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Impact of Farmers' Perception on climate change, rainfall, temperature and water scarcity in Thoothukudi district of Tamilnadu state

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Abstract

Climate change affects many aspects of human life, including freshwater availability, agricultural productivity, natural ecosystems, and human health. It is one of the largest environmental challenges confronting humanity. The severe effects of climate-related disasters on public health, food security, agriculture, water resources, and biodiversity have left India in a state of immense pain and economic losses. India places great attention on the effects of climate change on agriculture since over 60% of its population depends on activities that are sensitive to the climate, including agriculture. According to climate change forecasts, India's total temperature will rise by 2-4 degrees Celsius by 2100, along with an increase in precipitation, particularly during the monsoon season. The topics of agriculture and climate change are discussed in this paper, with a focus on the farming systems in Tamil Nadu's Thoothukudi district and their perceptions and adaption techniques. Along with these topics, the current research aims to investigate the rise and trend of climate change, trends in temperature and rainfall, and water scarcity. According to the study, there is a substantial positive correlation (P-value of 5% or less) between the socio-economic variables of age, sex, operating holding size, and irrigation supplies and the impact of rainfall on groundwater patterns. For these factors, the null hypothesis was thus rejected. Rainfall's influence on groundwater patterns is not significantly influenced by factors such as education level or family size. The null hypothesis has thus been accepted for these variables. Climate change, trends in temperature and rainfall, and water shortages have all been increasing at compound growth rates of 6.43 percent and 7.05 percent in the

Thoothukudi district, respectively. At the 5% level of significance, the trend coefficients for the Thoothukudi district are positive, suggesting that there is a positive trend in climate change, rainfall, temperature, and water shortage. The Thoothukudi district has a trend coefficient of 0.063 for temperature, precipitation, and climate change and a trend coefficient of 0.054 for water shortage.

Key words : climate change, agricultural productivity, biodiversity, global warming, water scarcity.

In contrast to some predictions that suggest global warming will assist agriculture during that time, unabated global warming will at least slightly diminish agricultural capacity worldwide by the end of this century. Where it is least possible to pay for them, in poor nations, is where the effects will be the worst and start the earliest. If the benefits of carbon fertilisation do not materialise, especially if water constraints restrict irrigation, the losses will be far greater.

Drought frequency, groundwater depletion, and global warming are all exacerbated by patterns of changing rainfall and temperature[1]. Due to astronomical cycles, continental drift, and volcanic eruptions, the natural process of climate change is now accelerated by human activity[11].

Black carbon's capacity to significantly absorb incoming solar radiation has scientists investigating its potential influence on climate change[13]. Due to the monsoon's importance to Indian agriculture, its early or late arrival can affect the demand for agricultural products as well as other necessities. Due to significant environmental deterioration brought on by climate change, rapid economic and population increase has put the foundation of sustainable development in jeopardy[1].

Climate change can impact agricultural productivity in two ways: firstly, directly, through variations in temperature, precipitation, and CO_2 levels; and secondly, indirectly, through adjustments to soil properties, pest and insect distribution, and the frequency of weed, disease, and pest infestation[2]. Although rainfed agriculture produces the majority of the world's food, for the past 50 years, water investments in this sector have been neglected[3].

There are significant social, economic, and environmental benefits to upgrading rainfed agriculture, especially in terms of poverty alleviation and economic growth. One of the main human activities impacted by climate change brought on by increasing greenhouse gas concentrations in the atmosphere is agriculture.

According to Orimoloye *et al.*,[12], climate change has an impact on human health through problems brought on by noticeable extreme weather events such as increased temperature, precipitation, heat waves that are more intense and frequent, floods, droughts, high winds, and landslides. As a result of these climatic changes, there is an increase in water and airborne infections, vector-borne infections,

malnutrition, the incidence of diarrhoeal diseases, and heat-related morbidity and mortality. Extreme heat, cold, and unpredictable rain are all symptoms of climate change, which is characterised by variations in both temperature and precipitation, conferring to Haines *et al*.,[8].

Urban dwellers, seniors, and children are especially susceptible to these negative effects on their health[7]. According to Dutta and Chorsiya[6], there are around 150,000 recorded deaths and 5 million illnesses annually as a result of climate change.

Respiratory infections, Pneumothorax, allergies, asthma, heat, and dehydration are among the human health issues that are allegedly associated with climate change, as stated by D'Amato *et al.*,[5]. In India, 2% of people have asthma, while 6% of children are susceptible to respiratory tract infections[10].

According to Hondula and Barnett[9], one of the main causes of heat-related illnesses in urban areas, including skin cancer, heat stroke, heart disease, diarrhoea, and higher mortality rates, is climate change's increased temperature. According to Dutta and Chorsiya[6], additional heat-related health effects on people include dehydration, cramping in the heat, heat exhaustion, heat stroke, fluid loss, heat injuries, and illnesses of the skin and eyes. According to Amutha[4], one significant effect of climate change is the rise in urban temperatures, often known as the urban heat island (UHI) effect.

Meanwhile, the agricultural sector presents a number of chances to reduce the share of greenhouse gas emissions in the world that are directly related to land use, land-use change, and land-management practices[8]. The topics of agriculture and climate change are discussed in this paper, with a focus on the farming systems in Tamil Nadu's Thoothukudi district and their perceptions and adaption techniques. Along with these topics, the current research aims to investigate the rise and trend of climate change, trends in temperature and rainfall, and water scarcity.

Specific objectives :

1. The goal of this study is to compile information about the people and their farming practices in the Thoothukudi area in the Indian state of Tamil Nadu.
2. The goal is to learn how farmers perceive climatic variability.
3. Learn about the risks to human health from climate change
4. Learn what farmers think are the most significant effects of climate change.
5. In order to learn more about the dynamics of water scarcity, temperature and precipitation changes, and the expansion of climate change.

In the Tamil Nadu district of Thoothukudi, a thorough field survey is being conducted. A field survey was carried out in the Thoothukudi district using a pre-tested questionnaire in order to investigate the climate change adaption tactics used by farmers. Ninety farmers, thirty from each of the marginal, small, and big categories, were chosen in the Thoothukudi district, and data on the adaptation tactics they used to combat the consequences of climate change was gathered. This study is only descriptive in nature. An ideal method for

gathering qualitative data is to have in-depth interviews that facilitate the recording of agricultural farmers' consciousness in their own words. Before the fieldwork began, a list of easy questions was developed. To collect household data, farmers' attitudes towards climate change, their knowledge and experiences on climate variability, impacts, and adaptation strategies, and in-depth interviews, a transect walk was undertaken. To make it easier to interpret and analyse, the data has been provided as tables. Journals, articles, theses, reports, publications, and websites were used to gather secondary data. ANOVA, trend coefficients, chi-square tests, probability analysis, averages, correlation, t-tests, standard deviation, and percentage analysis were all employed.

Data Analysis :

The main foundation of the research study is the tabulated data that was gathered from the primary source.

Table-1. Personal characteristics of the respondents

Sex	No. of respon-dents	Percen-tage
Male	62	68.89
Female	28	31.11
Total	90	100.0

Source: Primary Data

Survey responses came from ninety people in total. The table reveals that in the sample villages, there is a higher number of male respondents (68.89%).

Table-2. Age-wise classification of the respondents

Age	No. of respon-dents	Percen-tage
Young (15-30)	15	16.67
Middle (30-45)	54	60.00
Old (45-60)	21	23.33
Total	**90**	**100.0**

Source: Primary Data

According to the table, more responders are middle-aged (60.00%). The survey indicates that the involvement of middle-aged groups in the research region is higher than that of older and younger age groups.

Table-3. Educational Qualification of the Respondents

Qualification	No. of respon-dents	Percen-tage
Illiterate	2	2.22
Secondary	4	4.44
Hr. Sec	17	18.89
Graduate	41	45.56
Postgraduate	26	28.89
Total	**90**	**100.0**

Source: Primary Data

Opinion articulation differs depending on education. Only 2.22 percent of respondents are illiterate, while nearly 19% have only completed secondary school. Of the respondents, nearly 46% have at least a bachelor's degree, while 29% have doctorates.

Table-4. The number of respondents and their family size

Size	No. of respon-dents	Percen-tage
Low (1-3)	23	25.56
Medium (4-5)	56	62.22
Large (Above 5)	11	12.22
Total	**90**	**100.0**

Source: Primary Data

62.22 percent of the respondents, or most families, are medium-sized, with four to five members.

Table-5. Size of operation holding

Size of holding (acres)	No. of Respon-dent	Percen-tage
Less than 2	6	6.67
2-3	18	20.00
3-4	32	35.55
4-5	26	28.89
5 Above	8	8.89
Total	90	100.0

Source: Primary Data

According to the table, approximately 85% of the operating holding was smaller than 5 acres, with the remaining 8.89% being larger than 5 acres. The majority of sample farmers' operating holdings were between two and five acres.

According to Table 6, 42.22 percent of flower producers surveyed said they utilise well as their irrigation sources. Conversely, the sources of irrigation used by respondents are as follows: 31.11 percent use bore wells, 8.89 percent use rainwater, and 17.78 percent utilise the channel.

Table 6 Sources of irrigation

Sources of Irrigation	No. of Respon-dents	Percen-tage
Well	38	42.22
Bore Well	28	31.11
Rainwater	8	8.89
Channel	16	17.78
Total	**90**	**100.0**

Source: Primary Data

Table-7. Climatic Vulnerability-Temperature change

Temperature	No. of Respon-dents	Percen-tage
Increased	73	81.11
Decreased	8	8.89
Don't Know	9	10.00
Total	**90**	**100.0**

Source: Primary Data

The findings showed that ninety of the locals surveyed thought that temperatures have been changing over time. 81.11 percent of them, however, believe that the temperature has risen. On the other hand, only 8.89 percent reported a drop in temperature.

Table-8. Drought occurrences opinion of the respondents

Drought	No. of Respon-dents	Percen-tage
Increasing	78	86.67
Decreasing	7	7.78
Constant	5	5.55
Total	**90**	**100.0**

Source: Primary Data

A significant proportion of the participants, approximately 86.67 percent, reported a rise in the frequency of drought episodes and associated it with atypical and erratic rainfall patterns in recent times.

Table-9. Agricultural Vulnerability- Impact on crop productivity

Crops	No. of respon-dents	Percen-tage
Increasing	5	5.56
Decreasing	82	91.11
Constant	3	3.33
Total	**90**	**100.0**

As the temperature rises in three villages in the Tuticorin District, about 91.11 percent of the respondents reported a drop in crop productivity. Reduced crop durations are expected to have a detrimental influence on crop yield. However, this is countered by an increase in CO_2 at moderate temperature rises and higher warming.

Table-10. Climatic Vulnerability- Rainfall Pattern

Rainfall	No. of respon-dents	Percen-tage
Predictable	6	6.67
Unpredictable	80	88.89
Constant	4	4.44
Total	**90**	**100.0**

Source: Primary Data

Throughout the previous ten years, almost 89 percent of respondents saw an unpredictable rainfall pattern, 6.67 percent saw a predictable pattern, and 4.44 percent saw a steady pattern.

Table-11. Health Impacts Due to Climate Change (n=90)

Impact on Health	No. of respon-dents	Percen-tage
Infectious disease	28	31.11
Malaria	21	23.33
Dengue and Yellow fever	15	16.67
Diarrhea	9	10.00
Cholera	7	7.78
Skin cancers	5	5.56
Cataracts	3	3.33
Heat-related mortality	2	2.22

Source: Primary Data

The weather has a direct effect on the respondent's health. An overall increase in temperature will lead to an increase in health problems. In addition, 31.11% of respondents reported infectious disease cases, 23.33% reported malaria, 16.67% reported dengue and yellow fever, 10.00% reported diarrhoeal illness, 7.78% reported cholera, 5.56% reported skin cancer, 3.33% reporting cataracts, and 2.22% reporting heat-related mortality, the locals also reported rising warming days. It is anticipated that heat waves and other extreme weather events will occur more frequently and with higher severity, which will lead to a rise in fatalities.

Numerous respondents (82.22%) stated that new diseases have severely damaged the crops in the research area. Seventy percent of the locals said there are no behavioural changes in the livestock. According to 76.67% of respondents, fish species in the water are changing.

Table-12. Impact of Climate Change

Impact of Climate Change	Yes	No	Don't know	Total
Damage to agriculture	74(82.22)	11(12.22))	5(5.56)	90(100)
Behavioural changes in livestock	63(70.00)	17(18.89)	10(11.11)	90(100)
Change in fish species in the sea	69(76.67)	14(15.55)	7(7.78)	90(100)

Source: Primary Data

Table-13. ANOVA for sex and awareness about Climate Change

Sex	Sum of squares	df	Mean square	F	Sig
Between Groups	37.22	2	6.431	24.08	0.077
Within Groups	21.02	87	0.644		

The value of 0.077 in the table is higher than the value of 0.077 that was computed. 0.05). Ho has been accepted, meaning that the research hypothesis has been rejected (H2). It follows that there is no discernible difference in respondents' awareness of climate change based on their age.

Table-14. Correlation of Socio-Economic Variables and Impact on change of seasonal rainfall

Sl.no	Variable	r	sig
1	Age	-0.482	0.311
2	Education	0.351	0.136
3	Sex	0.104	0.131
4	Family size	-0.545	0.302
5	Size of operation olding	-0.311	0.315
6.	Sources of irrigation	-0.221	0.203

Source: Computed from Primary Data

The mathematical relationship between the socio-economic factors and their influence on the variation in seasonal rainfall has been attempted to be controlled. The association between socio-economic factors and their influence on changes in seasonal rainfall is displayed in the above table. The study found no evidence of a significant relationship between socio-economic factors and the variation in seasonal rainfall.

With a P-value of 5% or below, the above table shows that socio-economic variables, including age, sex, operating holding size, and irrigation sources, have a substantial correlation with the effect of rainfall on groundwater patterns. For these factors, the null hypothesis was thus rejected. Rainfall's influence on groundwater patterns is not significantly influenced by factors such as education level or family size. The null hypothesis has thus been accepted for these variables.

Table-16 displays the findings of the investigation and illustrates the Thoothukudi district's trends in temperature, precipitation, and water shortage.

Table-16 shows that in the Thoothukudi district, the trends in rainfall and temperature, together with the shortage of water, have all

Table-15 The effect of socio-economic characteristics on the influence of rainfall on groundwater pattern using the chi-square test

Socio-Economic variables	Chi-Square values	P Values	Significance
Age	18.95	0.010*	Significant
Sex	22.46	0.001*	Significant
Education	31.01	0.351	Not Significant
Family size	12.11	0.284	Not Significant
Size of operation holding	19.13	0.001*	Significant
Sources of irrigation	36.41	0.342	Not Significant

* Significant level of 5 per cent.

Table-16. Trend and growth of climate change, rainfall and temperature trends and water scarcity in Thoothukudi district

Particulars	Trend Coefficients		R^2	CGR (percentage)
	a	b		
Climate change, rainfall and temperature trends	7.79	0.063* (6.17)	0.77	6.43
Water scarcity	7.38	0.054* (8.01)	0.81	7.05

* Significant at 5 per cent level.

Note: CGR = Compound Growth Rate

Figures in parentheses indicate t-values.

been increasing at compounded growth rates of 6.43 percent and 7.05 percent, respectively. At the 5% level of significance, the trend coefficients for the Thoothukudi district are positive, suggesting that there is a positive trend in climate change, rainfall, temperature, and water shortage. The Thoothukudi district has a trend coefficient of 0.063 for temperature, precipitation, and climate change and a trend coefficient of 0.054 for water shortage.

Thoothukudi district, the research region, is seeing climate change, which has an impact on agricultural operations. To tackle the climate catastrophe, sustainable adaptation is therefore essential. The majority of farmers who believe that changes in rainfall patterns are the source of climate change employ, according to the survey, tactics such as cutting back on irrigation, altering planting patterns, and advancing or postponing cropping seasons. The majority of those who believe that climate change would result in less groundwater available also alter agricultural practices, use fewer irrigations, and cultivate crops that are rain-fed.

Conflicts of Interest :

The author does not have any conflict of interest.

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