Original Research Article

Climate change adaptation strategies by farmers in Tiruchirapalli District of Tamil Nadu, India

ABSTRACT

Climate change is widely viewed as one of the most serious concerns confronting society today. Climate change is due to natural internal processes or external factors, as well as long-term anthropogenic changes in atmosphere composition and land use. The main purpose of the study was to find out the climate adaptation strategies followed by the respondents and their causes of adoption. Random sampling techniques were used to select the respondents. A total of 60 farmers were selected for the study. The data were collected through direct face-to-face personal interviews, and then compiled, tabulated, and analyzed to get answers with the help of appropriate statistical tools. In this research study, major findings were more than 90 percent of the farmers had low to medium levels of climate adaptation strategies and the major cause for the adoption of adaptation strategies was the neighbourhood aspect (67.3%) followed by less prone to climate effects (65.60%) and shorter duration varieties (56.30%).

Keywords: Adaptation strategies, Causes, Climate change, Tiruchirapalli

1. INTRODUCTION

Climate is the average weather in a location over a lengthy period (30-50 years). Climate change is a systematic change in the long-term state of the atmosphere over multiple decades or more(1)caused by increasing human activities such as industrialization, deforestation, urbanization, agriculture, change in land use patterns, etc.,results ingreenhouse gas emission which leads to fluctuations in temperature, rainfall, wind, and other components.According to IPCC, modern humans have never seen the observed changes in our global climate.Some of these changes are irreversible over the next hundreds to thousands of years(2)which is linked to other catastrophic weather phenomena such as more occurrences of strong hurricanes, droughts, floods, wildfires, and winter storms(3). Climate changehas beena threat to all sectors worldwide such as trade, industry, and particularly the agricultural sector. Agriculture is one of the sectorsthat is more vulnerable to climate change which affects agriculture in many ways. Crops are very sensitive to changes in temperature, precipitation and other extreme weather conditions (4).

Climate change leads toan increased number of pest and disease occurrences which results in changes in food quality(5)and decreased access to food, as reported by USDA(6).If the projected climate change continues till 2100, there will be a 20-30% reduction in rice yield, a 20-45% reduction in maize, and a 5-50% reduction in wheat(7).Tamil Nadu is one of the states that is most vulnerable to climate change in Indiawhich experiences drought onceevery 2.5 years(8).There will be a 0.7 to 6.3% expected reduction in the rice yield of Tamil Nadu(9).Marginal and smallholder farmers are particularly helpless tothe impact of climate change.These transformations lead to damaging the agricultural growing areas, putting millions of people at risk of chronic famine. Sustainable climate change mitigation is important to reduce the negative impact of climate change and extreme weather events on agriculture productivitysuch as the adoption of heat tolerant, and drought tolerant varieties, changes in agronomical practices, efficient utilization of water, soil conservation practices, etc.,(10).

Hence the study was undertaken to determine the climate adaptation strategies followed by the farmersin Tiruchirapalli district of Tamil Nadu state.

1.1 Objectives

1.To study the climate adaptation strategies followed by the farmers in Tiruchirapalli District

2. To find out the causes for the adoption of climate adaptation strategies.

2. METHODOLOGY

2.1 Locale of the study

The present study was conducted in the Tiruchirapalli district of Tamil Nadu state. The study area of Tiruchirapalli district was purposively selected. Tiruchirapalli district consists of 14 blocks. Among these Andhanallur Block from Srirangam Taluk of the district was selected using random sampling techniques.

2.2 Population and Sampling

"Ex post facto" research design was used to undertake the study. The selection of the villages and farmers wasdone by using a random sampling procedure. The list of the total number of villages in the block was obtained from the State Department of Agricultural Office. Out of the total villages, two villages were selected using a random sampling technique. From each village, thirty farmers were selected randomly. Thus, a total of 60 farmers from two villages were selected for the study.

2.3Selection of Variables

A list of relevant variables was sent to the Subject Matter Specialists of State Agricultural University specialists, Extension scientists and ICAR institutions for Judges opinion. Based on the score obtained from the judge's opinion independent variables of the study were selected whereas climate adaptation strategies followed by the farmers were focused as the dependent variable of the study.

2.4 Data Collection

The data was collected through a face-to-facepersonal interview at the field level with the help of a pre-tested and well-structured interview schedule.

2.5Measurement of Climate Adaptation Strategies

Seven climate adaptation strategies at the field level were selected for study purposes by discussing them with the Agricultural Officers at the Block level. The scoring value of 2 and 1 was given to the respondents who followed the climate adaptation strategy and did not follow the climate adaptation strategies respectively.

2.6Causes of adopting the climate adaptation strategies

A seven-item statement was considered for finding out the causes of adoptionfollowed by (11). A five-point Likert-type modified scale was used which consists of five degrees of freedom such as strongly agree, agree, undecided, disagree and strongly disagree were employed against each statement. A score of 5(Strongly agree), 4 (Agree), 3 (Undecided), 2 (Disagree) and 1 (Strongly Disagree) were assigned against the rating scale. Causes of Adoption Index was used to find the most important cause for adoption by using the following formula

$$CAI\ (\%) = \frac{\text{OISCA}}{\text{HPISCA}} \times 100$$

$$\text{OISCA} = N_{sa} \times 5 + N_{ag} \times 4 + N_{ud} \times 3 + N_{da} \times 2 + N_{sd} \times 1$$

OISCA = Observed Index Score for Causes of Adoption
HPISCA = Highest Possible index score for causes of adoption

N_{sa} - Several respondents pointed as strongly agree

N_a - Severalrespondents pointed as agree

N_{ud} - Severalrespondents pointed as undecided

N_{da} - Severalpointed as disagree

N_{sd} - Severalpointed as strongly disagree

The score for the causes of the Adoption Index varies from 60-300 where 60 indicates the lowest number of causes and 300 indicates the highest number of causes for adoption of climate adaptation strategies. The causes for adoption were ranked by the percentage of CAI score.

3. RESULTS AND DISCUSSION

3.1 Selected characteristics of the respondents

The selected characteristics of the respondents are shown in Table 1. The majority of the respondents (51.7%) were in the age category of more than 50 years compared to the middle-aged category (30.0%) of between 41 to 50 years and the young age category (18.3 %) of less than 40 years. Above 80.0% percent of the respondents were male compared to female (11.7%). The highest proportion (40.0%) of the respondents belonged to the middle education level followed by collegiate (38.3%), and formal education (11.7%) and the lowest proportion is secondary and primary education level (5.0%). The major proportion (60.0%) of the respondents belongs to nuclear family while 40.0 percent belong to a joint family. Most of the respondents (95%) belong to the occupation of farming alone followed by farming and business (5.0%). The majority (36.7%) of the respondents possessed small farms followed by marginal farms (35.0%), medium farms (21.7%) and large farms (6.7%). 48.3 % percent of respondents utilized bore wells as irrigation sources followed by Open wells and bore wells (31.7%).73.3 percent of the respondents had high farming experience followed by 16.7 per cent of the respondents had low farming experience and 10.0 per cent of the respondents had medium farming experience. The highest proportion (60.0%) of the respondents had low annual income followed by medium (26.7%) and high annual income (13.3%). Majority (43.3%) of the respondents belong to medium information seeking behavior while 28.3 per cent of the respondents had high and low information-seeking behaviour. About 50.0per cent of the respondents taking independent decisions while other 43.3 per cent of the respondents taking decisions with others.31.7 per cent of the respondents have high-risk orientation followed by low (45.0%) and medium (23.3%). Majority of the respondents(41.7%) had medium scientific orientation followed by low (35.0%) and high (23.3%).61.7 percent of the respondents had medium innovativeness followed by high (21.7%) and low (16.7%).

Table1.Selected characteristics of the respondents

(n=60)

S.No	Characteristic	Categories	Respondents	
			No	%

1	**Age**	Young (≤ 40 years)	11	18.3
		Middle-aged(41 to 50 years)	18	30.0
		Old aged (≥ 51 years)	31	51.7
2	**Gender**	Male	53	88.3
		Female	7	11.7
3	**Educational status**	Formal Education	7	11.7
		Primary education	3	5.0
		Middle Education	24	40.0
		Secondary education	3	5.0
		Collegiate	23	38.3
4	**Family type**	Joint Family (≤ 5 members)	24	40.0
		Nuclear Family(> 5 members)	36	60.0
5	**Occupational status**	Farming alone	57	95.0
		Farming + wage earner	0	0
		Farming + business	3	5.0
		Farming + services	0	0
6	**Farm size**	Marginal (≤ 2.5 acres)	21	35.0
		Small (2.6 – 5.0 acres)	22	36.7
		Medium (5.1-10.00 acres)	13	21.7
		Large (≥ 10.00 acres)	4	6.7
7	**Source of Irrigation**	Canal / Ponds	5	8.3
		Open well	7	11.7
		Bore well	29	48.3
		Open well + Bore well	19	31.7
8	**Farming experience**	Low (≤ 10 years)	10	16.7
		Medium (11 to 25 years)	6	10.0
		High (>25 years)	44	73.3
9	**Annual income**	Low (≤ Rs 1,00,000)	36	60.0
		Medium (Rs 1,00,000 - 2,50,000)	16	26.7
		High (>Rs 2,50,000)	8	13.3

10	**Social Participation**	Low (≤ 3)	35	58.3
		Medium (3 – 4)	21	35.0
		High (>4)	4	6.6
11	**Information seeking behavior**	Low (≤ 39)	17	28.3
		Medium (39 to 44)	26	43.3
		High (> 44)	17	28.3
12	**Decision-making pattern**	Independent decision of respondent	34	56.6
		Joint decision with outsiders	26	43.3
13	**Risk orientation**	Low (≤ 22)	27	45.0
		Medium (22 to 24)	14	23.3
		High (> 24)	19	31.7
14	**Scientific Orientation**	Low (≤ 21)	21	35.0
		Medium (21 - 24)	25	41.7
		High (> 24)	14	23.3
15	**Innovativeness**	Low	10	16.7
		Medium	37	61.7
		High	13	21.7

3.2Adaptation strategies followed by the respondents

Table 1 and Figure 1 together present the same distribution of different adaptation strategies followed by therespondents. Changes in the sowing and planting date according to the changes in the occurrence of the monsoon were adopted by the farmers to the highest extent (67.20 %) while the lowest is the mixed cropping (28.10%).

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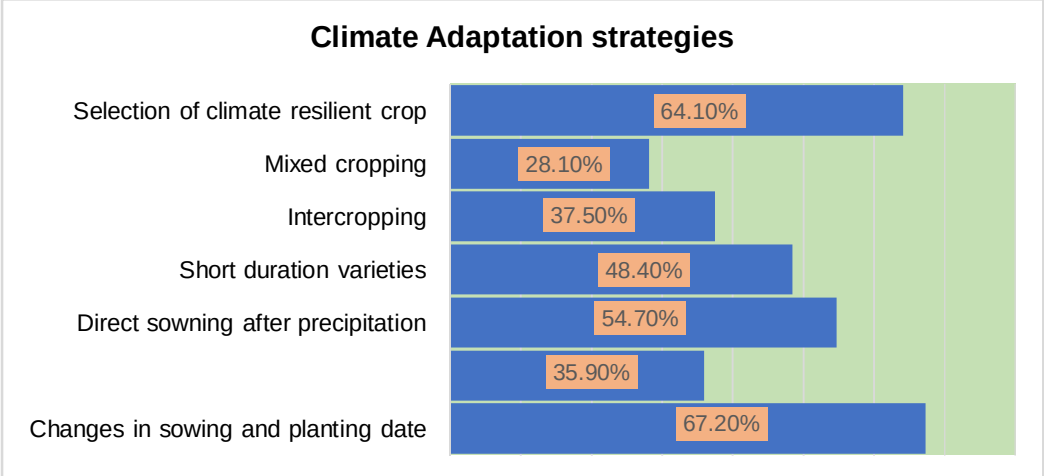

Figure 1. Climate Adaptation strategies of the respondents

Table 2. Distribution of respondents according to their adaptation strategies

(Multiple answers allowed)

S.No	Adaptation Strategies	No of respondents adopted	Percentage
1	Changes in sowing and planting date	43	67.20
2	Selection of climate specific variety such as drought	23	35.90
3	Direct sowing after precipitation	35	54.70
4	Short duration varieties	31	48.40
5	Intercropping	24	37.50
6	Mixed Cropping	18	28.10
7	Selection of climate-resilient crop	41	64.10

The other adaptation strategies were a selection of climate-resilient crops (64.10%), direct sowing after precipitation (54.70%), short-duration varieties (48.40%), intercropping (37.50 %), and selection of climate-specific variety (35.90%). Theresults also support the observations of (12)who noticed these adaptation strategies in agronomical practices as a welcome development.

3.3Overall Distribution of respondents according to their adaptation strategies

Based on the individual scoresof the respondent's adaptation strategies, the respondents are classified into three types such as low, medium, and high.

Table 3. Overall Distribution of respondents according to their adaptation strategies

(n=60)

S.No	Categories	Respondents No	Percentage
1	Low	29	48.3
2	Medium	26	43.3
3	High	5	8.3
	Total	**60**	**100**

The result from Table 3 indicates that the majority of the respondents belong to low adaptation strategies category (48.3 %) following medium adaptation strategies (43.3 %). Only eight percent of the respondents showed high adaptation strategies. The results are similar to the observation of (12) in which these adaptation strategies are a welcome development and may be beneficial to the farmers but not effective to the extreme climatic events.

3.4 Causes for the adoption of adaptation strategies

Farmers' cause for the adoption of adaptation strategies are illustrated in Figure 2.Most of the respondents(67.30 %) adopted climate adaptation strategies because of the neighbourhood

aspect followed by less prone to climate change affect (65.60%), high yield (64.0%), short duration varieties (56.30%), high income (54.60%) and lower input cost (45.60%). The contingency plan by the government was the least important cause for its adoption (29%).These findings align with the study by(11) who found that neighbourhood aspect and less prone to natural disaster were among the top reasons for farmers to adopt climate adaptation strategies.

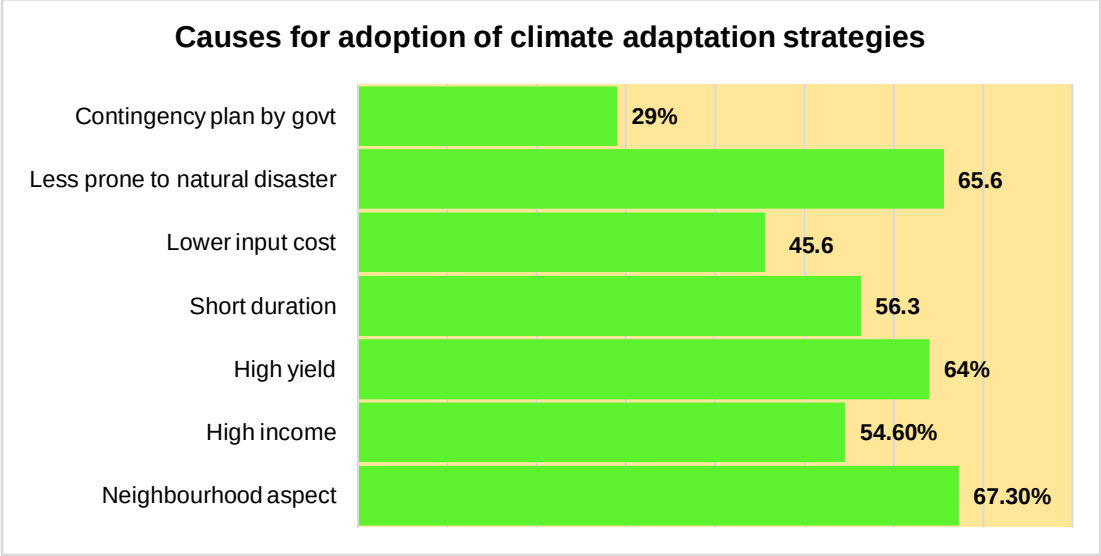

Figure 2. Causes for adoption of climate adaptation strategies by the respondents

3.5 Relationship between the selected characteristics of the respondents and their respondent's adaptation strategies

The zero-order correlation coefficients were computed for the examination of the relationship between the independent variables and the extent of use of extension teaching methods by extension personnel. The results to this effect are presented in Table 4.

Table 4. Relationship between the selected characteristics of the respondents and their climate adaptation strategies

Variable Code	Characteristics	r value
X_1	Age	0.131
X_2	Gender	-0.20
X_3	Educational status	0.243
X_4	Family type	0.218
X_5	Occupational status	-0.154
X_6	Farm size	0.102
X_7	Irrigation source	0.282*
X_8	Farming experience	-0.007

X_9	Annual income	0.295*
X_{10}	Social Participation	0.309*
X_{11}	Information seeking behavior	0.401**
X_{12}	Decision-making behavior	0.224
X_{13}	Risk orientation	0.602**
X_{14}	Scientific Orientation	0.623**
X_{15}	Innovativeness	0.505**
** - Significant at one percent level		* - Significant at five percent level

Among the 15 selected characteristics of the respondents, information-seeking behaviour, scientific orientation, risk orientation, and innovativeness were positively and significantly correlated with the adoption of climate adaptation strategies at a one percent level while farmers' irrigation source, annual income, farming experience, social participation were positively and significantly correlated at five percent level of significance.

4. CONCLUSION

Climate resilient agriculture plays a crucial role in sustainable production and ensures food security and the well-being of communities in the face of climate change. The study provided valuable insights into climate adaptation strategiesand their causes for adoption. The major adaptation strategies were changes in the sowing and planting date (67.20%) followed by a selection of climate-resilientcrops (64.10%) and direct sowing after precipitation (54.70%).

Moreover, the study identifies household attributes such as irrigation source, annual income, social participation, information-seeking behavior, risk orientation, scientific orientation and innovativeness as significant contributors to the adoption of climate adaptation strategies.

Even though half of the farmers had middle and collegiate education levels and most of them were in the category of farming alone as a major source of incomewere in the category of low to medium levels of adaptation strategies.So the government should take initiatives for farmers to aware of the climate adaptation strategies and encourage them by providing a subsidy or any other benefits.

Demonstration and more hands-on training practices should be given to the farmers. This approach integrates well with the attempts made by farmers to increase the adoption of climate adaptation techniques.

In conclusion, climate adaptation strategies are essential for addressing the multifaceted challenges posed by climate change and environmental degradation.Future research could focus on investigating the relationship between climate adaptation strategies and actual farm productivity to assess the impact of climate adaptation strategies, as well as in-depth qualitative research for better understanding the barriers for the adoption of climate adaptation strategies.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

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