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Farmers' Constraints and Suggestions for Adoption of Climate Change Adaptation Measures in Tamil Nadu's Madurai and Sivagangai Districts

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ABSTRACT

The purpose of this study was to evaluate farmers' problems and suggestions for climate change adaptation techniques in agriculture. The research was carried out in wetland, dryland and garden land farming systems in the Tamil Nadu districts of Madurai and Sivagangai. A total of 120 farmers representing three farming systems were chosen and surveyed for the study using a proportionate random sample procedure. For data analysis, descriptive statistics were utilized. Results, indicated that majority of respondents (87.50 %) in wetlands had difficulty obtaining agricultural loans from banks because it was time consuming. In dryland farming, the majority of respondents (95.00 %) stated that the failure of the monsoon and a lack of water were their biggest restraints. The majority of garden land respondents had difficulty obtaining technical information about adaptation measures (92.50 %). More than three-fifths of wetland respondents were advised to seek financing services through bank loans and cooperatives in order to implement adaption measures (82.50 %). In the dryland system, the majority (90.00 %) of respondents requested that a proper marketing channel and pricing determination for millets and pulses be constructed. In garden land farming, the majority of respondents (90.00 %) requested that effective plant protection technologies for onion, groundnut, mango and other vegetables be developed.

Keywords Climate change, Farmer's adaptation, Impact, Monsoon, Plant protection.

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INTRODUCTION

Farming systems are hampered by problems such as limited land area, a scarcity of resources, and increasing soil degradation, all of which obstruct long-term

crop productivity and food security. Global climate change poses unique challenges to the resilience of agriculture in the United States and farmers and advisors must employ effective adaptation measures to be both economically and environmentally sustainable (Masea *et al*. 2017). Climate change's consequences (e.g., more frequent occurrence of extreme weather events) exacerbate these issues (Zerssa *et al*. 2021). Climate change-related weather events such as severe drought and high rainfall have an impact on agriculture. Crop failures will also rise as a result of weather variability (Tamer *et al*. 2014) as well as excessive heat and water stress. Even heavy rains can make harvesting difficult and cause crop quality to suffer (Gaál *et al*. 2014). Internal and external operation is another key issue for understanding the features of hurdles to technological innovation adoption by farmers (Boons *et al*. 2013). Gowers facing various constraints viz lack of access to information, lack of access to extension services, limited awareness and expertise, and restricted financial choices were cited as barriers impeding their adaptive capacity. The review concludes with several research suggestions for the future (Nguyen *et al*. 2021). Policy and regulatory obstacles, such as difficulties in obtaining subsidies available for rival technologies (Weiss and Bonvillian 2013). Farmers' inability to acquire modernized farming methods due to a lack of access to agricultural extension agents is a major hindrance to their adaptation (Esham and Garforth 2013). Constraint analysis is quickly becoming a key component of extension research. It is impossible to determine the impact of climate change on the farming community without first assessing the limits. Based on this background, this research is aimed to identify the barriers to climate change adaptation among farmers in Madurai and Sivagangai districts of Tamil Nadu.

MATERIALS AND METHODS

Study area

The study was conducted in wet land, dry land and garden land farming systems of Madurai and Sivagangai district of Tamil Nadu (Fig. 1). Thiruparankundram, T.Kallupatti, Tirumangalam, Kalligudi, Sedapatti, Usilampatti, Vadipatti, Melur, Madurai West, Madurai East, Kottampatti, Alanganallur and Chellampatti are the thirteen blocks that make up Madurai district. Vadipatti and Kallikudi blocks were chosen for research because they reflect wet and dry land farming systems, respectively.

The districts of Sivagangai, Kalaiyarkoil, Mana-

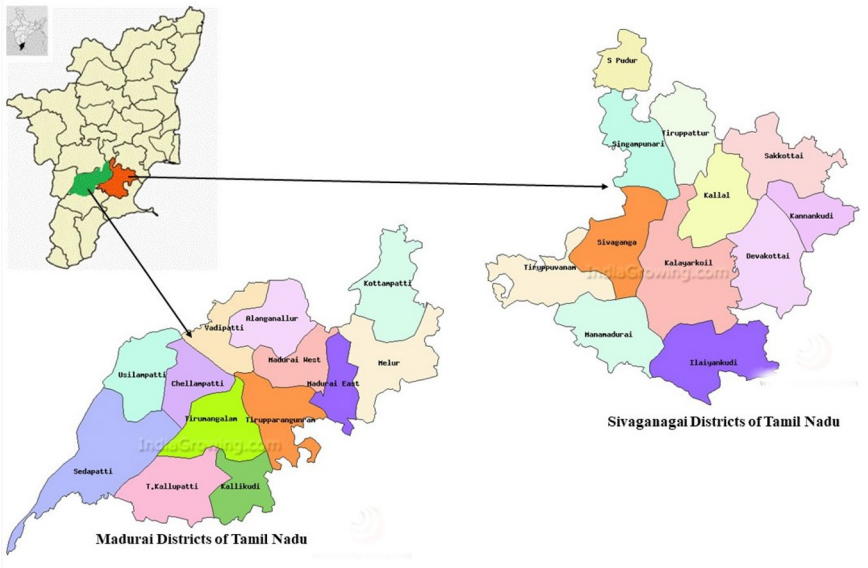

Fig. 1. The map shows the study area.

madurai, Thiruppuvanam, Ilayangudi, Thiruppathur, Singampunari, Sakkottai, Kallal, Devakottai, Kannangudi and S. Pudur are made up of eleven blocks. Kalayarkovil and Thiruppuvanam blocks were specifically chosen for research to illustrate the garden land farming method.

Sampling and research design

The sample size for the study is 120 consisting of 40 each from wet, dry and garden land conditions (Table 1), the number of respondents from each of the selected village was fixed based on the probability proportionate random sampling method. For this study, since climate change, as an ever existing recurrent phenomenon in the study area over a period of time, the *ex-post facto* and exploratory research design was employed to analyze the adaptation behaviour of farmers towards climate change.

Data collection

Considering the objectives and the variables under study, a comprehensive, structured interview schedule covering all aspects was prepared. Before finalizing the interview schedule, it was pre-tested in a non-sampling area. After pre-testing, inconsistencies noted were properly modified and the schedule was finalized for data collection. Farmers' use of weather and climate information, concerns about various weather-related threats (drought, increased disease, extreme rainfall), climate change beliefs, perceptions of variable or unusual weather on their farm, and short- and long-term weather/climate risk management strategies were among the topics covered in the survey. The following question, first used in the Iowa farm poll (Arbuckle *et al*. 2013a), was included to measure farmers' attitudes about the existence and causes of climate change.

Statistical tool used

Percentage analysis was used in descriptive analysis for making simple comparisons. For calculating percentage, the frequency of the particular cell was multiplied by 100 and divided by the total number of respondents pertaining to particular cell. Percentage was corrected to two decimal places. ANOVA is used to test the significant difference between the more than two means. In this study, one-way ANOVA test is used to understand any significant difference exist in terms of profile characteristics and adoption of climate change adaptation measures of the respondents in the wetland, dryland and garden land farming systems.

RESULTS AND DISCUSSION

Constraints experienced by the farmers in the adoption of climate change adaptations

Constraints faced by the respondents while taking adaptation measures to climate change were also studied and the results are presented below in the Table 2.

It could be concluded from the Table 2 that more than three-fourth of the respondents in wetlands faced the problems in availing the agricultural loan from banks (87.50%) as it was time consuming and the lack of information about the adaptation technologies in paddy, banana and in other wetland crops (80.00%). More than 70% of the respondents faced the problems in financial source to adopt the climate change adaptation measures (77.50%), cost of the fertilizers, pesticides and other inputs were increased

Table 1. The selection of the farmers from the districts.

District	Block	Village	Farming system	Total farmers in village	Number of selected farmers
Madurai	Kallikudi	Sengapadai	Dryland	176	40
	Vadipatti	C. Pudur	Wetland	114	24
		Ramaianpatti	Wetland	79	16
Sivagangai	Kalayarkovil	Valayampatti	Garden land	91	18
	Thiruppuvanam	Sengulam	Garden land	98	22
Total				558	120

Table 2. Constraints faced by the respondents in the adoption the climate change adaptation measures (n=120). (Multiple response *).

Sl. No.	Constraints	Wetland		Dryland		Garden land		Total	
		No.	%	No.	%	No.	%	No.	%
I.	Information on climate change								
1	Lack of access to weather forecasting technologies	18	45.00	27	67.50	32	80.00	77	64.17
2	Poor information on early warning systems	10	25.00	12	30.00	27	67.50	49	40.83
3	Poor agricultural extension service delivery	28	70.00	22	55.00	18	45.00	68	56.67
II.	Farm inputs utilization								
1	High cost of farm inputs	30	75.00	23	57.50	26	65.00	79	65.83
2	Non-availability of timely farm inputs	10	25.00	14	35.00	17	42.50	41	34.17
3	Lack of information for input management	32	80.00	25	62.50	37	92.50	94	78.33
III.	Irrigation and water management								
1	Scarcity of water	21	52.50	38	95.00	31	77.50	80	66.67
2	Non-availability of water storage facility	11	27.50	35	87.50	28	70.00	74	61.67
3	High cost-efficient irrigation systems	16	40.00	13	32.50	34	85.00	63	52.50
IV.	Credit constraints								
1	Adaptation to climate change requires more of money	31	77.50	29	72.50	26	65.00	86	71.67
2	More time consumption to avail crop loan from the banks	35	87.50	0	0.00	23	57.50	58	48.33
V.	Labor constraints								
1	Non-availability of farm labor	10	25.00	17	42.50	27	67.50	49	40.83
2	Labor wage rate is high	28	70.00	29	72.50	18	45.00	68	56.67

(75.00%), labor wages were also increased (70.00%) and the problems with the extension system to provide adequate information during the cropping (70.00%). Nearly half of the respondents reported that scarcity of water (52.50%) for irrigation due to the monsoon failure and lack of weather forecasting technologies to provide location specific crop advisories (40.00%). These factors were found to be major constraints of farmers in adoption of climate change adaptation measures in the wetland farming system.

In dryland farming, majority of the respondents (95%) responded that the failure of monsoon and scarcity of water were their primary constraints followed by the non-availability of water storage structures in the dryland areas (82.50%). More than 60% of the respondents had revealed that lack of credit for the adaptation measures and it requires lot of money (72.50%), labor wage was very high due to the MGNREGA in dryland (72.50%), lack of weather forecasting technologies and advisories related to the climatic changes (67.50%) and information about the climate change adaptation measures were not available on time (62.50%). More than half of the respondents faced the problem of poor extension service to the farmers (57.50%) and high cost of farm inputs like seeds, fertilizer, pesticides. These were the major constraints reported during the adoption of climate change adaptation measures in dryland farming system.

It was observed from the Table 2 that the majority of the garden land respondents had faced the problems in access of technical information about

adaptation measures (92.50%), high cost of efficient irrigation system (85.00%) and lack of weather forecasting technologies and crop advisories due to the climate change (80%). More than 60% of the respondents had scarcity of water for irrigation (77.50%), non-availability of water storage structures (70.00%) to use the water for cultivation, poor information about early warning systems about climate change in agriculture (67.50%), non-availability of farm labor due to the MGNREGA scheme (67.50%), higher cost of farm inputs like seeds, manures, plant protection chemicals (65.00%) and lack of financial source for adoption of climate change adaptation techniques (65.00%). Nearly half of farmers had indicated that problems in availing the crop or livestock loan from the banks (57.50%), poor extension service to solve the farmer's queries (45.00%) and non-availability of farm inputs (42.50%) found to be as determinants of climate change adaptations in the garden land farming system.

From the above findings, it could be revealed that the major constraints of respondents in all the three farming systems were, lack of information about the adaptation technologies (78.33%), credit requirement of farmers to follow the adaptation measures (71.67%), scarcity of water (66.67), high cost of farm inputs (65.83%) and lack of weather forecasting technologies (64.17%).

Suggestions for better adoption of climate change adaptations

Different activities are to be carried out to enhance or to improve the farmer's adaptation measures in agriculture to mitigate the climatic changes. These actions are given as suggestion to enhance the farmer's adaption measures to climate change and presented in Table 3. In study area more than three- fifth of the wetland respondents suggested that assurance of credit services through bank loans, cooperatives to adopt the adaptation measures (82.50%), marketing of banana, paddy and other crops should be improved to earn profit from agriculture (77.50%), trainings should be given to expose the different adaptation measures at farm level (70.00%), accurate and location specific weather and agro services can be provided at local language (65.00%) and the MGNREGA scheme should be modified to avoid the labor problems in the wetland farming. More than half of the respondents indicated that farm inputs like planting materials, seeds, fertilizers should be provided in subsidized cost to reduce the cost of cultivation (57.50%) government extension services should be strengthened to solve the farmers problems (57.50%) and efficient plant protection technologies for paddy, banana, and

Table 3. Suggestions given by the farmers to overcome the problems in adoption of climate change adaptation measures (n=120). (Multiple response *).

Sl. No.	Constraints	Wetland		Dryland		Garden land		Total	
		No.	%	No.	%	No.	%	No.	%
1.	Improved information delivery of weather based advisories to be developed	26	65.00	21	52.50	18	45.00	65	54.17
2.	Farm inputs and machineries can be provided on subsidized cost	23	57.50	16	40.00	21	52.50	60	50.00
3.	Training on new adaptation strategies should be provided	28	70.00	13	32.50	25	62.50	66	55.00
4.	Less water use technologies can be developed and disseminated	12	30.00	28	70.00	32	80.00	72	60.00
5.	Effective technologies can be developed for pest and disease management due to climate change	22	55.00	13	32.50	36	90.00	71	59.17
6.	MGNREGA Scheme has to be modified to solve labor problems	26	65.00	29	72.50	32	80.00	87	72.50
7.	Ensure the timely credit service to the farmers	33	82.50	17	42.50	24	60.00	74	61.67
8.	Development of proper marketing opportunities for the produce.	31	77.50	36	90.00	32	80.00	99	82.50
9.	Government extension system should be improved to provide service to the farmers	23	57.50	19	47.50	30	75.00	72	60.00

vegetables can be developed and disseminated to the farmers (55.00%).

In dryland system majority (90.00%) of the respondents suggested that proper marketing channel should be developed and appropriate price determination has to be done for millets and pulses. More than half of the respondents were reported that drought tolerant, less water usage technologies can be developed for dryland crops (70.00%) and location specific weather forecasting technologies and crop advisories should be given in appropriate time (52.50%). More than one third of dryland farmers advised that government extension system should be improved to provide better service to the farmers at village level (47.50%) and the farm inputs should be given in the subsidized cost by the government to the farmers (40.00%) to adapt the dryland agriculture towards climate change.

In garden land farming majority of the respondents suggested that effective plant protection technologies can be developed for onion, groundnut, mango and other vegetables (90.00%), water efficient crop technologies should be disseminated to the farmers (80.00%), MGNREGA scheme should be modified to provide work during offseason (80.00%) and the government extension system should be regulated to provide the agricultural technical information adequately (75.00%). More than half of the respondents needed the trainings and demonstration should be provided to the farmers to know about the different adaptation measures (62.50%), credit services (60.00%) and farm inputs should be distributed at subsidized cost to improve the adaptation measures (52.50%) in the garden land farming. It could be finalized from the above results that, development of marketing opportunities, modification of MGNREGA schemes to adjust the working days in fallow season, promotion of credit facilities through government, development use of water efficient technologies, varieties, government extension service to be made available to provide service the farmers were the suggestive measures given by the respondents of all the three faming systems.

CONCLUSION

The ability of farmers to enhance their adaptation is reliant on a complex set of supportive factors and barriers. While socio economic determinants are still relevant, further research into policy issues is required. The authors also indicate that a systems thinking approach can help potential research in conceptualising and acting toward the integration of economic, social, and political issues in boosting farmers' adaptive capability. Sensitizing state department of agriculture policymakers and officials on the impact of climate variability on dry farming and proper adaptation measures would aid in the development of appropriate mitigation policies and initiatives. Extension services should be strengthened as a valuable source of information on climate change, new farming practises, market information, and current government programs.

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