Women's Perceptions Towards Climate Variability: A Case of Female Farmers in Bundelkhand Region of Uttar Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

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ABSTRACT

The study was conducted with the aim of women perception towards climate change in Bundelkhand region of Uttar Pradesh. Based on the output of this study, the sample had consisted of women aged 26–35 years (36.25%), the majority of whom were married (88.75%), belonged to medium-sized families (46.25%), and had a moderate monthly income (53.75%). Most participants had limited exposure to mass media (61.25%) and owned small landholdings (1–2 hectares) (65%), with 42.50%. A majority of women had experienced noticeable climate change effects, including rising temperatures, unpredictable weather patterns, reduced groundwater availability, altered plant nutrient content, delayed rainfall, increased drought frequency, and soil erosion. Most respondents agree on the environmental and economic effects of climate change. Data were analyzed using correlation coefficient which revealed that family Size, annual income, farming experience, and marital status were strongly and significantly associated with perceptions of climate change ($p < 0.001$). Age, Education, and Mass Media Exposure also showed statistically significant with moderate correlations ($p < 0.05$).

1. INTRODUCTION

Many developing countries depend on agriculture and women are involved in more than half the agricultural work through either farming or related activities (Tripathi et. al., 2023). Women's and men's roles in farming change across cultures but are influenced by external pressures. In most developing countries, women's contributions go unnoticed. Women have a major role in farming condition therefore greatly affecting rural development in India. They engage in more than 50% of farm tasks, keep their homes fed and help the family earn money. They contribute to the rural economy by farming, earning an income, starting businesses and looking after family members (Narain et. al., 2015).

Farmers around the world have identified climate change as a major long-term problem. Small and marginal farmers are very important to farming in India (Maleknia & Salehi, 2024). The area of semi arid region is affected by great climate variability which includes hot weather, unpredictable rain and a lack of water supply (Zafar & Ammara, 2024). In semi arid region like Bundelkhand, the importance of agriculture is a major concern it is very vulnerable to climate change. It can seriously influence the health of plants and animals on farms (Pathak, et. al., 2024).

Bundelkhand, a drought-prone region in India, specially known for pulses hub, faces significant climate variability, marked by extreme temperatures, unpredictable rainfall, and water scarcity. Women in Bundelkhand are actively involved in various agricultural activities such as sowing, weeding, harvesting, and post-harvest processing (Dechezleprêtre et al., 2025). Despite challenging environmental and socio-economic conditions, they contribute significantly to farming and household sustainability. In many cases, especially where male migration is high due to lack of local employment, women become the primary agricultural laborers and caretakers of the land. Often, where men move away to find work because no jobs exist locally, women become responsible for both farming and further care for the land. Apart from field duties, women are responsible for livestock, look for fuel and water and tend to the routine tasks inside the home. Still, most people farm on their own village land or land someone else owns, without money, land, education or technical help. The importance of women to food security and local livelihoods is ignored by certain cultural traditions, despite their useful role (Pathak, et. al., 2024).

Agriculture is the main occupation and lifeline of Bundelkhand region of Uttar Pradesh. Here women play a critical and potentially transformative role in agricultural growth in multiple directions like production of crops, rearing of animals, care and management of physical & natural resources as well as family matter, but they face persistent obstacles and economic constraints limiting further inclusion in agriculture as well as the recognition and acceptance of women are not found in Bundeli society (Bhardwaj, et. al., 2023). Many studies have looked at the ways in which men and women respond to climate change and risks. They make clear that women are usually harmed more by climate change than men (Habtezion, 2013; Goh, 2012). The divergent roles between men and women in farming lead to differences in response to climate change and inform how best to assist them (Murage, 2015; Khan et. al., 2016). A comprehensive approach that amalgamates financial, educational, institutional, and environmental solutions is crucial for improving adaptation techniques. Cooperative initiatives among farmers, policymakers, academics, and extension agencies can cultivate enduring resilience, guaranteeing sustainable livelihoods and food security amidst climate variability (Yadav, et. al., 2025).

2. MATERIALS AND METHODS

Bundelkhand region of Uttar Pradesh is often exposed to changes in weather patterns so the study was conducted in this region.Two districts Banda and Hamirpur of this dry zone were selected purposively. From each district, two blocks and from each block, two villages were selected randomly. From each selected village, 10women were selected randomly. Therefore, 80 women were chosen from the eight villages involved in the study. The present study followed a descriptive study design to examine how women in Bundelkhand region of Uttar Pradesh are able to cope with different climate changes. A survey with a pre-tested and set-up questionnaire was used to collect primary data, giving respondents the chance to choose answers that fill them best. The survey included several sections to learn about women's economic situation, the farm area they use, their part in farming and their opinions on changing climate in recent years. Information collected through observation and tests in the study area was arranged and then analyzed using tools such as mean, frequency, standard deviation, range, weighted mean method, exploration and factor analysis to reach a conclusion.
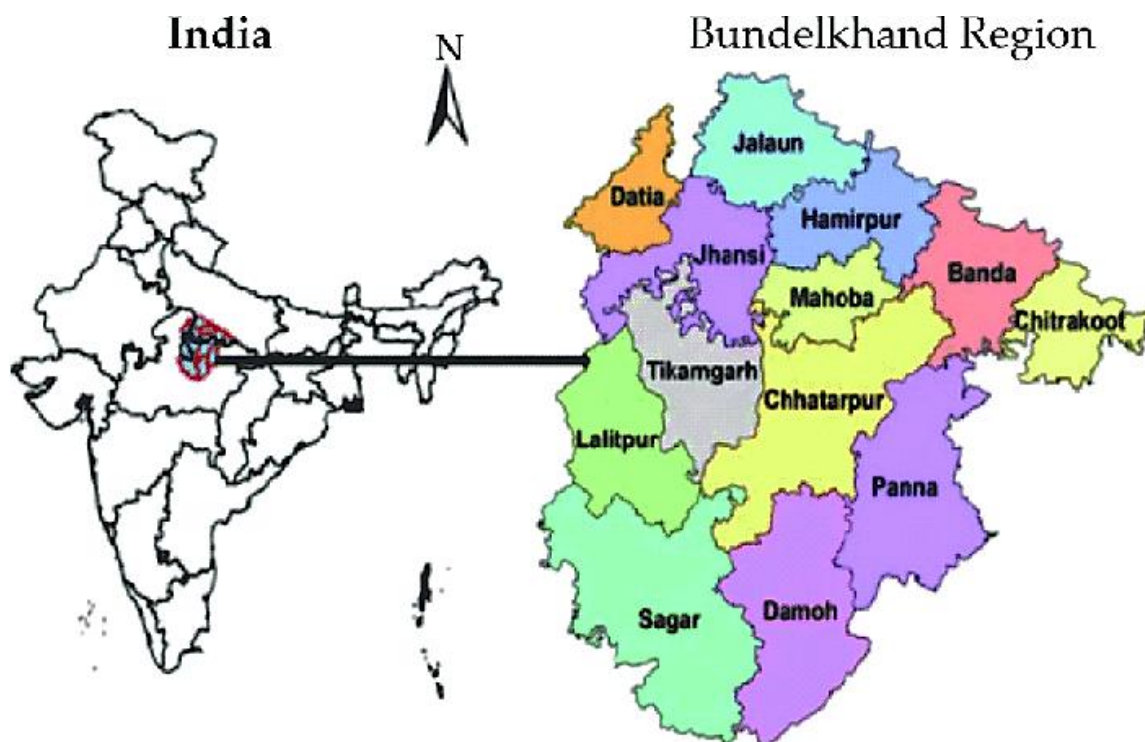

Fig. 1. Map showing study location

3. RESULTS AND DISCUSSION

Socio Economic Status of Women: The survey respondents were primarily in the age group of 26–35 years, comprising 36.25% of the total sample, followed by those aged 36–45 years at 27.50%, 20–25 years at 21.25%, and above 45 years at 15%. A significant majority of the respondents were married (88.75%), while 11.25% were unmarried, and none were divorced. Regarding family structure, 65% of respondents lived in nuclear families, whereas 35% belonged to joint families. When it comes to family size, 46.25% had medium-sized families, 32.50% had large families, and 21.25% had small families. In terms of religious affiliation, the majority were Hindus (70%), followed by Muslims (23.75%) and Sikhs (6.25%). The income levels showed that 53.75% of respondents fell into the medium-income bracket (₹2000–₹5000), while 25% were in the high-income category (above ₹5000), and 21.25% were in the low-income group (below ₹2000). Most of the respondents (65%) owned 1–2 hectares of land, 23.75% had 2–5 hectares, and 11.25% owned more than 5 hectares. In terms of educational background, 30% had completed junior high school, 28.75% had finished high school, 21.25% had primary education, 11.25% reached the intermediate level, and 8.75% were illiterate. 33.75% women had less experience of forming while others had more than 5 years farming experience.

Agricultural Women'sPerception towards Climate Variability: Perception is an important psychological attribute which is affected by factors such as culture, knowledge and access to information. However climate variability perception helps the farmers to adjust to their own situations. An attempt has been made to judge the perception towards climate variability.

Table 1. Socio Economic Status of Agricultural Women

Socio Economic Factors	Description	No. of Respondent	Percentage
Age	20-25	17	21.25
	26-35	29	36.25
	36-45	22	27.50
	Above 45	12	15.00
Marital Status	Un married	9	11.25
	Married	71	88.75
	Divorces	0	00.00
Family Type	Joint	28	35.00
	Nuclear	52	65.00
Family Size	Small	17	21.25
	Medium	37	46.25
	Large	26	32.50
Religious	Hindu	56	70.00
	Muslim	19	23.75
	Sikh	5	06.25
Monthly Income	Low (0-2000)	17	21.25
	Medium (2000-5000)	43	53.75
	High (Above 5000)	20	25.00
LandHolding	1-2 Hac	52	65.00
	2-5 hac	19	23.75
	>5 hac	9	11.25
Education	Illeterate	7	08.75
	Primary	17	21.25
	Junior High School	24	30.00
	High School	23	28.75
	Intermediate	9	11.25
Farming Experience (Years)	Less (< 5 years)	27	33.75
	Moderate (5-10 years)	34	42.50
	More (> 10 years)	19	23.75
Mass Media Expoxure (Numbers)	Low (<8)	49	61.25
	Medium (8-12)	25	31.25
	High (>12)	06	7.50

Table 2. Women's Perception towards Climate Variability

No.	Statements	Responses					WM	Rank
		SA %	A%	UD%	D%	SD%		
1.	Climate variability is an important environmental issue	48.75	22.50	15.00	7.50	6.25	21.33	II
2.	High temperature is an issue in last five years	52.50	23.75	12.50	7.50	3.75	22.07	I
3.	Ground water label goes down due to climate variability	35.00	18.75	21.25	15.00	10.00	18.87	III
4.	Increase in number of droughts in recent years	18.75	30.00	23.75	20.00	7.50	17.73	VI
5.	Increase in disease infection and pest infestation	15.00	22.50	35.00	21.25	6.25	17.00	VII
6.	Delay in rainfall due to climate variability	17.50	32.50	25.00	16.25	8.75	17.80	V
7.	Change in current farm management practices	13.75	27.50	31.25	16.25	11.25	16.87	VIII
8.	Change in investment in farming due to climate variability	17.50	28.75	15.00	26.25	12.50	16.67	IX
9.	Soil erosion due to climate variability	21.25	26.25	26.25	16.25	10.00	17.73	VI
10.	Alteration in nutrient value in plant	26.25	28.75	20.00	20.00	5.00	18.73	IV
11.	Human plays a big role in climate variability	12.50	15.00	37.50	22.50	12.50	15.60	X
12.	Climate variability is beneficial for farming	8.75	16.25	33.75	30.00	11.25	15.00	XI

76.25% women identified that High temperature is the most pressing issue in last five years and they had assigned first rank to it with weighted mean score of 22.07. Approximately 71.25% respondents perceived that Climate variability is an important environmental issue and provide second rank on the basis of weighted mean score 21.33. Groundwater depletion due to climate change is also found third major concern which aligns with the water scarcity issues faced in Bundelkhand on the basis of weighted mean score 18.87. Approximate 55% women were in favour that there is alteration in nutrient value in plant and it was assigned rank fourth with weighted mean score 18.73 and delayed rainfall with weighted mean score 17.80 was seen as key consequences affecting crop health and farming schedules and it was assigned rank fifth. Increase in number of droughts and soil erosion reflect visible climate impacts on land and water resources. With weighted mean score (17.73) they assigned rank sixth. Pest and disease infestations, Changes in farm management practices, farming investments, Human contribution to climate variability and the notion that climate change could benefit farming were some other major issues identified by the women with raked seventh, eight, ninth, tenth and eleventh respectively.

Factor analysis of the perception towards climate variability: Data on women's perception towards climate variability was examined for the presence of errors and found no serious outliers for the analysis. Kaiser-Meyer-Olkin (KMO) and Bartlett's Chi-square test was used to assess the suitability of data for factor analysis and check the sampling adequacy. The Exploratory Factor Analysis has estimated the Kaiser-Meyer-Olkin (KMO) value of 0.707 which was above the minimum level of 0.5, and a significant Bartlett's Chi-square ($\chi2$= 462.3, d.f.= 66, p<0.001) indicates sampling adequacy. In a good factor analysis, there are few factors that explain a lot of variance and the rest of factors explain relatively small amount of variance. In this study, a total of 71.36% of the total variance in the perceptions of climate variability was explained by a four-factor solution obtained via component loadings and eigen values from the analysis of 12 perception statements. According to this factor which accounts for 32.90% of the variation, participants tend to agree that climate variability in their region is an essential concern, along with issues related to late rainfall and the rising

temperature experienced over the past five years. We can view it as displaying immediate effects of the climate and it is strongly consistent within itself.The other factor which explains 19.17% of the variation (α = 0.784), involves changes such as "An increase in disease and pest problems", "Different levels of farm investment" and "Variations in nutrient content of plants on the farm". Climate variability reveals its effects on farming and the economy and this variable is considered reliable.This factor consists of things like "Increase in droughts" and "Soil erosion", accounts for 10.27% of the variation and its reliability is modest, with a Cronbach's alpha value of 0.563. Officially, this factor deals with handling damage caused by disasters and damage to land.

Comprising just 9.02% of the variance and with 0.431 as internal consistency, the fourth factor contains items such as "The amount of climate variability depends on what humans do" and "More variability in climate is good for farming". This component seems to focus on personal views about people's responsibilities and advantages, yet its low reliability means that its items may not all measure a single thing.

Overall, the first two points show good internal agreement and have the biggest role in explaining why peoples' opinions differ, showing that most respondents agree on the environmental and economic effects of climate change.

Association between selected independent variables and women's perception towards climate variability: Correlation between social participation and women's perception towards climate variability are shown in Table 4. The correlation analysis reveals several significant relationships between social participation and women's perception towards climate variability. Notably, Family Size**,** Annual Income**,** Farming Experience**,** andMarital Status show strong positive correlations with high statistical significance (p < 0.001), indicating a meaningful association. Age**,** Education, and Mass Media Exposure also demonstrate moderate but statistically significant correlations (p < 0.05), suggesting their potential influence. In contrast, Family Type**,** Land Holding**,** and Religion show weaker correlations with p-values above the 0.05 threshold, indicating that their associations are not statistically significant.

Table 3. Orthogonal (VARIMAX) Rotational

Item	Statement	Component			
		1	2	3	4
A1	Climate variability is an important environmental issue	.602			
A2	High temperature is an issue in last five years	.628			
A3	Ground water label goes down due to climate variability	.482			
A4	Increase in number of droughts in recent years			.694	
A5	Increase in disease infection and pest infestation		.612		
A6	Delay in rainfall due to climate variability	.465			
A7	Change in current farm management practices	-.528			
A8	Change in investment in farming due to climate variability		-.542		
A9	Soil erosion due to climate variability			.608	
A10	Alteration in nutrient value in plant		.591		
A11	Human plays a big role in climate variability				.542
A12	Climate variability is beneficial for farming				.442
	Eigen Value	3.94	2.36	1.23	1.08
	Variance explained (%)	32.90	19.17	10.27	9.02
	Cronbach alpha	.821	.784	.563	.431

Table 4. Association between selected independent variables and dairy farmer's perception towards climate variability

S. No.	Variables	Correlation Coefficient	p value
1.	Age (years)	0.359	0.001
2.	Education	0.251	0.024
3.	Family Type	0.186	0.098
4.	Family Size	0.491	0.000
5.	Annual Income	0.412	0.000
6.	Land Holding	0.214	0.056
7.	Farming Experience	0.422	0.000
8.	Mass Media Expoxure	0.264	0.017
9.	Marital Status	0.51	0.000
10.	Religion	0.198	0.078

4. CONCLUSION

Due to uncertain weather in Bundelkhand, women farmers suffer difficulties in agriculture and its related works. The correlation study suggested that demographic and socio economic factors such as age, income, and farming experience play a more critical role in influencing the women's perception than structural or background factors like religion or family type.The findings of the present study would be helpful to the researchers, extension personnel, policy makers, to mitigate the problems and formulate the strategies for improving the condition of women involved in agriculture.

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 this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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