Original Research Article

Farmers' Perception Towards Climate Change and its Effect on Agriculture

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ABSTRACT

This study aimed to assess farmers' perception of climate change and its implications for agriculture in Kolar district, Karnataka, during the year 2021-22. Data from 160 respondents were collected using a multi-stage random sampling technique, employing a well-structured, pre-tested questionnaire administered through personal interviews. Descriptive statistics, regression analysis, and Garret's ranking technique were employed for data analysis. The results revealed that 40% of the respondents had been aware of climate change for the past five years, with farmers' personal observations being a primary source of information. Most farmers identified climate change through rising temperatures, irregular rainfall patterns, and increased overall rainfall. Respondents also noted climate change effects on agriculture, such as increased pest and disease occurrences, altered sowing periods, and heightened competition from weeds. Regression analysis indicated that factors such as education, the use of social media, sources of weather information, and farming experience had a positive and significant influence on farmers' perception levels. As a result, this study suggests the development of climate-based advisory services, including weather alerts, climate-resilient crop varieties, adaptation strategies, and enhanced weather forecasting systems by relevant government departments to mitigate the impacts of climate change on agriculture in the region.

Key words: *Climate change, farmers' perception, adaptation strategies, climate resilient*

INTRODUCTION

Climate change is a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global and/or regional atmosphere and which is in addition to natural climate variability observed over comparable time periods[1]. Climate change includes major changes in temperature, precipitation, or wind speed patterns that occur over several decades or longer. Climate change results from carbon dioxide (CO2) and other greenhouse gas (GHG) emissions viz. methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, etc., and also due to anthropogenic activities like deforestation, burning of fossil fuels, etc. The impacts of climate change are manifested in many ways, which include periods of moisture stress, high incidence of pests and diseases, increased salinity, high temperature, and floods[2].

The footprints of climate change can already be seen in India. In India, the average annual temperature in 2021 is about 26.5 degree Celsius and which is 24.4 degree Celsius in 1901 and temperature is increasing at the rate of 1.9 percent during 2001-2020. In 2010 southwest monsoon was delayed by 1 day to onset and 27 days to withdrawal, whereas in 2019 it delayed -7 days to onset and 39 days to withdrawal. In 2017 India faces 10 extreme weather events such as floods, heat waves, drought, etc., [3] these are the evidences for rapid climate change in India. The national clean energy fund, Paris

agreement, international solar alliance, and national action plan on climate change are some of the actions taken by the Government of India to tackle ongoing climate change.

The agriculture sector is dependent on climate and weather conditions, if any small change in these will have profound effects on crop productivity[4]. Because of extreme weather conditions, there exists a high probability of soil infertility which leads to low quality and quality of the produce[5] and will affect the groundwater recharge and water holding capacity[6]. Water plays a key role in agriculture production, water cycle will also be affected by climate change and will have several effects on agriculture such as, low productivity, increase in pests and diseases, groundwater depletion, and change in cropping period etc.,[7]. An increase in temperature and heavy rainfall will invite more pests and diseases which ultimately reduces the output and farmers' income[8]. A decrease in crop production will lead to create food scarcity in the country.

There are possibilities to mitigate the adverse impacts of climate change at field as well as farm level. Hence, before taking proper controlling measures, it is important to know the perception of the farmers towards climate change. Perception is the ability of the individual to see, hear or become aware of something through sense. With this backdrop, the study analysed (i) perception of farmers towards climate change and its effect on agriculture (ii) factors influencing the perception level of the farmer towards climate change.

METHODOLOGY

This research study was conducted in Kolar district, Karnataka during 2021-22 to investigate the perceptions of farmers regarding climate change and its consequences for agriculture. The study employed a multi-stage random sampling technique to select a sample of farmers. In the first stage, Kolar district was chosen as it was identified as a region particularly susceptible to climate change in South Karnataka[9], providing the foundation for district selection. In the second stage, four climate-vulnerable blocks - Malur, Chintamani, Bangarapet, and Mulbagal - were selected based on the list of climate-vulnerable blocks in Kolar district provided by the Karnataka State Natural Disaster Monitoring Center (KSNDMC). In the final stage, 40 farmers, consisting of 20 small-scale farmers (holding 2 acres or less) and 20 large-scale farmers (holding more than 2 acres) in each block, were randomly chosen, resulting in a sample size of 160. Data on socio-economic characteristics, farmers' awareness of climate change, and their perceptions of its impact on agriculture were collected from the sampled farmers through well-structured and pre-tested interview schedules. The research design employed in this study was ex-post facto, which is a systematic empirical inquiry where the researcher lacks direct control over the variables as they have already occurred. To gauge the respondents' perceptions of climate change and its effects on agriculture, a numerical rating scale developed by[10] 2014 was utilized. The study employed descriptive statistics, multiple linear regression analysis, and Garret's ranking technique to achieve its research objectives.

RESULTS AND DISCUSSION

Awareness of climate change by the respondents

Table 1 provides an overview of the farmers' awareness of climate change within the study area. The results indicate that among the respondents, 40 percent were aware of climate change for the last five years, 24 percent had been aware for the past 15 years, 15 percent had awareness spanning the last decade, 12 percent became aware in the previous year, and only 9 percent had been aware for the past 25 years. Among small-scale farmers, the majority (38 percent) had become aware in the last five years, with an additional 29 percent having awareness dating back 15 years. Among large-scale farmers,

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approximately 43 percent had gained awareness in the last five years, while 20 percent had been aware for the past 15 years. Notably, there is a discernible trend where the number of years of awareness of climate change appears to have a positive influence on the level of perception. This section provides an insight into the duration of awareness among the study participants regarding climate change, with the results highlighting varying levels of awareness among the respondents and the potential correlation between the duration of awareness and their perception levels.

Table 1: Farmer awareness about climate change

Sl. No	Particulars	Kolar		
		Small farmers (n_1=80)	Large farmers (n_2=80)	Pooled (n=160)
1	A year ago	12 (15.00)	7 (8.75)	19 (11.87)
2	In the last 5 years	30 (37.50)	36 (42.50)	66 (40.00)
3	In the last 10 years	10 (12.50)	12 (17.50)	22 (15.00)
4	In the last 15 years	23 (28.75)	16 (20.00)	39 (24.37)
5	>25 years	5 (6.25)	8 (11.25)	13 (8.75)
	Total	80 (100)	80 (100)	160 (100)

Note: Figures in the parenthesis indicates percent to the respected column

Sources of climate change information by the respondents

Table 2 provides an insight into the sources from which respondents obtain information about climate change. Six primary sources were considered, and farmers were asked whether they received weather information from these sources. The data was analyzed using Garret's ranking technique, and the results are presented below. Among the six enlisted sources, mass media, social media, personal observation, and farmers' organizations emerged as the top three sources for climate change information in the study area. For small-scale farmers, personal observation was identified as the primary source of information, ranking first, followed by mass media and social media as the second source, and farmers' organizations ranking third. In the case of large-scale farmers, mass media and social media were found to be the major sources of information, ranking first, followed by personal observation as the second source, and information from extension agents ranking third.

These findings shed light on the prominent sources of climate change information for both small and large-scale farmers in the study area, indicating that personal observation plays a significant role in shaping small farmers' perceptions, while mass and social media are influential sources for large-scale farmers.

Table 2: Sources of information about climate change to the farmers

Sl. No.	Sources of information	Kolar					
		Small farmers (n_1=80)		Large farmers (n_2=80)		Pooled (n=80)	
		Garret's score	Rank	Garret's score	Rank	Garret's score	Rank
1	Personal observation	82.07	I	80.39	II	80.94	II
2	Through extension agent	68.36	IV	74.33	III	68.97	IV

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3	Through farmers' organizations	72.06	III	69.39	IV	75.20	III
4	Mass media and social media	78.29	II	84.20	I	82.48	I
5	Developmental Departments	58.39	V	52.30	V	52.54	V
6	Agro met advisory services	41.39	VI	48.03	VI	43.20	VI

Farmers' perception towards climate change and its effects on agriculture

In order to achieve the objectives of assessing farmers' perception of climate change and its impacts on agriculture, a total of sixteen factors were enlisted, comprising eight factors related to perceptions of climate change and eight factors concerning the effects of climate change on agriculture. These factors were assessed by a sample of respondents using a three-point continuum scale, where 'strongly agree' was assigned a score of 3, 'agree' was assigned a score of 2, and 'not agree' was assigned a score of 1.
Table 3 illustrates the significance of each climate change factor, as perceived by the sample of farmers. It was observed that an increase in average temperature was deemed the most significant climate change factor, and it received the highest rank from the majority of the farmers. Similar findings were reported by[11]. The erratic distribution of rainfall was considered the second most crucial climate change factor, followed by an increase in average rainfall, an increase in wind speed, a decrease in the number of rainy days, early withdrawal of the monsoon, late withdrawal of the monsoon, and a decrease in average rainfall.Moreover, a majority of the farmers perceived that climate change would lead to a higher incidence of pests and diseases, and this factor ranked first in their assessment. This was followed by changes in the timing of sowing, an increase in weeds, reduced crop productivity, alterations in soil fertility, a decrease in water-holding capacity, diminished produce quality, and changes in soil structure and texture.When examining the differences between small and large farmers, it was noted that small farmers primarily perceived an increase in average temperature, erratic distribution of rainfall, and an increase in rainfall as the three major climate change factors. In contrast, large farmers perceived an increase in average rainfall, an increase in average temperature, and early withdrawal of the monsoon as the three most significant climate change factors.Furthermore, in terms of farmers' perceptions of the effects of climate change on agriculture, the majority of both small and large farmers perceived that an increase in pests and diseases, changes in sowing times, and an increase in weed growth were the three primary effects.

The ranking of an increase in average temperature as the highest-ranked climate change factor aligns with the prevailing climate conditions in the study area, characterized by dry conditions and an average annual temperature of 40°C. Temperature fluctuations over time have made it the most significant climate change factor in the area. Regarding rainfall patterns, data reveals substantial variations over the years, with an average annual rainfall of 564 mm in 2016, increasing to 1081 mm in 2020, with variations across different blocks. These variations correspond to the perceptions of farmers, who ranked erratic rainfall distribution as the second most significant factor and an increase in rainfall as the third most important climate change factor. Majority of farmers perceived that, climate change will increase pest and disease attack, this was also proven by [12] that temperature rise and change in rainfall pattern leads to increase pest severity.

This analysis demonstrates the concordance between farmers' perceptions and empirical climate data, highlighting the critical role of both temperature and rainfall patterns in shaping the understanding of climate change in the study area.

Table 3: Framers perception towards climate change and its effect on crop production

		Kolar

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Sl. No.	Particulars	Small farmers (n_1=80)			Large farmers (n_2=80)			Pooled		
		Total score	Mean score	Rank	Total score	Mean score	Rank	Total score	Mean score	Rank
I	Perception towards climate change									
1	Increase in average temperature	202	2.52	I	190	2.37	II	392	2.45	I
2	Late onset of monsoon	140	1.75	VIII	159	1.98	VII	299	1.86	VII
3	Early withdrawal of monsoon	176	2.20	IV	185	2.31	III	361	2.25	VI
4	Erratic distribution of rainfall	196	2.45	II	184	2.30	IV	380	2.37	II
5	Increase in average rainfall	179	2.23	III	193	2.41	I	372	2.32	III
6	Decrease in average rainfall	168	2.10	V	134	1.60	VIII	302	1.88	VIII
7	Increase in wind speed	163	2.03	VII	161	2.01	VI	324	2.02	VI
8	Decrease in number of rainy days	169	2.11	VI	165	2.06	V	334	2.08	V
II	Perception towards effect of climate change on crop production									
1	Increases pest and diseases	221	2.76	I	225	2.81	I	446	2.78	I
2	Decrease in quality of the produce	123	1.53	VII	100	1.25	VIII	223	1.39	VII
3	Reduction in crop productivity	170	2.12	V	187	2.33	IV	357	2.23	IV
4	Changes in time of sowing	208	2.60	II	225	2.81	II	433	2.70	II
5	Increase in weed	198	2.47	III	201	2.51	III	399	2.49	III
6	Change in soil fertility	178	2.22	IV	156	1.95	V	334	2.08	V
7	Decrease in water holding capacity	166	2.07	VI	124	1.55	VI	290	1.81	VI
8	Change in soil structure and texture	96	1.20	VIII	108	1.35	VII	204	1.27	VIII

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Factors influencing farmers' perception behavior towards climate change

To understand the factors influencing the perception of climate change and its impact on agriculture, a regression analysis was conducted, and the results are presented in Table 4. The coefficient of multiple determination (R^2) was determined to be 0.58 in the study area, signifying that the

variables included in the model explain approximately 58 percent of the total variation, and the fitted model was statistically significant, as indicated by the F-value.

The analysis revealed that several variables played a significant role in shaping perceptions towards climate change. Education of the respondents was found to have a positive and significant effect, signifying that individuals with higher levels of education exhibited a higher level of perception regarding climate change. Farming experience also had a positive and significant impact on perception, indicating that more experienced farmers tended to have a better understanding of climate change. Additionally, a positive relationship was observed between the use of mass media and social media and perception, suggesting that increased exposure to mass media and social media platforms improved individuals' perceptions of climate change. Moreover, participation in extension programs and reliance on social weather information sources were both positively and significantly associated with perception, further enhancing awareness and understanding of climate change. The obtained results were similar with[13].

Table 4: Factors influencing the farmers' perception towards climate change

Sl. No	Particulars	Kolar		
		Small farmers (n_1=80)	**Large farmers (n_2=80)**	**Pooled (n=80)**
		Co-efficients	**Co-efficients**	**Co-efficients**
1	Constant	42.93	20.49	32.30
2	Age	0.0293 (0.0029)	0.0673 (0.1683)	0.0479 (0.0923)
3	Education	1.2039** (0.2039)	0.9992** (0.1065)	1.1101** (0.0043)
4	Farming experience	0.1029 (0.0468)	1.0939* (0.3489)	0.9010* (0.0443)
5	Use of mass and social media	1.9383** (0.0029)	1.9203** (0.0100)	1.7990** (0.0304)
6	Extension participation	0.9839 (0.0283)	1.0048 (0.0032)	0.1019** (0.0129)
7	Social participation	0.0923 (0.0202)	0.4950 (0.0020)	0.0193 (0.0203)
8	Sources of weather information	1.2938** (0.0022)	1.0200* (0.0456)	1.1030** (0.1020)
9	Decision making ability	0.0203 (0.1029)	0.0293 (0.0106)	0.0230 (0.0039)
10	Economic motivation	0.0048* (0.1010)	0.0023 (0.0030)	0.0020 (0.0102)
11	Risk bearing ability	0.0230 (0.0023)	0.3048 (0.0384)	0.0930 (0.2003)
	R^2	0.53	0.48	0.58
	F-value	2.03 (0.0478)	1.98 (0.3011)	3.05 (0.0237)

Note: Dependent variable: Perception about climate change and its effect on agriculture.

In the case of small-scale farmers, the coefficient of multiple determination (R^2) was determined to be 0.53. The regression coefficients for education (1.2039), use of mass media and social media (1.9383), sources of weather information (1.2983), and decision-making ability (0.0203) were all positive and significant, demonstrating their influence on the perception of climate change among small-scale farmers. For large-scale farmers, 48 percent of the variation was explained by the ten variables included in the

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model. Regression coefficients for education (0.9992), farming experience (1.0939), use of mass and social media (1.9203), and sources of weather information (1.0200) were all found to be positive and significant. The obtained results are in line with [12]. However, the other variables included in the model did not exhibit a significant influence on perception. The results indicate that education, farming experience, use of mass media and social media, participation in extension programs, and access to social weather information sources all contribute significantly to farmers' perceptions of climate change and its effects on agriculture. These findings underscore the importance of education and information dissemination in enhancing awareness and understanding of climate change among farmers, with specific variations between small-scale and large-scale farmers.

CONCLUSION

Climate change is changing every year and it has an adverse impact on agriculture. Hence climate change awareness, perception and control measures are essential to tackle its adverse impacts. While studying farmers ' awareness of climate it was found that the majority were aware of it from the past five years. Farmers notice climate change such as the increase in average temperature as a major change and the incidence of pest and diseases as a major effect of it. The sources of climate information play a key role in agriculture, the study found that personal observation is the major climate change information. Education, farming experience, and use of social media have positive and significant impact on the perception behavior of the farmers. Hence climate-based advisory services such as weather alerts, climate-resilient crop varieties, climate-resilient adaptation strategies, and weather forecasting systems should be devised by concerned departments.

RECOMMENDATIONS

Given the findings, this study recommends that relevant government departments and agricultural institutions in Kolar district should develop climate-based advisory services. These services could include the provision of weather alerts, the promotion of climate-resilient crop varieties, the dissemination of climate-resilient adaptation strategies, and the enhancement of weather forecasting systems. These measures aim to empower farmers with the knowledge and tools they need to mitigate the adverse impacts of climate change on their agricultural practices, ultimately contributing to the sustainability of agriculture in the region.

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