measures for sources of social participation of dairy farmers

(n=120)

Sr. No.	Source	Degree Centrality		Closeness Centrality		Betweenness Centrality	
		Low Risk	High Risk	Low Risk	High Risk	Low Risk	High Risk
1	Panchayat	0.07	0.02	0.41	0.40	0.00	0.00
2	Milk Co-operative society	1.00	1.00	1.08	1.11	0.78	0.80
3	Kudumbasree (SHG)	0.43	0.35	0.55	0.51	0.08	0.05
4	Other Self Help Group (SHG)	0.05	0.10	0.41	0.42	0.00	0.00
5	Farmer's Association	0.20	0.25	0.45	0.47	0.02	0.02
6	Credit Co-operative Society	0.13	0.03	0.43	0.41	0.01	0.00
7	Non-Governmental Organization (NGO)	0.02	0.00	0.40	0.00	0.00	0.00

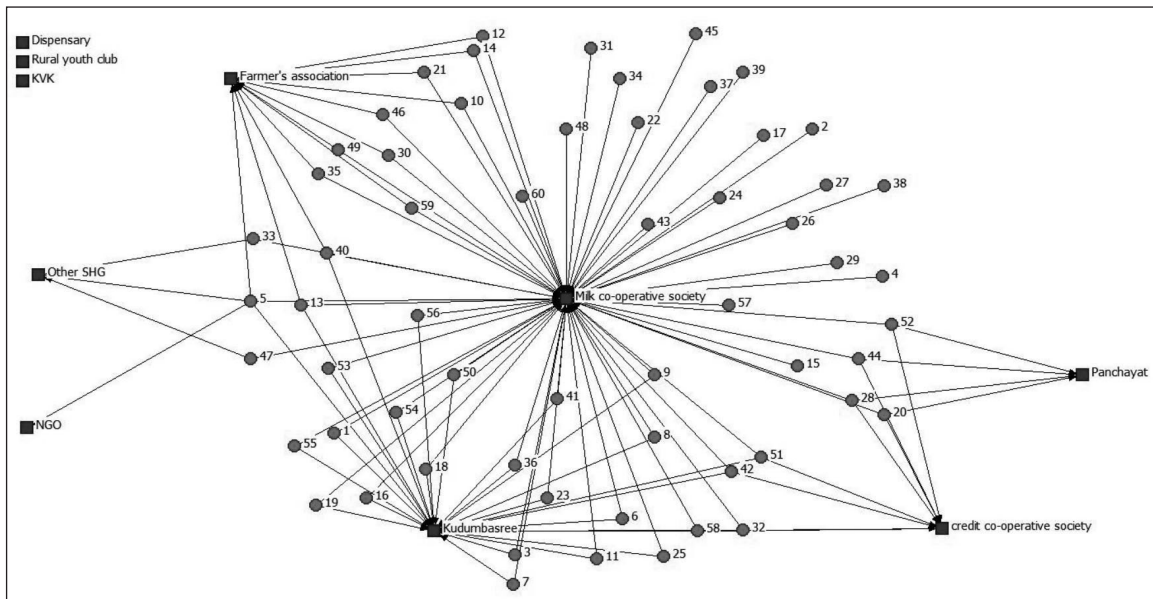


Fig. 5 : Social participation network – low risk respondents

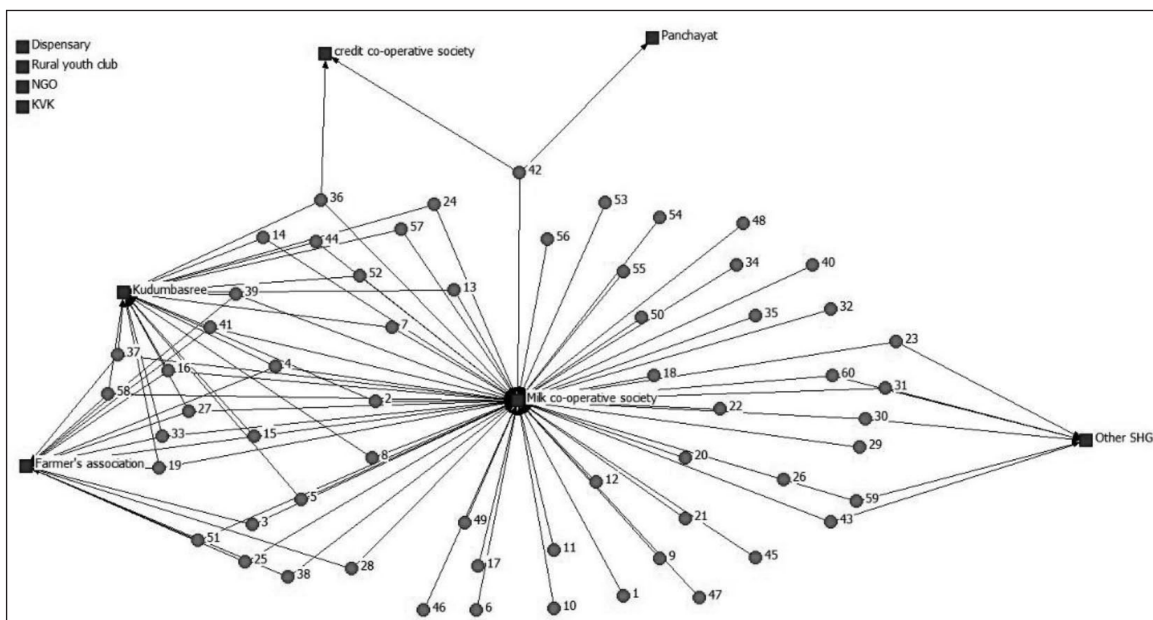


Fig. 6 : Social participation network – low risk respondents

3. Socio-economic correlates

Table 4: Relationship between socio-economic characteristics of respondents with extension contacts for livestock and climate information, and social participation (n=120)

Sr. No.	Variable	Correlation co-efficient (r) [Extension contacts]	Correlation co-efficient (r) [Social participation]
X ₁	Age	0.01	0.09
X ₂	Education of household head	0.43*	0.38**
X ₃	Education of family	0.34*	0.32*
X ₄	Sex ratio of family	-0.23*	-0.20*
X ₅	Land area	0.28**	0.25**
X ₆	Annual income	0.20*	0.22*
X ₇	Herd size	0.27**	0.28**

The correlation analysis in Table 4 reveals that variables such as education of the household head and family education have a moderately positive and significant relationship with extension contacts, indicating that better-educated families are more likely to interact with extension services. Similarly, land area and herd size also showed positive correlations, suggesting that households with more resources are more likely to engage with extension contacts. A negative correlation with sex ratio implies that a higher proportion of females in the household may limit extension contact, possibly due to gender-based access barriers. Similarly with social participation also, all variables (except sex ratio) showed positive correlations, with education, herd size, and income influencing significantly. Overall, education and resources were identified as key factors influencing both extension contact and social participation.

CONCLUSION

In conclusion, a substantial difference between the high and low climate risk farmers can be observed in extension contacts and in social participation. Low-risk farmers showed a more diversified approach in accessing information, while high-risk farmers exhibited a greater reliance on few extension contacts. However, no notable differences were observed in the sources for climate-related information and livestock-related information, indicating the lack of interest of farmers to seek for specific climate information. Analysis of social participation networks highlights importance of milk co-operative in the locale, with higher interaction with all of the farmers regardless of the climate risk variation. Low-risk farmers showed a wider and exhaustive social participation network relative to high-risk farmers, which might have helped them to handle the challenges in the changing climate scenario. Education and resources like land and herd were found to have influencing both extension contact and social participation, whereas a lower sex ratio favoured higher participation among farmers. The results show how the

differences in the social networking characteristics of coastal dairy farmers differ with respect to risk to climate change, which is in turn related with their adaptive capacity to climate change. Several implications can be drawn from these results, specifically, providing awareness regarding availability of various information sources, conducting campaigns or fairs regarding the importance of climate-awareness, and encouraging social participation, especially among high-risk groups. The crucial role of milk co-operative societies and *kudumbasree* groups suggests that these platforms can be effectively utilized for disseminating climate advisories and promoting adaptation measures.

POLICY IMPLICATIONS

Policies shall be formulated with a focus on strengthening climate information delivery through multiple extension contacts including local institutions such as milk co-operatives and Kudumbashree groups to ensure wider outreach. Government and extension agencies should promote inclusive capacity-building programs that encourage dairy farmers' active social participation. Livestock and veterinary hospitals can be utilised for the dissemination of various climate adaptation strategies for dairy farming.

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CONFLICT OF INTEREST

There is "No conflict of interest" among the researchers

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