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Farmers' perception of climate change and its impact on agriculture in Jaipur district of Rajasthan

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Abstract
The present study titled "Farmers' Perception towards Climate Change and its Impact on Agriculture in Jaipur District, Rajasthan" was conducted in Jaipur District, Rajasthan in 2020-21. A multi-stage sampling technique was used to select respondents. A total of 385 respondents were selected as a sample for the study. The results showed that most respondents agreed that there had been a drastic change in rainfall pattern, rainfall timing, rainfall amount and undecided rainfall intensity. A large majority of respondents strongly agreed that hail and storm events, duration of the dry season varies during the wet season. A large majority of respondents agreed that there had been an increase in incidence of crop failures.

Keywords: Agriculture, climate change, farmer, impact, perception

Introduction
Climate change is one of the most significant problems in the world today and has significantly reshaped or is changing Earth's ecosystems. Although climate change on Earth is a continuous process, recently, over the last 100 years or so, the rate of these changes has increased manifold. Overall, the impact of climate change is very broad, but its profound effects are now clearly visible in the agricultural sector. Climate change has already become a major threat to farmers' livelihoods. However, climate change is a global phenomenon, but the population is affected by its local effects. Climate change has caused widespread misery and huge economic losses in India, negatively impacting agriculture, food security, public health, water resources and biodiversity. Most farmers did not clearly understand the causes of climate change and what its consequences might be in the future. Farmers' perception is very helpful in establishing the fact that the region is facing direct or indirect problems in agriculture and other activities due to climate change. Therefore, understanding the important perceptions of farmers regarding climate change can determine the willingness of these actors to adapt and modify their practices. The adaptability of farmers and the successful implementation of new technologies in their ecosystems depends on their tendency to perceive and respond favorably to climate and environmental changes.
Understanding farmers' perceptions of climate change significantly contributes to the formulation of other adaptation initiatives and strengthens farmers' social learning to address future climate risks. The link between farmers' perceptions, learning processes and their decisions to adopt adaptation strategies in agriculture remains a controversial topic in the literature. Keeping this issue in mind, this study aimed to investigate farmers' perceptions towards climate change and its impact on agriculture in Jaipur district, Rajasthan.

Methodology
The present research was conducted in Jaipur district of Rajasthan. Multistage sampling was used to select the farmers in the sample as respondents. Based on soil types and water availability, the district was divided into four agro-ecological situations. Two representative villages were selected from each agro-ecological situation. A complete list of all households in each selected village was prepared. Respondents were selected from each sample village; for the purpose of the study. Thus, a total of 385 farmers were selected as respondents.
Farmers' perception of climate change is conceptualized as comprising three dimensions – first, as farmers' “awareness”; second, "conceptual understanding"; and third, the “experience” of climate change. Individual farmers' perceptions of climate change were measured using a

scale developed by Jaishi *et al.* (2018) [3] with some modification according to the study requirements.

Results and Discussion

The results presented in Table 1 revealed that most farmers in study region experienced climatic aberrations because they had been farming there for many years. The results indicated that most farmers agreed that there was a drastic change in rainfall pattern (37.92%), timing of rainfall (34.81%), amount of rainfall (31.43%) and the intensity of indecisive rains (21.04%). A large majority of respondents, as shown in the table above, strongly agree with the fact that hailstorms (27%) and dry spell during the rainy (39.48%) season had changed. A general perception prevalent among respondents was that there was an increase in the incidence of insect pests, incidence of harmful diseases, hailstorms, thunder, and lightning. Similarly, Singh (2021) [6] also reported that farmers perceived changes in rainfall distribution, increase in temperature, increase in frequency of heat waves and droughts. Furthermore, degradation of common property resources, uncertainty in crop yields, increased soil salinity, agricultural unemployment and reduced consumption were some of the possible non-climatic impacts perceived by farmers. Additionally, Ansari *et al.* (2018) [1] also revealed that most of the respondents believed that there had been significant changes in various parameters of climate change. Furthermore, research by Dhanya and Ramachandran (2016) [2] on farmers' perceptions of climate change in a semi-arid region of southern India found that farmers perceived climate variability and identified an increase in temperature, delayed onset of monsoon, intermittent dry periods and decreasing soil moisture is a critical factor affecting its cultivation. This study revealed that farmers' perceptions were consistent with the actual trend analysis carried out on weather variables. The results of the study conducted by Shankara *et al.* (2013) [4] also concluded that most farmers had high perceptions of climate change parameters such as temperature, precipitation and dry spells.

Table 1: Farmers perception on extent of variability of climate change faced by farmers (n=385)

Perceptual statement	Responses									
	Strongly agree		Agree		Undecided		Disagree		Strongly disagree	
	No	%	No	%	No	%	No	%	No	%
Rainfall pattern has been changed	132	34	146	37.92	48	12.47	36	9.35	23	5.97
Timing of the rainfall is changing	112	29	134	34.81	69	17.92	47	12.21	23	5.97
Amount of rainfall is changing	109	28	121	31.43	77	20	43	11.17	35	9.09
Intensity of rainfall is changing	69	18	81	21.04	98	25.45	83	21.56	54	14.03
Summer temperature is changing	57	15	81	21.04	177	45.97	39	10.13	31	8.05
Winter temperature is changing	59	15	67	17.40	177	45.97	49	12.73	33	8.57
Overall, of the annual temperature is changing	47	12	69	17.92	207	53.77	43	11.17	19	4.94
Hail-storm events is changing	103	27	93	24.16	91	23.64	49	12.73	49	12.73
Thunderstorm and lightening events are changing	113	29	131	34.03	78	20.26	37	9.61	26	6.75
Duration of dry spell during rainy season is changing	101	26	152	39.48	63	16.36	37	9.61	32	8.31
Wind velocity is changing	64	17	70	18.18	64	16.62	106	27.53	81	21.04
Increase in the insect pest incidence	103	27	134	34.81	62	16.1	46	11.95	40	10.39
Increase in the disease pest incidence	117	30	149	38.70	57	14.81	39	10.13	23	5.97

Farmers' perception of the overall impact of climate change was analyzed, mainly: loss of agricultural production, loss of trees/orchards/houses, loss of domestic animals and loss of income, and the results are presented in Table 2.

It is clear from the results that 39.22% of the farmers strongly agree that agricultural production is hampered by climatic variabilities. Farmers strongly pointed out that due to reduced water availability, their livelihoods were in trouble. The delayed onset of the southwest monsoon and its poor performance during the months of June and July affected the sowing of the Kharif crop. Delays in the normal monsoon pattern created challenges in the timing of soil preparatory work and sowing of crops. These delays due to the monsoon impact the crops produced throughout the agricultural year. Even after the onset of the monsoon and the start of sowing, there may be a withdrawal of the monsoon leading to unexpected periods of drought and water stress in plants and created difficulties in the adoption and timing of cultural practices, ultimately causing instance reactions in terms of yields and production. Most farmers believed that the rainy season has decreased unreasonably and unpredictably over the past two decades.

Nearly 21.04 percent of respondents strongly agreed while 21.04 percent agreed that there had been substantial reduction in water level due to high temperature and lack of timely rains. A large majority of respondents (25.19%), as can be seen from the table below, agree with the statement that there had been an increase in crop failure. Further, about 26.75% respondents strongly agreed and 31.95% respondents only agreed that “decline in population and tree species” and 17.40% strongly agreed and 25.45% respondents agreed that “decline in population and animal species". Farmers had perceived the impacts of climate change on various aspects related to agriculture, and the main response had focused on the reduction of groundwater levels, flora and fauna, and production.

Table 2: Overall perception about impact of climate change by farmers (n=385)

Statement	Responses									
	Strongly agree		Agree		Undecided		Disagree		Strongly disagree	
	No.	%	No.	%	No.	%	No.	%	No.	%
Agriculture production hampered	151	39.22	123	31.95	47	12.21	43	11.17	21	5.45
Loss of population and species of trees	103	26.75	123	31.95	65	16.88	57	14.81	37	9.61
Loss of population and species of animal	67	17.40	98	25.45	123	31.95	58	15.06	39	10.13
Depletion of ground water table	81	21.04	81	21.04	98	25.45	84	21.82	41	10.65
Incidence of crop failure	89	23.12	97	25.19	89	23.12	61	15.84	49	12.73

Similarly, the results were also supported by Shukla *et al.* (2019) [5] that the majority of respondents across all types of farmers experienced a decrease in summer and winter precipitation and an increase in summer temperature. While the perception of the impacts of climate change varied among different types of farmers, as specific types of farmers experienced only few impacts. The impact of climate risks on food security and household income was significantly more strongly perceived by subsistence farmers with low resources.

Conclusion

From this study, it can be concluded that farmers are exposed to climate change and extreme weather events, including abnormal rainfall, which can have serious consequences on yields. High temperatures and a prolonged dry season have damaged crops and yields, leading to increased vulnerability. It can also be concluded that education and access to information are essential for farmers to accurately perceive climate change. To increase the effectiveness and sustainability of adaptation interventions in the study area, we recommend that knowledge about climate change and the adaptive capacity of farmers be part of the local development agenda. These actions can go a long way in raising awareness and promoting informed measures to adapt to climate change.

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