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FARMERS' PERCEPTION ABOUT CLIMATE CHANGES AND ITS IMPACT ON AGRICULTURAL PRODUCTIVITY IN DISTRICT JHANG

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ABSTRACT

Both emerging and developed nations see climate change as having a great deal of unpredictability. When it comes to climate change, Pakistan is among the world's most vulnerable nations. There is a vast population in the nation, and the poverty rate is quite high. Additionally, the country is extremely vulnerable to the negative impacts of natural disasters. The current study is essential to understand farmers' perceptions of climate change and its impact on agricultural productivity in district Jhang. A multistage sampling technique was applied to selected study area and farmers. At first stage, one tehsil (Tehsil Jhang) out of 4 tehsils of district Jhang was chosen randomly. At the second stage, 2 union councils were selected randomly. At the third stage, 4 villages (two from each UC) were selected randomly and at the last stage, 120 farmers (30 from each village) were chosen randomly. The data were collected via an interview schedule. It was found that a significant proportion of the farmers observed increases in dry-season temperatures (82.5%), rainy-season temperatures (76.7%), fog (50.0%), smog (78.3%), windstorms during summer (73.3%), shortage of winter season (93.3%), longer summer season (91.7%) and length of hot periods (81.7%). It was noted that a big proportion of the farmers observed unpredictable rains (85.8%), high temperature (79.2%) and rising input prices (85.8%) had a negative impact on agricultural production. It is recommended that modern technology be integrated into agricultural practices, as a significant majority of respondents (78.3%) believe it has the potential to enhance crop production.

Keywords: Climate change, Temperature, Rain, Season, Productivity

Introduction

Farmers have been able to adjust their practices to accommodate shifting environmental, social, and economic situations over the course of human history (Kurukulasuriya and Rosenthal, 2013). However, it is uncertain whether farmers will be able to cope with the extraordinary rate of climate change anticipated in the upcoming years (Jones *et al.*, 2012). The adverse consequences of these modifications will be more severe for agricultural producers who engage in rainfed agriculture, as well as for those who have restricted access to credit and insurance and are disconnected from regional or national markets (Quiroga *et al.*, 2015; Castells-Quintana *et al.*, 2018). To mitigate these adverse



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effects, public policies and initiatives aimed at promoting and facilitating adaptation are necessary (Kumar *et al.*, 2020). However, for farmers to be inclined to adopt adaptation strategies, they must be cognizant of climate change (Silvestri *et al.*, 2012; Meldrum *et al.*, 2018). Farmers' perceptions of climate change influence their planting decisions and dictate the implementation of adaptation strategies (DeMatos *et al.*, 2020). Consequently, comprehending farmers' perspectives of climate change is essential for the formulation and effective execution of agricultural adaptation programs (Hansen *et al.*, 2004; DeMatos *et al.*, 2020).

Climate change is one of the most prevalent concerns that affects everyone. This is despite the fact that pollution, climate change, and global warming are some of the environmental difficulties that civilization confronts on a worldwide scale (Steffen *et al.*, 2015). Changes in the climate have an impact on the whole planet, resulting in broad disruptions and always having an impact on the economy (Kohler and Maselli 2009). Multiple facets, such as agriculture, ecosystems, forestry, infrastructure, water resources, fisheries and human health, are deemed vital for livelihoods (Pulhin, 2006). Climate change has adversely affected numerous ecosystems due to environmental differences such as increasing temperatures, altered rainfall patterns, increased sea levels, glacier melting, and catastrophic flooding (IPCC, 2007). The IPCC (2007) reported a temperature increase of 0.6 °C in the last century, with projections indicating a 2-3 °C rise by the century's end (IPCC, 2007). Consequently, releasing greenhouse gases is anticipated to result in climate change that exceeds the previous century (Pachauri and Spreng, 2011).

Pakistan is among the most vulnerable nations globally, highly prone to climatic natural disasters. Natural disasters may have a devastating impact on the country's already massive population and severe poverty. Pakistan has a range of climatic pressures, including droughts, avalanches, cyclones, landslides, floods, and snowstorms, affecting diverse regions of the nation. The agricultural industry constitutes 23.5% of Pakistan's gross domestic product and accounts for 37.0% of the nation's labor force; hence, any negative impacts from climatic events could damage the lives of millions (Govt. of Pakistan, 2025). The agricultural sector and economy of the country were significantly impacted by previous natural disasters, specifically the floods of 2010, 2011, and 2014, which caused extensive damage to fisheries, livestock, animal shelters, forestry, agricultural machinery, tube wells, fertilizers, seed reserves, residences, and infrastructure. In addition to this, there were around 250000 farming households and over one million acres of land were affected (Fahad and Wang, 2018).

In terms of its vulnerability to climate change, Pakistan is placed fifth on the Global Climate Risk Index 2023. This ranking was provided by the World Bank. This ranking is based on weather-related events that occurred between the years 2000 and 2019. The nation displayed a high level of vulnerability during the terrible floods that occurred in 2022, showing the serious effect of climate change. This is despite the country contributing less than 0.9 percent to the total world emissions (Govt. of Pakistan, 2024). The study is essential to understand farmers' perceptions of climate change and its impact on agricultural productivity in district Jhang, Pakistan, as this region is predominantly agrarian and highly vulnerable to climatic variations. The agricultural sector has substantial problems in maintaining food security and livelihoods due to rising temperatures, unpredictable rainfall patterns, and a growing incidence of severe weather events. Exploring how farmers perceive these changes and their impact on productivity is crucial for identifying gaps in awareness, adaptive capacities, and resilience strategies. This research can provide valuable insights to policymakers and stakeholders for



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developing targeted interventions, promoting climate-smart agricultural practices, and enhancing the socio-economic well-being of farming communities in the face of a changing climate. The following are the objectives of the present study.

To study the socio-economic attributes of the farmers.

To investigate farmers' perceptions of climate change and its effects on crop output.

REVIEW OF LITERATURE

Arshad *et al.* (2017) observed the influence of climate variability on agricultural output; nevertheless, comprehension of its effects on land prices and their correlation with farmers' decisions to adapt and alter land-use practices is still rudimentary in developing countries. They analyzed farmers' perspectives of climate change during this era, including its effects on agricultural productivity and historical and expected adaptation techniques. They found that positive temperature anomalies relative to the medium-term average, indicative of climate change, influence agricultural land values in Pakistan. On the other hand, the variation in yearly cumulative precipitation seems to exert no substantial influence. Estimates of the marginal effect of temperature departure indicated a modest nevertheless adverse linear correlation with agricultural land values. The proximity of farms to regions where farmers may access financial or extension services significantly influenced land prices, as did the presence of irrigation facilities. Their examination of farmers' beliefs in climate change and subsequent adaptive behaviors revealed a significant awareness of climatic unpredictability, which impacted several proactive and predicted future farm adaptation methods. Examples include diversification of agricultural businesses, increased use of enhanced irrigation, and changes in land use, mostly from agriculture to other land uses. Pakistan's national policy stresses maintaining a strong rural farming industry. Their results highlight the need for suitable coping strategies to maintain agricultural output and land values throughout most of Pakistan. The consequences of increasing extension and financial services to enhance farmers' capacity to adapt to climate change are investigated in this study.

Karki *et al.* (2019) determined that climate change is the foremost environmental challenge globally, affecting almost all economic sectors. Agriculture is a sector whose performance is mostly influenced by a progressively changing environment. Thus, agricultural laborers, especially subsistence farmers, are direct observers of the shifting climate, as they contend with challenges to their livelihoods due to these rising disturbances. Researchers have increasingly concentrated on determining the perceived effects of and reactions to climate change on agriculture. This study examined studies about climate change-related experiences and observations of individuals within agricultural communities. The report, derived from a systematic evaluation of original research publications published till October 2016, elucidates the current state of in-field knowledge that may guide future research endeavors. The analysis indicated that farmers globally are encountering climatic changes, mostly characterized by increasing temperatures and erratic, diminished precipitation. A significant number have seen decreased agricultural output. Farmers possess varying interpretations and react correspondingly to address those alterations. It is essential to acknowledge and comprehend their perspectives when developing adaptation strategies and policies to direct adaptation efforts towards individuals presently facing and attempting to address such changes.

Abbas *et al.* (2023) indicated that climate change significantly impacted grain yields in Punjab, Pakistan 2022. The production of the crops decreased first owing to an intense heatwave, followed by heavy rainfall and flooding. The Crop Insurance Program in Punjab has shown efficacy as a relief and compensation mechanism after disasters, aimed



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at bolstering the resilience of the state's vulnerable agricultural and rural communities. Prior to the implementation of the crop insurance program, there was no substantial risk management instrument specifically designed to assist farmers impacted by the uncertainties of climate change. The Government of Punjab has made efforts to assist farmers in times of need via a crop insurance scheme, despite budgetary limitations. The program's scope may be augmented by the allocation of more funding, enabling a significant number of farmers to profit from it. Given that Pakistan is among the nations most adversely impacted by climate change, programs and interventions such as crop insurance have become a need and critical demand.

Khan *et al.* (2023) indicated climate change (CC) is a global environmental challenge impacting all economic sectors, particularly agriculture. Pakistan is among the nations most impacted by climate change due to its susceptibility to catastrophic occurrences and constrained adaptive capacity. Evaluating current actions for climate change adaptation at the farm level is essential for comprehending their effectiveness and suggesting further governmental interventions. This research looks at possible changes in farming methods Pakistani farmers might employ to reduce agricultural production losses brought on by the frequency of dangerous weather events caused by climate change. Data for this study were gathered from 432 rural Pakistani wheat producers. This research examined the factors that impact farmers' climate change crop production decisions. Education, gender, farm size, agricultural experience, damage, and financial resources are major determinants in whether farmers will adapt to climate change. Farmers' adaptation to climate change depended on their farm size and training. Policy ideas to help farmers in study areas adapt to climate change. They include creating regulations to integrate agricultural practices, expanding training programs, and incorporating climate change and adaptation principles into regional government operations. The findings will help legislators address climate change and strengthen the agricultural economy. This will sustainably enhance agricultural and food security.

Berhanu *et al.* (2024) indicated that climate change presents substantial issues for smallholder farmers globally, especially in areas such as sub-Saharan Africa, including Ethiopia, necessitating strong coping techniques for resilience. This research investigates farmers' vulnerability to climate disturbances and their use of adaptive measures. Results from a survey of 646 agricultural families and qualitative interviews indicated farmers' significant susceptibility to climate-related risks. Smallholder farmers rely on proactive coping strategies, including early planting (48%), income diversification (41%), increased savings (41.9%), water management (39%), and the production of drought-resistant varieties (37%). Similarly, people use ex-post coping techniques, such as reducing expenditures, using savings, modifying consumption habits, seeking assistance from relatives, borrowing, liquidating assets, and migrating for employment. Farmers encounter difficulties such as restricted access to meteorological data, inadequate extension services, weak institutional support, insufficient skills, high poverty rates, and limited access. Factors like land acreage, climate education, self-efficacy, perceptions of cost-effectiveness, and perceptions of hazard implications positively influence farmers' adoption of proactive solutions to combat climate change. Conversely, factors such as being male, older, less educated, owning a farm, having restricted access to extension services, and encountering market barriers hinder anticipatory actions. Additionally, a male household head, elevated educational attainment, substantial agricultural experience, land ownership, and access to climatic data positively affect the implementation of ex-post measures, while age, agroecological conditions, infrequent visits from extension agents, and limited road access exert negative influences.



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Collins *et al.* (2024) claimed climate change increases household food insecurity, reduces revenue generation, and compromises smallholder farmers' productivity. Smallholder farming households must adapt and find coping strategies to minimize the consequences of climate change. This paper investigated the research trends on smallholder farmers' coping and adaptation strategies to climate change from 2010 to 2022 using a bibliometric analysis. A total of 1,635 publications were analyzed from the Scopus and Web of Science databases to delineate the area and examine research trends. The papers from these databases indicate a significant increase in publications (54–300) throughout the studied period, highlighting the relevance of research on adaptation and coping techniques related to climate change. The study results indicated that most studies were from institutions in developed nations, whilst relatively few originated from developing economies. Findings suggested that smallholder farmers have used several adaptation and coping strategies to alleviate the effects of climate change, including modifying planting schedules and diversifying crop kinds, among others. African scholars and institutions must intensify research focused on devising methods to alleviate the hazards associated with climate change.

METHODOLOGY

In the social sciences, *methodology* refers to the overall strategy and rationale that guides how researchers collect, analyze, and interpret data about social phenomena. It's not just about choosing tools or techniques, it's about understanding why a certain method is best suited for a specific research question. A well-defined methodology ensures that the research is systematic, credible, and relevant to the social context being studied (Creswell, 2014). Essentially, it helps researchers stay grounded in their purpose while navigating the complexities of human behavior and society.

A descriptive study examined the farmers' perception of climate changes and its impact on agricultural productivity in district Jhang. A multistage sampling technique was applied to selected study area and farmers. At first stage, one tehsil (Tehsil Jhang) out of 4 tehsils of district Jhang was chosen randomly. At the second stage, 2 union councils were selected randomly. At the third stage, 4 villages (two from each UC) were selected randomly and at the last stage, 120 farmers (30 from each village) were chosen randomly. The data were collected via an interview schedule. Descriptive and inferential statistical techniques were used for data analysis.

RESULTS AND DISCUSSION

Table 1: Socio-economic characteristics of the farmers

Socio-economic indicators	Categories	<i>f</i>	%
Age	Up to 35	40	33.3
	36-50	53	44.2
	Above 50	27	22.5
	Total	120	100.0
Education	Illiterate	21	17.5
	Primary-Middle	32	26.7
	Matric	37	30.8
	Above matric	30	25.0
	Total	120	100.0
Household income (PKR)	Up to 250,000	25	20.8
	>250000 to 500000	62	51.7
	>5 Lac	33	27.5



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	Total	120	100.0
Farming experience (years)	Up to ten	42	35.0
	Eleven to twenty	55	45.8
	Above twenty	23	19.2
	Total	120	100.0
Size of land (acres)	Up to five acres	60	50.0
	>5-10	38	31.7
	>10	22	18.3
	Total	120	100.0

Age: The age variable plays a critical role in social research because it has a complex influence on several elements of human behaviour and societal dynamics. Age is a crucial demographic factor that allows for examining population patterns and trends. Moreover, age plays a significant role in socialization since individuals of different ages engage with diverse socialisation agents, including family, peers and educational institutions. These agents have a profound impact on shaping their ideas, attitudes and behaviours (Arnett, 2021). Table 1 reflects that around 33% of participants were up to 35 years old and a considerable number (44.2%) were 36-50 years old. However, 22.5 percent of participants were above fifty.

Education: Table 1 further shows that only 17.5 percent of the participants were illiterate, and 26.7 percent had primary-middle level education. On the other hand, around one-third of the participants (30.8%) had completed their secondary education, and 25.0 percent had above matric level education. Blair *et al.* (2009) highlighted the role of education in promoting awareness of the nutritional value of homegrown produce and the importance of consuming fresh, organic foods. Study findings oppose those of Akhtar (2011) and Arshad (2009) who reported that many Pakistani farmers were uneducated.

Household income: The term "household income" refers to the aggregate gross income of all individuals who are above a certain age and who are members of a household. It is not necessary for people to have a blood relation in order to be deemed members of the same household, according to some definitions (Scott, 2022). Table 1 also shows the household income of the participants. Around one-fifth (20.8%) percent of the participants had up to 2.5 lac rupees annual household income from all sources, while almost half (51.7%) had >2.5 to 5 lac rupees annual household income and 27.5 percent of participants had above 5 lac rupees income from all sources.

Farming experience: Farming experience influences their adaptive methods in response to climate change. Veteran farmers are more inclined to use adaptation strategies such as crop diversification, soil conservation methods, and water management procedures to alleviate the detrimental impacts of climatic unpredictability (Deressa *et al.*, 2009). The above table depicts that 35.0 percent of the sample farmers had up to 10 years of experience. However, a significant part (45.8%) of the farmers had 11 to 20 years of experience and 19.2 percent had more than twenty years of farming experience.

Landholding size: In the context of agricultural and animal production, the landholding size refers to the size of a farm that is controlled by a single agriculturist and his family by that individual. On the other hand, there is a growing trend toward adopting bigger farms while simultaneously using modern technologies (USDA, 2007). Table 1 specifies



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that almost half (50.0%) of the farmers had up to 5 acres of land. However, around 32% of the study population had >5 to 10 acres of land and 18.3 percent had above 10 acres of land.

Farmers' views on climate change and crop yield

All of the countries on the earth have come to recognize climate change as one of the most significant ecological concerns confronting them. Considering the fact that it has the potential to have undesirable repercussions all over the globe, it has developed into a significant cause for concern for society (Watson, 2010).

Table 2: Farmers' perception regarding climate-changing (n = 120)

Climate changes	Increase	No change	Decrease	No response
Dry season temperature	82.5	0.0	9.2	8.3
Rainy season temperature	76.7	0.0	9.2	14.2
Humidity	30.0	23.3	41.7	5.0
Rainfall	14.2	0.0	70.0	15.8
Fog	50.0	6.7	30.0	13.3
Smog	78.3	0.0	0.0	21.7
Windstorms during summer	73.3	5.0	15.0	6.7
Shortage of winter season	93.3	0.0	0.0	6.7
Longer summer season	91.7	0.0	0.0	8.3
Length of hot periods	81.7	0.0	15.0	3.3
Length of cold periods	9.2	5.0	68.3	17.5
Groundwater	0.0	13.3	80.0	6.7

Table 2 reflects the farmers' perceptions about climate change across various environmental factors. It was found that a significant proportion of the farmers observed increases in dry-season temperatures (82.5%), rainy-season temperatures (76.7%), fog (50.0%), smog (78.3%), windstorms during summer (73.3%), shortage of winter season (93.3%), longer summer season (91.7%) and length of hot periods (81.7%). On the other hand, most of the farmers noticed decreases in Humidity (41.7%), Rainfall (70.0%), Length of cold periods (68.3) and groundwater (80.0%).

The data indicate that farmers are seeing and acknowledging substantial climate changes, especially in rising temperatures, prolonged summers, and diminished water resources. These views are in line with the general scientific consensus on the subject of global warming. Almost the same results were presented by Bokhari *et al.* (2017), who also observed increases in temperature and significant variability in rainfall patterns.

Table 3: Farmers' assessment on climate change's effect on agricultural yield (n = 120).

Impact	Mean	S.D.	Rank
Increase in input prices	2.83	.18	1
Agricultural production suffered from unpredictable rains.	2.82	.15	2
Decrease in crop productivity	2.79	.19	3
Due to recent temperature changes, agricultural output has suffered.	2.73	.22	4
I believe climate change will adversely affect agricultural output in the future.	2.72	.22	5



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Dry spells, heatwaves, and floods have reduced agricultural output.	2.71	.27	6
Agricultural income is declining due to climate change.	2.68	.35	7
Due to climate change, water shortages negatively affect agricultural yield.	2.66	.31	8
Climate change has reduced soil fertility.	2.65	.30	9
Increase in pest and disease attack	2.63	.33	10

Scale: 1 = Disagree, 2 = Neutral, 3 = Agree

The rankings that are shown above indicate how farmers feel about the influence that climate change will have on crop production. The primary factors adversely impacting agricultural production owing to climate change were identified as "increase in input prices" (mean = 2.83±0.18), "unpredictable rains" (mean = 2.82±0.15), and "decrease in crop productivity" (mean = 2.79±0.19). These factors were ranked as 1st to 3rd, respectively. It was noted that "due to recent temperature changes, agricultural output has suffered" (mean = 2.73±0.22) and farmers believed climate change would adversely affect agricultural output in the future (mean = 2.72±0.22). These effects were ranked as 4th to 5th, respectively. The mean values fall between the "neutral" and "agree" categories but tend towards the "agree" category.

However, agricultural income is declining due to climate change (mean = 2.68±0.35), due to climate change, water shortages negatively affect agricultural yield (2.65±0.30), climate change has reduced soil fertility (mean = 2.65±0.30) and increase in pest and disease attack (2.63±0.33) were ranked as 6th to 10th, respectively. The mean values fall between the "neutral" and "agree" categories but are inclined towards the "agree" category.

The data indicates climate change has increased input prices and decreased crop productivity. Agricultural output was adversely affected by unpredictable rainfall and temperature fluctuations. The majority of farmers anticipated that climate change would negatively impact agricultural production in the future. Similarly, Nasir *et al.* (2018) reported that agricultural production suffered from unpredictable rains. They also observed an increase in input prices and a decrease in crop productivity.

Table 4: Bi-variate analysis (Testing of hypotheses)

H1: Age will affect farmers' perception of climate change's influence on agricultural output.			
Variables	Chi-square value	Gamma	Remarks
Age * Impact of climate change	0.77 ^{NS}	0.051 ^{NS}	Rejected
H2: Education will affect farmers' perception of climate change's influence on agricultural output.			
Variables	Chi-square value	Gamma	Remarks
Education * Impact of climate change	16.12*	0.315**	Accepted
H3: Income will affect farmers' perception of climate change's influence on agricultural output.			
Variables	Chi-square value	Gamma	Remarks
Income * Impact of climate change	22.69**	0.465**	Accepted
H4: Farming experience will affect farmers' perception of climate change's influence on agricultural output.			
Variables	Chi-square value	Gamma	Remarks



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Farming experience * Impact of climate changes	33.71**	0.463**	Accepted
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* = significant, ** = highly significant

H1: Chi-square value (0.77) and gamma coefficient (0.051) show a non-significant relationship between age and impact of climate changes. Consequently, hypothesis# 1 is rejected:

H2: Analysis reveals a statistically significant relationship between education levels and human perception of climate change impact with the chi-square value (16.12*). Results indicate a positive link between education levels and climate change perception assessment because the calculated gamma coefficient stands at 0.315 and shows a statistically significant correlation. Consequently, the above-mentioned hypothesis no. 2 is accepted.

H3: The chi-square value (22.69) shows a strong connection between income levels and climate change perception. Farmers who earn more money tend to notice greater impacts of climate change according to the gamma coefficient value of 0.465. So, the hypothesis no. 3 is accepted.

H4: The chi-square test results in 33.71 value thus showing a powerful relationship between farm experience and climate change perception. Farming experience correlates moderately to strongly with perception intensity regarding climate change's impact on crop productivity, as shown by the gamma coefficient value of 0.463 (P-value = 0.000). So, the hypothesis no. 4 is accepted.

Based on the overall results of the bi-variate analysis, some insightful patterns about how different factors shape farmers' perceptions of climate change's impact on agricultural output. Interestingly, age did not significantly influence, suggesting that perceptions about climate change are shared across different age groups. Nevertheless, education, income, and farming experience all showed statistically significant relationships with farmers' perceptions. This indicates that individuals with higher education levels, better income, and more farming experience are more likely to recognize the effects of climate change on agriculture. These findings highlight the importance of awareness, resources, and hands-on knowledge in shaping farmers' understanding of environmental changes and their potential impacts on crop production.

These findings align with several previous studies that emphasize the role of socio-economic factors in shaping farmers' perceptions of climate change. For instance, Bryan et al. (2009) found that education significantly increases farmers' awareness and willingness to adapt to climate risks in African countries. Similarly, a study by Deressa et al. (2011) highlighted how income and farming experience contribute to a deeper understanding of climate variability and its effects on agriculture. On the other hand, the insignificant role of age in the current analysis also echoes earlier research, such as Mertz et al. (2009), which observed that age alone does not necessarily shape climate-related perceptions unless combined with experience or exposure. Overall, the results confirm a growing consensus that knowledge, resources, and direct engagement with farming play a central role in recognizing and responding to climate change.

Conclusion and recommendations

According to the findings, a significant majority of farmers in District Jhang are of the opinion that climate change poses a significant threat to agricultural production. Farmers saw clearly increasing temperatures, irregular rainfall, and extended summer seasons, all of which have resulted in decreased agricultural yields, increased input prices, and an



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increased risk of pests, diseases, and water shortages. The paper also highlights the ways in which agricultural experience, financial resources, and education have a positive impact on farmers' viewpoints toward climate change and the effects they have. These realizations highlight the importance of enhanced extension services, agricultural systems that are more climate-resilient, and legislative acts to assist farmers in an appropriate manner in responding to changing climatic conditions. Given the observed impact of climate change on agricultural productivity, farmers should be encouraged to adopt climate-smart practices such as drought-resistant crop varieties, improved irrigation techniques, and conservation agriculture to enhance resilience.

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