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Analyzing farmers perception towards climate change in Nainital district of Uttarakhand

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ABSTRACT: Climate change with expected continuing changes in rainfall pattern and shifting temperature cycles are expected to have significant negative effects on food and water security, agriculture and economic rise of the country. Climate change is likely to have a serious and lasting impact on agriculture sector in India. The most significant effect of climate change is seen in the clear phenomenon of rising global temperatures, commonly referred to as global warming.There was a worldwide increase (0.4-0.7 °C) in temperature. The study was conducted in Nainital district of Uttarakhand. Total 143 respondents were selected. Results indicated that majority of farmers were middle aged, middle level educated, males, havingmain occupation farming with middle level farming experience, low annual income with high economic motivation, had medium scientific orientation. Majority of the respondents had medium level of information seeking behavior,majority of farmers have observed significant shifts in climatic patterns over recent years. Specifically, (77.6%) of the farmers strongly agree that temperatures have increased compared to previous years, indicating a widespread acknowledgment of rising heat levels. This is further supported by (66.4%) who strongly agree that the intensity of summer heat has increased, and (53.8%) who strongly agree that high temperatures and heat waves have become more frequent. This growing heat stress is a critical concern, especially for agricultural activities.

Keywords: Climate change, farmers, perception

Climate change is widely acknowledged as one of the most urgent challenges threatening human survival. It poses significant environmental, economic, and social risks, particularly to Indian agriculture. Numerous studies have highlighted that its adverse effects outweigh the benefits. Primarily driven by human activities such as the burning of fossil fuels, climate change is leading to lasting alterations in weather patterns, making agricultural practices more uncertain. The global temperature is projected to rise by approximately 0.2^0C per decade, resulting in an increase in extreme weather events like droughts, floods, and heat waves, which can severely impact crop production and reduce yields. Shifts in rainfall patterns disrupt planting and harvesting schedules, while rising sea levels and ecological changes threaten the availability of cultivable land. India is grappling with the severe impacts of climate change, which manifest in rising temperatures, unpredictable monsoons, and increased frequency of extreme weather events.

Uttarakhand, a Himalayan state in India, is experiencing acute impacts of climate change, threatening its fragile ecosystem and livelihoods. Rising temperatures have accelerated the melting of glaciers like Gangotri and Pindari, leading to reduced water flow in rivers crucial for agriculture and hydroelectric power. Erratic weather patterns, including unseasonal rainfall and cloudbursts, have caused devastating floods and landslides, as seen in the 2013 Kedarnath disaster and the 2021 Chamoli glacier burst. These events have led to significant loss of life, infrastructure, and biodiversity. Increasing human activity, deforestation, and unregulated tourism further exacerbate the vulnerability of the region to climate-induced disasters. The disruption of traditional farming practices and shrinking biodiversity hotspots underscore the need for urgent climate adaptation strategies, disaster preparedness, and sustainable development in Uttarakhand to preserve its environment and ensure the well-being of its communities.

The agriculture sector in Uttarakhand has been severely impacted by shifting seasonal patterns and the increased density of extreme climatic weather events, leading to a decline in crop yields and

disrupting food security and accessibility. (Roy *et. al.,* 2013). Changes in key climatic factors such as temperature and rainfall are adversely affecting snow and ice cover, as well as glacial flows, which in turn threaten the livelihoods of local communities. Water availability across the region including surface and underground sources has diminished due to ongoing weather fluctuations. (Sati *et. al.,* 2019). This shortage of water resulted in a decrease in irrigated land and, consequently, reduced crop production. Additionally, declining soil fertility has further lowered agricultural productivity (Singh, 2008).
The agriculture sector is closely linked to human activities and climatic conditions, as well as how people perceive and respond to climate change. The pace of these transforms and their effects on the entire agro-ecosystem including soil, crops, and livestock play a crucial role. Farmers' ability to adapt to climate change largely depends on their awareness and responsiveness to environmental and climatic shifts. As a conclusion, inadequate understanding or awareness of climate change and its impacts on agricultural productivity can negatively affect the long-term sustainability of agriculture, particularly in developing countries.The impact of climate change on agriculture are likely to intensify in future years, as climate models project rising temperatures, more erratic rainfall, and a potential increase in the intensity and frequency of extreme weather events (Kapri and Kaushik, 2022). Farmers, as the primary producers of food, are increasingly vulnerable to the adverse impacts of climate change, such as erratic rainfall patterns, extreme weather events, and rising temperatures. Thus, understanding farmers' perceptions is crucial for developing effective climate change mitigation and adaptation policies.

The present study was undertaken with the objectives to study the socio-economic, communication and psychological characteristics of farmers and to study the perception of farmers about climate change.

MATERIALS AND METHODS

The study was conducted in the Nainital district of Uttarakhand, India.Nainital district consist of 8 administrative blocks which includes (Betalghat, Ramgarh, Dhari, Kotabagh, Bhimtal, Okhalkanda, Ramnagar, Haldwani) while Nainital is a popular tourist attraction as a town. its district is characterized by an agrarian economy. Here, subsistence crops, mostly farmed for local use and markets, occupy about 90% of the total planted area. According to the data from Global Forest Watch, Nainital had the highest rate of tree cover loss from 2001 to 2023 due to fires with an average of 12 ha lost per year. In Uttarakhand the warming temperature trend worsening forest fires events to a greater extent. Nainital district recorded even more erratic and extreme rainfall in certain years.Nainital along with Dehradun shows the largest concentration of area under fruits and vegetables, accounting for roughly 13% each of the state's horticultural land (Sati *et al.* 2019).

Out of the 8 blocks from Nainital, one block Ramgarh was selected purposively, Ramgarh block was specifically chosen for this study because it is one of the area's most impacted by climate change. As a result of adverse weather conditions and changing farmer preferences, the agricultural and horticultural patterns in the Nainital district have shifted. For example, the once-famous apple orchards in the Ramgarh belt have been successfully replaced by peaches. From the Ramgarh block three villages were selected randomly. The study sample comprised of one hundred forty-three (143) respondents (farmers) which was selected randomly. To measure the perception of the farmer, scale taken by Joshi (2016) was used. The collected data were analyzed using frequency, percentage and mean score to derived meaningful interpretation.

RESULTS AND DISCUSSION

The study's findings reveal a demographic profile of farmers in the study area that is predominantly middle-aged (63%) and male (54.54%), with farming being their primary occupationThe findings of the present study are same as the findings of Rastogi and Hasan (2014) who found that the majority (73.75 percent) of respondents were middle age farmers. The educational attainment of the majority of

Table 1: Socio - economic, communication and psychological characteristics of farmers. (n=143)

S. No	Category	Frequency	Percentage (%)
A.	AGE		
1	Young (Less than 30 years)	24	17
2	Middle (30- 58 years)	90	63
3	Old (More than 58 years)	29	20
B.	EDUCATION		
1	Illiterate	20	13.98
2	Primary level	19	13.28
3	Middle level	48	33.56
4	Intermediate	42	29.37
5	Graduate and above	14	9.79
C.	SEX		
1	Male	78	54.54
2	Female	65	45.45
D.	OCCUPATION		
1	Farming	68	47.55
2	Farming + government jobs	22	15.38
3	Small scale businesses + farming	29	20.27
4	Private jobs + farming	24	16.78
E.	FARMING EXPERIENCE		
1	Long (more than 33 years)	9	6.29
2	Medium (between 10 – 33 years)	81	56.64
3	Short (less than 10 years)	53	37.06
F.	LAND HOLDING		
1	Small farmer (up to 6)	75	52.44
2	Medium farmer (between 6 to 15)	55	38.46
3	Large farmer (more than 15)	13	9.09
G.	ANNUAL INCOME		
1	Low	75	52.44
2	Medium	55	38.46
3	High	13	9.09
H.	ACCESS TO WEATHER FORECAST		
1	High	12	8.39
2	Medium	37	25.87
3	Low	94	65.75
I.	SCIENTIFIC ORIENTATION		
1	High	13	9.09
2	Medium	82	57.34
3	Low	48	33.56
J.	ECONOMIC MOTIVATION		
1	High	79	55.24
2	Medium	50	34.96
3	Low	14	9.79
K.	INFORMATION SEEKING BEHAVIOUR		
1	High (More than 27)	32	22.37
2	Medium (20 to 27)	75	52.44
3	Low (less than 20)	36	25.17

Table 2: PERCEPTION OF FARMERS ABOUT CLIMATE CHANGE

Table 2.1: Distribution of the farmer according to perception of farmer about climate change

S. No.	Statements	SA		A		UD		DA		SDA	
		F	P(%)	F	P(%)	F	P(%)	F	P(%)	F	P(%)
1	Do you agree that temperature as compared to previous years has increased?	111	77.6	30	20.9	0	0	2	1.39	0	0
2	Do you agree that amount of rainfall as compared to previous year has decreased?	65	45.45	42	29.37	24	19.78	12	8.39	0	0
3	Do you agree that frequency of heavy rains have decreased?	41	28.67	58	40.55	31	21.67	8	5.59	5	3.49
4	Do you agree that the rains are occurring either earlier or later than the expected rainy season?	78	54.54	29	20.27	6	4.19	22	15.38	8	5.59
5	Do you agree that total rainy days as compared to previous years have decreased?	66	46.15	52	36.36	7	4.89	15	10.48	3	2.09
6	Do you agree that duration of dry spell during rainy season has increased?	64	44.75	48	33.56	9	6.29	21	14.68	1	0.69
7	Do you agree that the number of sunshine hours during rainy season have decreased as compared to previous years?	72	50.34	45	31.46	16	11.18	6	4.19	4	2.79
8	Do you agree that intensity of heat during summer has increased?	95	66.43	33	23.07	2	1.39	8	5.59	5	3.49
9	Do you agree that bitterness of cold during winter has increased?	32	22.37	21	14.68	4	2.79	66	46.15	20	13.98
10	Do you agree that chances of high temperature and heat wave occurrence have increased?	77	53.84	28	19.58	14	9.79	18	12.58	6	4.19
11	Do you agree that the intensity of fog compared to previous years has increased?	25	17.48	15	10.48	6	4.19	88	61.53	9	6.29
12	Are you experiencing shorter winter as compared to previous years?	91	63.63	32	22.37	7	4.89	10	6.99	3	2.09
13	Do you agree that the dew drops occurrence compared to previous years has increased?	33	23.07	22	15.38	5	3.49	77	53.84	6	4.19
14	Do you agree that night temperature compared to previous years has increased?	88	61.53	29	20.27	6	4.19	15	10.48	5	3.49
15	Do you agree that ground water table compared to previous years has decreased?	56	39.16	78	54.54	2	1.39	5	1.49	2	1.39

Table 2.2: Distribution of respondents according to Perception of farmers towards climate change (N=143)

S. No.	Categories	Frequency	Percentage (%)
1	Positive (more than 66.67 percent)	83	58.04
2	Neutral (33.34-66.66 percent)	33	23.07
3	Negative (Up to 33.33 percent)	27	18.88
	Total	143	100

farmers is at the middle level (33.56%), with a significant proportion having an intermediate education. Most farmers are categorized as small-scale (52.44%) with a medium level of farming experience (56.64%), and over half of them fall into the low-income category (52.44%). The findings of the present study are same as the findings of Joshi (2016) who found that the majority (56.67 percent) of respondents had low annual income.This suggests that farming is primarily an activity for experienced, small-scale, middle-aged male farmers with limited income.

The data also highlights a significant challenge: a majority of the farmers have low access to weather forecasts (65.75%). Despite this, they exhibit a medium level of scientific orientation (57.34%) and a high level of economic motivation (55.24%), which is similar to the findings of Kumar *et al.* (2023) who found that the majority of respondents have medium scientific orientation. The findings also indicate that farmers have a medium level of information-seeking behavior (52.44%), The findings of the present study are similar to the findings of Chauhan (2019)who found that the majority of respondents have medium information seeking behavior. which, when combined with their limited access to weather information, suggests a potential disconnect between their desire for profit and their ability to acquire the necessary data to make informed decisions. This profile points to the need for targeted interventions that can improve access to critical resources like weather forecasts and agricultural information to empower this motivated yet resource limited population.

In terms of rainfall, (45.4%) of farmers strongly agree that the total amount of rainfall has decreased compared to previous years, while (46.1%) strongly agree that the total number of rainy days has reduced, and (44.7%) strongly agree that the duration of dry spells during the rainy season has increased. Furthermore, (54.5%) of farmers strongly agree that rains are now coming either earlier or later than expected, signaling disrupted seasonal patterns that make planning agricultural activities more difficult. Additionally, (50.3%) of the farmers strongly agree that the number of sunshine hours during the rainy season has decreased, possibly due to cloud cover or shifts in rainfall patterns. When it comes to winter conditions, the perceptions are more varied: only (22.4%) strongly agree that the cold has become bitterer, though (63.6%) strongly agree that the winters have become shorter, suggesting a shift in season length rather than intensity. Perceptions regarding dew drops and fog show mixed responses. While only (23%) strongly agree that dew occurrences have increased, a significant (61.5%) strongly agree that fog intensity has gone up compared to previous years.
Lastly, groundwater levels are another concern, with (39.1%) strongly agreeing and (54.5%) agreeing that the water table has decreased. This combined perception points toward mounting pressure on water resources, which is a critical issue for sustaining agricultural productivity in the face of climate variability.

The findings given in table revealed that majority of the farmers (58.04 percent) had positive perception towards climate change followed by neutral (23.07 percent) and negative (18.88 percent). This suggests that most of the farming community in the study area is aware of climate change and acknowledges its impact on agriculture and livelihoods.

CONCLUSION

Findings of the study concluded that majority of farmers were middle aged, middle level educated, males, havingmain occupation farming with middle level farming experience, low annual income with high economic motivation, had medium scientific

orientation. Majority of the respondents had medium level of information seeking behavior, with regard to farmers perception about climate change it was revealed that majority of the farmers were having high perception index range which means it showed positive perception towards climate change. Most of them perceived that the temperature has increased as compared to previous years.

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