Social Networks of Farmers on Climate Change Mitigation and Adaptation in Western Agro Climatic Zone of Tamil Nadu

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ABSTRACT

Climate change is widely recognized to be a global threat to natural systems, human populations, and economies. India is facing the challenges of sustaining its rapid agricultural growth while dealing with the global threat of climate change. Faced with these threats and challenges there are two major responses for policy intervention in agriculture. The first strategy is to mitigate/reduce the rate and magnitude of climate change itself through reducing the emissions of human causes of climate change, for example, mitigation of greenhouse gases, prevention of soil erosion etc. The second option is to promote adaptation to climate change to minimize the impacts and take advantage of new opportunities and new technologies. The pattern of flow of information through social networks and the factors that facilitate or impede the flow and utilization of such information are among important areas that need to be studied in technology adoption of climate smart technologies in adaptation and mitigation to climate change context. The derivatives of Social Network Analysis (SNA) revealed that Arkaraipatti village had an equal average in-degree and out-degree of 3.619 and similarly, Attur village had an equal average in-degree and out-degree of 2.286. In the social networks of Appipatti and Odaipatti villages of Chinnamanur block, it was found that degree centrality of Appipati village had an equal average in-degree and out-degree of 1.909 and similarly, Odaipatti village had an equal average in-degree and out-degree of 1.571. There was no strong Tie in both the Blocks. Attur block was having more Density (0.16) as compared to Chinnamanur block. With Geodesic Distance of 3.119, Chinnamanur block had advantage to pass information faster. Since, Arkaraipatti and Odaipatti villages augured well in information sharing on mitigation and adaptation of climate change in agriculture as compared to Attur and Appipatti villages.

Key words: *Social network analysis (SNA); In- degree and out -degree; Density; Tie and geodesic distance;*

Climate change is widely recognized to be a global threat to natural systems, human populations, and economies. Despite global efforts to ameliorate these concerns by the mitigation of green house gases (GHGs) historical and ongoing emissions mean that some impacts from climate change are now unavoidable. India is facing the challenges of sustaining its rapid agricultural growth while dealing with the global threat of climate change. Faced with these threats and challenges there are two major responses for policy intervention in agriculture. The first strategy is to mitigate/reduce the rate and magnitude of climate change itself through reducing the emissions of human causes of climate change, for example, mitigation of greenhouse gases, prevention of soil erosion etc. The second (and complementary) option is to promote adaptation to climate change to minimize the impacts and take advantage of new opportunities, for example, enhance existing production systems by using different practices (e.g. changing sowing patterns) and new technologies (e.g. irrigation systems, adapted varieties etc.). Social network analysis (SNA) is the study of relationships among agents, groups and entities that provide channels for the transfer of information (*Matuschke, 2008*). When combined with computer programmes it can be used to model, visualize and analyze interactions between individuals within groups and organizations (*Springer and Steiguer, 2011*). SNA can measure the relations between extension agents, farmers and any other intermediaries, which in turn can study the network in relation to adoption of better practices, improved decision making by the farmer and performance which are influenced by the kind and sources of information (*Anderson and Feder, 2004*).Engaging farmers in climate initiatives on mitigation and adaptation of climate change in agriculture is possible only when under pinning social networks of farmers are analyzed for structural patterns. This is because mitigation and adaptation of climate change in agriculture is more of a social activity. Strong social networks have been shown to improve collaborative governance processes by facilitating the generation, acquisition and diffusion of different types of knowledge and information by overcoming many of the traditional barriers associated with knowledge sharing (*Bodin and Crona, 2009*). However, despite increasing awareness about the potential importance of social networks, there is very limited evidence for their application in relation to climate policy. Advancing the understanding about the potential importance and role of social networks for engaging the community in climate initiatives is of critical importance.

METHODOLOGY

In this study, the investigator has attempted to describe the social networks of farmers on climate change in agriculture. The study was conducted in western Agro–Climatic Zone (ACZ) of Tamil Nadu state. The data collection related to this study was carried out in the year 2016. Exploratory research design has been followed in the study. The researcher followed mix method of sampling. Tamil Nadu state was purposively selected based on need and relevancy of the research problem and snowball sampling method was used in order to identify any actors who were involved in mitigation and adaptation of climate change in agriculture. The dindigul and Theni district was purposive selected and from that two villages were purposively selected from each district namely Arkaraipatti, Attur (Attur block) Appipatti and Odaipatti (Chinnamanur block). Based on snowball sampling, a total of 85 respondents had been covered in the social network study.

In order to study the characteristics of pattern of distribution of relationships among respondents for transfer of information on the adoption of agricultural technologies for mitigation and adaptation of climate change in agriculture, SNA had been performed. The present SNA dealt with Centrality, Ties, Cohesiveness, and Homophily of the identified social networks. The software UCINET 6 (*Borgatti et al., 2002*) to calculate network measures. Social Networks were depicted by using NETDRAW software.Centrality measures indicated who occupied the critical positions in the network. Two measures of Degree Centrality which was used in this study were In -degree and Out -degree. In-degree is the number of actors/edges pointing to a given node (*Degenne & Forse, 1999*). The in-degree is expressed by=ei/n-1, where, is no. of ties coming into node. Out-degree is the number of ties that a node directs to others within the network. It is calculated by dividing the number of ties 'di' going out of a node. The out-degree is expressed by=di/n-1, where, is no. of ties going out of a node. Cohesiveness is the degree to which actors are connected directly to each other by cohesive bond. In the present study, cohesiveness was measured by using Network density. Network Density was calculated using the following formula: Δ = L/g (g-1). Ties described a connection of a pair of actors by one or more relations is called tie. Ties, generally, come in three varieties: strong, weak or absent. The "strength" of a tie is a linear combination of the amount of time, the emotional intensity, the intimacy (or mutual confiding), and the reciprocal services which characterize each tie. Homophily measures the tendency of individuals to associate with those similar to themselves. The value ranges from 1 to -1 and can be seen as a measure of the extent a group chooses themselves a value of -1 showing 'Homophily' and a value of +1 showing 'Heterophily.'Degree centrality is the number of ties a node has; it measures the likelihood of getting any resource flowing through a network .

RESULTS AND DISCUSSION

Degree centrality measures on Social networks of farmers on mitigation and adaptation of climate change in agriculture : Analyzing the in-degrees and out-degrees of the actors as a measure of who was "central" or "influential" in identified social network of the Arkaraipatti and Attur villages, as stated in Table 1. unveiled that Arkaraipatti village had an equal average in-degree and out-degree of 3.619 and similarly, Attur village had an equal average indegree and out-degree of 2.286. The findings signified that most of farmers in

Arkaraipatti village had more than three inter-personnel sources of information seeking and also acted as a source of information dissemination for more than three farmers/respondents. However, for Attur village, most of respondents roughly had two inter-personnel sources of information seeking and also acted as a source of information dissemination for two farmers/respondents.

Further analysis on social networks of both the villages could reveal that the maximum in-degree and out-degree in Arkaraipatti and Attur villages were 11 & 6, and 6 & 4, respectively. This connoted, in Arkaraipatti village, most of node/respondent received information on mitigation and adaptation of climate change in agriculture from 11 nodes through interpersonal connection. The maximum out-degree of 6 indicated that at least a node/respondent in the network disseminated or relayed information on mitigation and adaptation of climate change in agriculture to 6 farmers in the village. Similarly, in Attur village, most of node/ respondent received information on mitigation and adaptation of climate change in agriculture from 6 nodes through interpersonal connection. The maximum out-degree of 4 indicated that at least a node/respondent in the network disseminated or relayed information on mitigation and adaptation of climate change in agriculture to 4 farmers in the village. Hence Arkaraipatti village augured well in information sharing on mitigation and adaptation of climate change in agriculture as compared to Attur village. Similarly in chinmannur block, Odaipatti village augured well in information sharing on mitigation and adaptation of climate change in agriculture as compared to Appipati village.

Cohesiveness measures on Social networks of farmers on mitigation and adaptation of climate change in agriculture : Perusal of Table 1 unveiled that the average geodesic distance for Arkaraipatti and Attur villages were 2.902 (approximately 3) and 3.105 (approximately 3), respectively. This depicted that a farmer, on an average, in these villages had to go through three nodes/instances in order to gain access to information on climate change mitigation and adaptation in agriculture. This might be due to less usage of mass media and poor intervention of extension agents in providing information on mitigation and adaptation of climate change in agriculture.

The sociogram of Arkaraipatti and Attur villages showed low densities of 0.181 and 0.169 which meant less cohesiveness in the networks and similarly take place in chinnmannur block also. The less cohesiveness lead to slow rate of diffusion of information on mitigation and adaptation of climate change in agriculture in the farming society and consequently the adoption of advanced climate change mitigation and adaptation practices, as observed during the study, was very low. Since mitigation and adaptation to climate change in agriculture is only successful when it is tackled in groups and by groups, mobilization of farmers to form groups in way of interest groups, commodity groups etc. should be encouraged in both the villages.

Ties measures on Social networks of farmers on mitigation and adaptation of climate change in agriculture: Administering Granovetterian ties measures, as could be referred from Table 1, it was concluded that there was no strong tie in the sociogram of four villages, further it was revealed that Arkaraipatti, Attur, Appipatti and Odaipatti villages had 12.38%,

Table 1. Graph metric values of the villages

	Measures	Values of the villages			
		Arkaraipatti	Attur	Appipatti	Odaipatti
Degree centrality	Maximum in -degree	11	6	5	7
	Average in -degree	3.619	2.286	1.909	1.571
	Maximum out –degree	6	4	3	4
	Average out-degree	3.619	2.286	1.909	1.571
Cohesiveness	Density	0.181	0.169	0.091	0.079
	Average Geodesic Distance	2.902	3.105	2.931	3.119
Ties	Absent	87.62%	85.57%	90.90%	92.14%
	Weak	12.38%	11.42%	9.09%	7.85%
	Strong	0.00%	0.00%	0.00%	0.00%
Homophiliy	-0.1842	-0.1831	-0.333	-0.7576	

11.42%, 9.09 % and 7.85% were weak ties respectively. The per cent absent ties in the sociogram of four villages were 87.62%, 85.57%, 90.90% and 92.14% respectively, which signified that majority of actors in the sample network had no link between the actors on information sharing with respect to climate change mitigation and adaptation in agriculture. However, the presence of weak ties in four villages could be taken as an opportunity for the government agencies or policy makers to alleviate social cohesion with respect to adoption of mitigation and adaptation practices of climate change in agriculture.

Homophily measures on Social networks of farmers on mitigation and adaptation of climate change in agriculture : The homophily value of the social network, as it could be observed in Table 1 for four villages were -0.184, -0.183, -0.333 and -0.7576 respectively. These negative values indicated that information sharing in the identified social network of four villages on climate change mitigation and adaptation in agriculture was mostly persuaded amongst respondents having similar socio-economic and psychological characteristics. During the time of data collection, it was observed that respondents in the villages were introvert and less mingled and discussed with non-villagers. In order to advance mitigation and adaption of climate change in the study area by the respondents, it is suggested that the villagers/farmers should be more exposed to social forums, trainings, exposure visits to other places etc. with respect to advance techniques on climate change mitigation and adaption in agriculture and allied activities. In parallel, there is need for ready intervention of different stakeholders in the village to meet the challenges posed by climate change in agriculture.

In the social network structure detailed (fig 1, 2, 3 & 4) account about the most important person in the villages. Social network structures were directed graph. A directed graph is graph, a set of objects (called vertices or nodes) that are connected together, where all the edges are directed from one vertex to another. A node (or vertex) of a network is one of the objects that are connected together. The connections between the nodes are called edges or links. By observing the structures in fig 1, Extension officer important person to disseminate the information about climate change in the akarapatti village. Similarly, Jeyaram, Vishnu and Ramesh from attur, appipatti and odaipatti villages respectively (fig 2, 3 & 4).

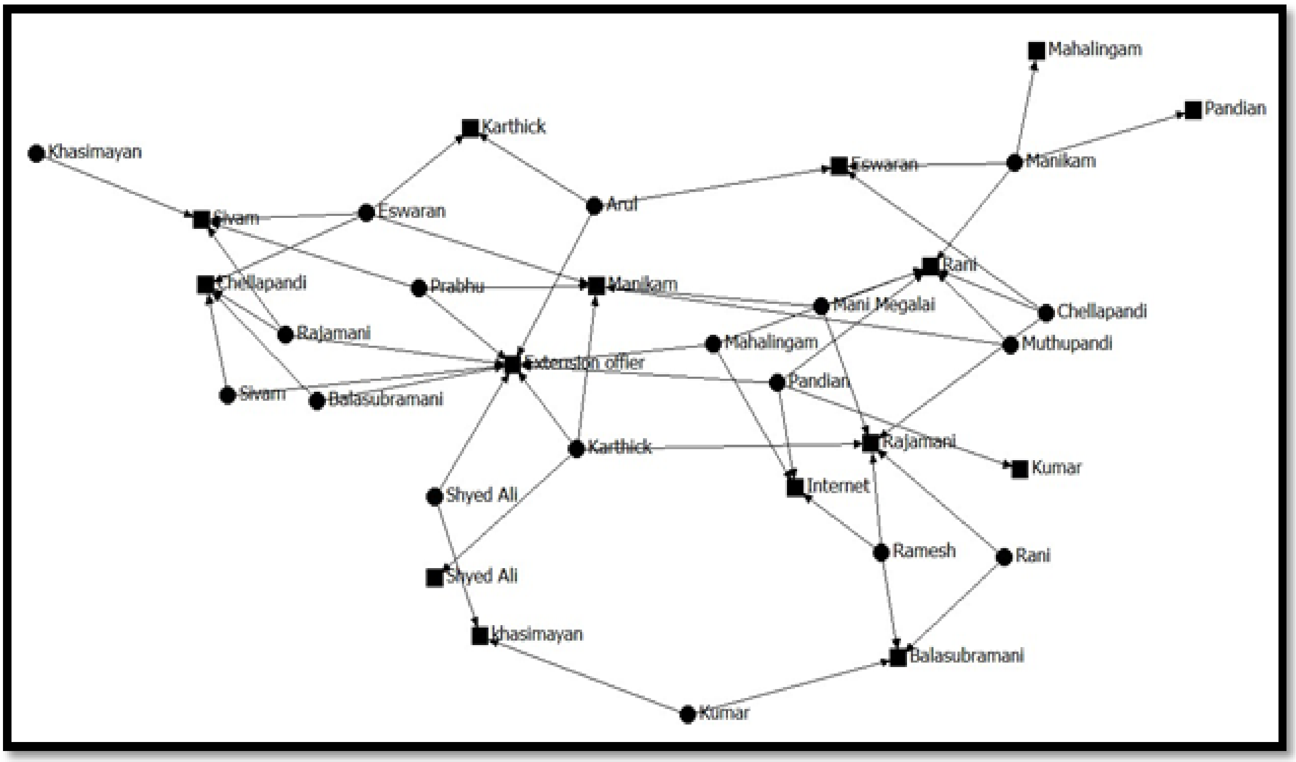

Fig. 1. Sociogram of Arkaraipatti Village

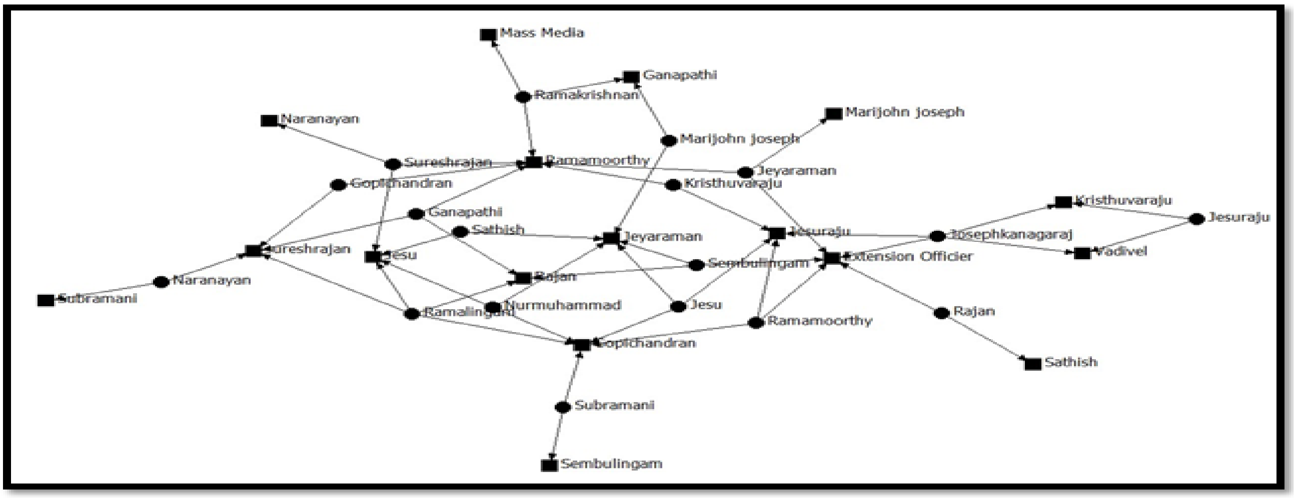

Fig. 2. Sociogram of Attur Village

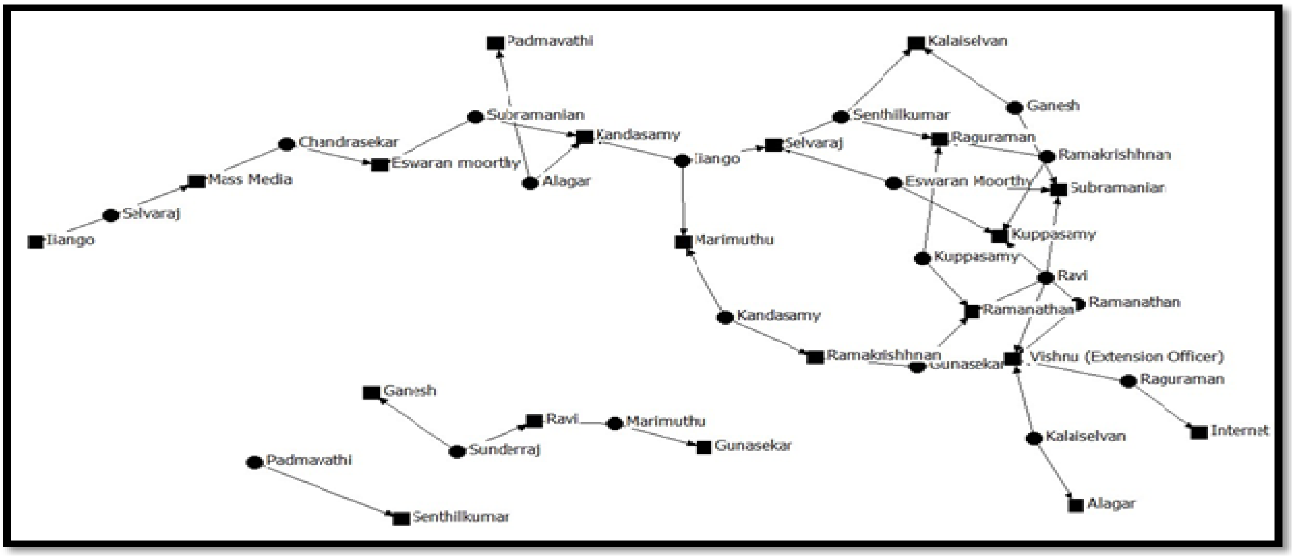

Fig. 3. Sociogram of Appipatti Village

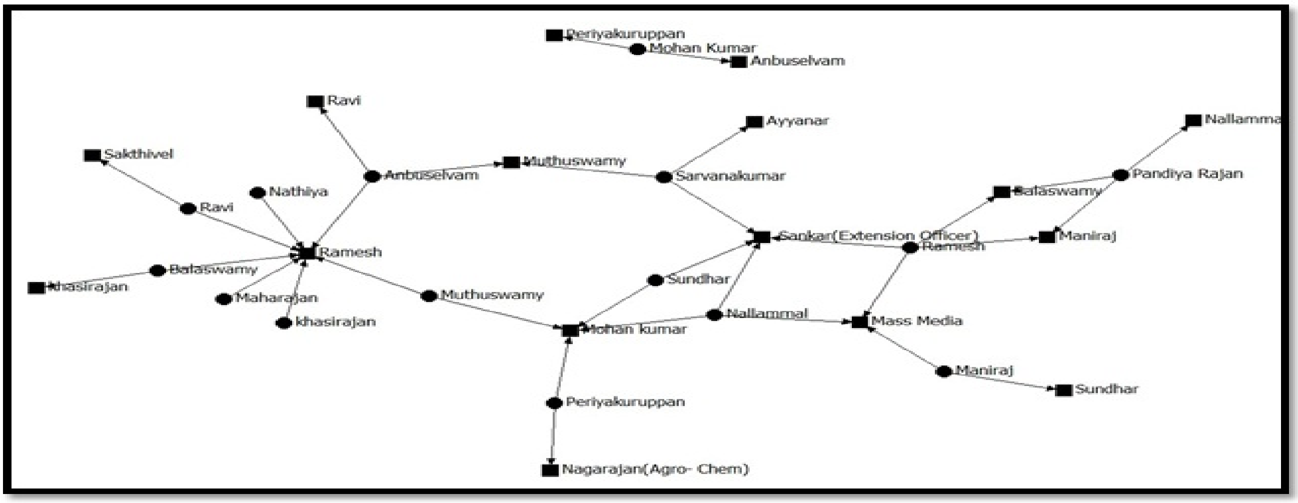

Fig. 4. Sociogram of Odaipatti Village

●{node /vertices}Indicate the respondents with whom (■{node /vertices}) would you like to ask the queries / doubt /information about climate change→Edges.

CONCLUSION

The derivatives of Social Network Analysis (SNA) revealed that Arkaraipatti village had an equal average in-degree and out-degree of 3.619 and similarly, Attur village had an equal average in-degree and out-degree of 2.286. In the social networks of Appipatti and Odaipatti villages of Chinnamanur block, it was found that degree centrality of Appipati village had an equal average in-degree and out-degree of 1.909 and similarly, Odaipatti village had an equal average in-degree and out-degree of 1.571. There was no strong Tie in both the Blocks. Attur block was having more Density (0.16) as compared to Chinnamanur block. With Geodesic Distance of 3.119, Chinnamanur block had advantage to pass information faster. Since, Arkaraipatti and Odaipatti villages augured well in information sharing on mitigation and adaptation of climate change in agriculture as compared to Attur and Appipatti villages. The study highly recommends SNA a prior for any intervention of agricultural innovation systems. Since the adoption of agricultural technologies for mitigation and adaptation of climate change in agriculture is through social learning it is important to understand social networks of farmers that are adapting to climate change. In order to advance mitigation and adaption of climate change in the study area by the respondents, it is suggested that the villagers/farmers should be more exposed to social forums, trainings, exposure visits to other places etc. with respect to advance techniques on climate change mitigation and adaption in agriculture and allied activities. In parallel, there is need for ready intervention of different stakeholders in the village to meet the challenges posed by climate change in agriculture.

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