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Research Paper

Climate literacy in Pakistan: socio-economic and demographic influences on public perceptions and awareness

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ABSTRACT

Climate change literacy is essential for engaging communities in efforts to address and mitigate natural disasters. This study employs a mixed-methods approach, integrating both qualitative and quantitative data, to analyze previous research, including scholarly articles, interviews, reports, and conference proceedings, to understand the factors shaping public perceptions of climate change in Pakistan. The findings indicate that economically prosperous countries possess greater resources, such as enhanced educational access, resulting in distinct perspectives on climate change compared to those in developing nations. In Pakistan, fewer than half of the population is aware of climate change issues, primarily due to limited resource access and a lack of proactive engagement from key stakeholders. Various factors contribute to shaping perceptions and knowledge about climate change, including economic status, educational attainment, gender, age, geographic location, and social media usage.

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1. INTRODUCTION

Climate change entails persistent alterations in weather patterns over extended periods, leading to intensified events such as floods, droughts, wildfires, heavy rainfall, and rising sea levels. Defined by the United Nations as "long-term shifts in temperatures and weather patterns," climate change is primarily driven by the combustion of fossil fuels, which releases greenhouse gases that trap heat, causing temperatures to rise. Currently, Earth's surface is approximately 1.1°C warmer than it was in the late 19th century and over the past 100,000 years, with the last decade recorded as the warmest to date (UN, 2022). Key greenhouse gases, notably carbon dioxide and methane, are emitted from fossil fuel use, transportation, coal, and agriculture, with major industries playing a substantial role in accelerating climate change.

Table 1. Projected Greenhouse Gas Emissions by Sector from 1994-2050 in Pakistan (ADP, 2017)

Sector	Year				
	1994	2008	2012	2020	2050
Energy	86	157	169	385	2685
Agriculture	72	120	165	245	1395
Industrial Processes	13	18	14	26	67
Land use change & forestry	7	9	10	14	38
Wastes	4	6	10	7	15
Total national emissions	182	309	369	650	4200

NOAA research highlights climate change's profound impacts, including a 0.32–0.55°F rise in global temperatures, sea level rise, and significant glacier thinning (EPA, 2022). Arctic sea ice has decreased by 40% since 1979 (NOAA, 2020). Increasing carbon dioxide levels threaten water supplies, agriculture, food security, and biodiversity. Pakistan, identified as the fifth most vulnerable nation to climate change (UN, 2023), faces critical challenges such as overpopulation, poverty, water scarcity, and land degradation. Over the past two decades, the country has experienced over 150 extreme weather events, impacting labor, health, and cognitive performance. By century's end, temperatures may exceed human comfort levels [1]. Rising CO_2 accelerates snowmelt, endangering water resources, agriculture, and food security for future generations, with forest fires worsening biodiversity loss globally, including in Pakistan's Margalla Hills.

2. RELATED WORK

Knowledge, creativity, and innovation are essential for addressing challenges [2]. It is commonly believed that higher education leads to greater environmental concern, and environmental education should be mandatory at least at the university level [3]. Effective climate change mitigation requires action at all levels—individual, community, and national (Ledley, 2017). However, in Pakistan, awareness about climate change is low among local officials and moderately understood by university students [1]. Japan has a high climate awareness rate in Asia, showing that stronger economies tend to have more climate-conscious citizens (Masud, 2013). Teachers are generally more aware of climate change than students, highlighting the role of education in climate literacy (Natalia, 2023). In Pakistan, local officials believe more government support is needed to promote awareness, but instability hampers efforts [4]. Social media is influential in raising climate awareness. American youth consider it more impactful than formal education, and Pakistani youth rely heavily on the internet for information (Shaheen, 2015). In Nigeria, social media has a greater influence on climate awareness than education, and platforms like Team Trees and activists like Greta Thunberg highlight social media's role in mobilizing awareness (Ayanlade, 2017; Rubens, 2023). However, in Pakistan, financial challenges limit media's climate change coverage, though activists like Iqbal Badruddin use social media for advocacy (Manzoor, 2021; Interview, 2020). Gender differences in climate

perception show women are more likely to adopt eco-friendly practices but face barriers like limited resources and decision-making power [5], [6]. Transgender activists like Kalki Subramanian also advocate for climate awareness in South Asia (Naqvi, 2023). In Pakistan, regional differences in climate awareness exist, with higher levels in resource-reliant areas like Gilgit, Hunza, and Chitral (Geest, 2017). Farmers' climate change awareness in Pakistan is moderate compared to other developing nations. Awareness factors include age, education, income sources, and access to services [7]. In Swat, climate shocks are perceived to impact agriculture severely, especially in mountainous regions [8]. An online survey reveals that Pakistani youth feel they can contribute to climate action through reforestation and clean-up drives, though most have yet to participate in formal initiatives. Urban females are more engaged in climate action than their rural counterparts, and many youth see themselves as potential climate awareness agents [9].

Some studies suggested that black and white people have difference in thoughts to climate change. Black people are more concerned about climate change suggesting that they are frequently more exposed and sensitive to environmental risks and catastrophic weather occurrences, people of color may be more concerned about climate change than white people [10].

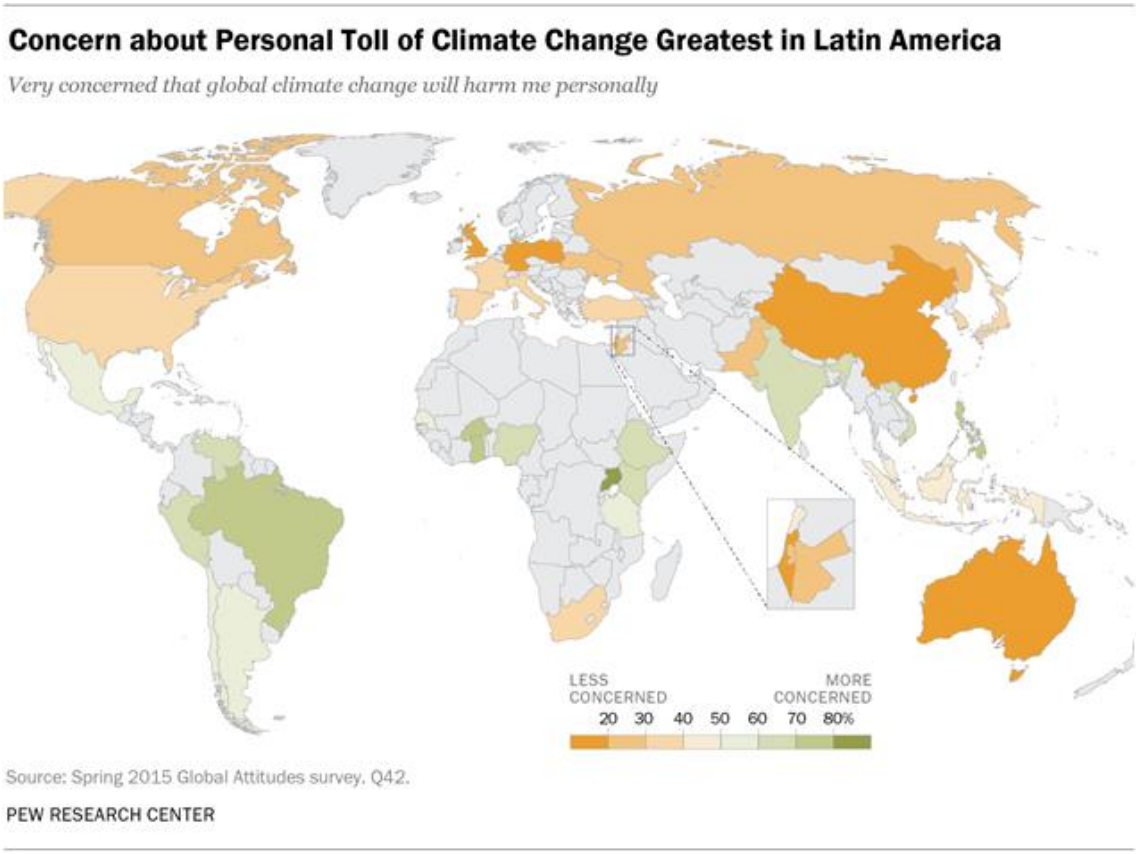


Figure 1. Global Concern about the Personal Impact of Climate Change (Pew Research Center, spring 2015 Global Attitudes Survey)

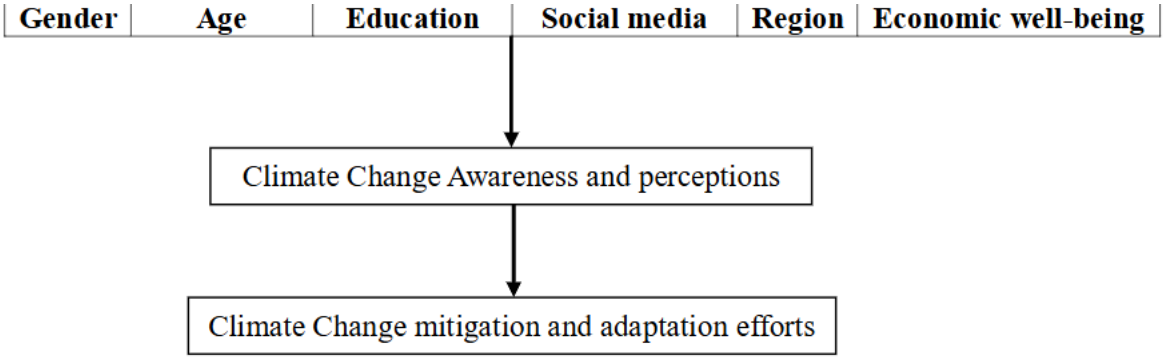
To combat environmental exploitation, public awareness and engagement are essential. Climate change perception is influenced by economic status, education, social media, age, location, and gender. Achieving SDG 13's target of enhanced climate awareness by 2030 (UN, 2015) is crucial, leaving only six years to educate communities about climate crises. Studies show that more educated populations recognize climate change as a survival threat. Landmark frameworks like the 1992 Rio Earth Summit, UNFCCC, and the 2015 Paris Agreement aim to limit warming below 2°C. However, these lack binding measures and full stakeholder commitment [11], underscoring the need for robust laws and increased climate literacy to drive effective action. Therefore, the objectives of this study are to assess the overall climate change literacy and understanding among the Pakistani public, investigate how various factors impact people's

perceptions of climate change in Pakistan, and analyze the differences in perspectives on climate change between developed and developing countries.

3. RESEARCH METHODOLOGY

This study assesses climate change perception and awareness levels among the Pakistani population, comparing them with global trends, and examines factors influencing these perceptions. The research relies on secondary data, including academic articles, reports, surveys, and previously conducted interviews, to develop a comprehensive review. Data analysis and interpretation are enhanced through maps and tables for clarity. A mixed-method approach, incorporating both qualitative and quantitative data, is used to explore the various factors shaping public awareness and perception of climate change. This approach aims to provide insights into Pakistan's standings on climate awareness and the factors affecting public perceptions.

3.1 Conceptual Model



3.2 Findings

Education plays a significant role in climate change awareness in Pakistan. Educated individuals are generally more likely to recognize climate change as a real phenomenon, with moderate awareness levels observed at the university level. Studies indicate that teachers display a higher awareness of climate change than students. Economic status also influences perception; economically well-off individuals, having better access to education, demonstrate greater awareness and concern about climate change, while those in resource-limited regions often perceive it as a natural phenomenon not influenced by human actions.

Gender differences in climate change awareness reveal that women are more conscious of climate change's impacts on their lives. However, they frequently face challenges in adapting to environmental shifts due to barriers like religious constraints, limited environmental education, restricted access to technology, economic challenges, tenure insecurity, and limited involvement in policy-making. Regionally, people in northern Pakistan, who depend heavily on natural resources, are more aware of climate change effects because they experience its direct impacts. Age also influences climate change awareness, especially among farmers, with older farmers being more aware due to their experience in handling climatic challenges. Social media has become a crucial platform for climate change information, particularly among Pakistani youth, who constitute 68% of the population. Studies indicate that 43% of social media users in Sialkot are aware of climate change's causes and effects, showing social media's role in informal, self-directed learning that may sometimes overshadow traditional media sources.

Finally, the study reveals that 70.8% of Pakistani farmers have some awareness of climate change, though a smaller percentage actively perceive its implications. Factors influencing farmers' awareness include their education level, farming experience, proximity to urban centers, off-farm income, and the variety of adaptation strategies available to them. Compared to international benchmarks, awareness among Pakistani farmers is relatively low, highlighting the need for targeted educational interventions.

4. RESULT AND DISCUSSION

The findings indicate that various demographic factors—such as gender, education, age, region, social media engagement, and economic status—significantly influence climate change awareness in Pakistan. The study identifies a strong link between literacy levels, political commitment, and awareness of climate change in the country. Limited attention to climate change within the educational system, which is often career-focused, has hindered broader climate literacy. Universities have a vital role in enhancing climate awareness by improving environmental practices and fostering public consciousness. The Ministry of Climate Change (MOCC) recommended integrating climate education at all academic levels in 2023; however, political instability has delayed implementation. Research conducted in public and private universities in Lahore highlights a moderate awareness of climate issues among university students [1]. Nevertheless, perceptions vary, with some students prioritizing the sustainable use of technology, while others show limited concern. Integrating environmental studies at foundational levels could promote long-term environmental sustainability.

Additionally, a UNDP survey in 2021 for MOCC showed that 35% of respondents aged 19-34 with post-secondary education demonstrated a high understanding of climate change, while a similar percentage of individuals without formal schooling reported little awareness of environmental changes. Among those with no formal education, rural respondents exhibited greater knowledge of climate-related interventions than their urban counterparts (68% vs. 47%). This suggests a direct link between education levels and climate awareness, with rural populations reflecting moderate-to-high awareness due to their close connection with natural systems, despite lower educational attainment. The survey also revealed that 53% of respondents had received some form of climate education during their formal schooling, while 22% identified climate education as crucial for advancing climate action (UNDP, 2023).

Public awareness programs are limited, and civil society and non-governmental organizations face challenges in promoting climate awareness due to media sensationalism and profit-driven motives. The UNDP's 2021 report found that young people with digital access exhibit heightened climate change awareness, with 43% demonstrating a solid understanding [12]. Social media plays a transformative role in climate awareness by amplifying information, engaging audiences, providing real-time updates, encouraging public dialogue, and empowering activism. Social media allows individuals and organizations to share climate-related information, expanding the reach of climate messages and fostering communities that engage in environmental discussions. Platforms also facilitate rapid dissemination of real-time updates on climate events, prompting immediate public action and promoting pro-environmental attitudes. Social media has significantly influenced climate activism, including movements like Fridays for Future, led globally by Greta Thunberg and locally by advocates such as Iqbal Baddruddin in Pakistan. High-profile campaigns, like Imran Khan's 10 Billion Tree Tsunami, aim to reduce carbon emissions by up to 1% (Zafar Iqbal, Scientific Officer, NARC). Public figures, scientists, and activists, including Ali Rehman Khan and Anoshy Ashraf, advocate for climate action on these platforms.

The UNDP 2021 survey further supports the role of digital literacy in climate change awareness, revealing that 69% of respondents recognized the Ministry of Climate Change due to digital content exposure. A study conducted in Sindh on digital media use among university students highlights the role of online media in enabling young climate activists to express concerns and organize climate awareness initiatives. Researchers have evaluated the link between digital platforms and climate activism, finding that such media effectively meet students' informational needs. However, complex scientific terminology in digital content can reduce comprehension. The study recommends using digital platforms for future climate literacy initiatives among Pakistan's youth, as these media channels are instrumental in conveying climate information to younger audiences in Sindh (Ali Akbar Hingorjo, 2023).

Economic Well-Being & Climate Change: A Comparison of Developed and Developing Countries

Economic well-being and climate change awareness show a marked contrast between developed and developing countries Figure 2. The data reveals that global awareness of climate change is significantly lower in developing nations compared to their developed counterparts. For instance, in regions like Japan, Europe, and North America, over 90% of the population is aware of the severe impacts of climate change.

Conversely, worldwide, about 40% of adults lack awareness, and in Pakistan, awareness levels hover around 30-40% Figure 2. The correlation between education, environmental awareness, and economic strength indicates that economically stable countries exhibit greater concern for climate change. Research suggests that nations with robust economies and higher education levels tend to have populations that are more aware of climate issues, with Japan achieving 99% awareness in 2013. The lower climate awareness in Pakistan can be attributed to a lack of resources and a weak educational system, which restricts individuals' ability to prioritize environmental concerns until their basic needs are met. Although many people in developing countries acknowledge climate change, there's a perception that tackling these issues is primarily a concern for developed nations, which possess the resources to address environmental challenges.

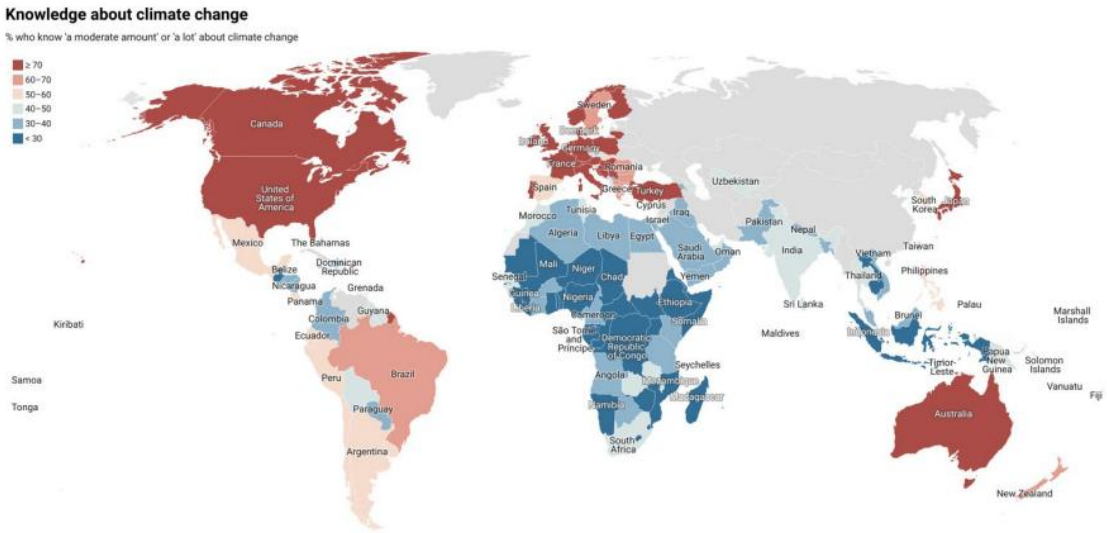


Figure 2. Global Distribution of Self-Reported Knowledge about Climate Change

Moreover, gender disparities in climate change awareness reveal that women in Pakistan generally possess more knowledge about climate issues than men, as reported by UNICEF. Women are disproportionately affected by the consequences of climate change due to their lower socioeconomic status, limited resources, and increased community responsibilities. Despite their active involvement in agriculture and climate-related issues, women are often underrepresented in climate negotiations and policy-making roles. In rural areas, their connection to agriculture heightens their vulnerability to climate challenges, furthering their understanding of climate change. However, they face significant barriers in adapting to environmental changes, including religious insecurities and limited access to environmental education and decision-making processes.

The findings also indicate that populations in Africa and Latin America exhibit heightened concern about climate change. Many individuals in these regions, particularly marginalized groups, experience a lack of basic facilities and increased exposure to climatic conditions, which exacerbates their vulnerability (International Public Opinion on Climate Change, 2022). Awareness levels can also vary due to cultural factors. Age significantly impacts climate change awareness, particularly among farming households. Research indicates that older farmers tend to be more aware of climate change [13]. This heightened awareness may stem from their historical perspective, continuous learning, media exposure, and concern for future generations. Older individuals often witness significant climate changes over their lifetimes, and their access to diverse news sources—such as traditional newspapers and television—contributes to their understanding of the issue. Additionally, the reflective nature of older age may lead them to contemplate critical challenges facing the planet. However, climate change awareness is not confined to any specific age group; individuals of all ages can actively engage in addressing and mitigating its effects.

Regional differences also play a critical role in climate change awareness. A study funded by the National Geographic Society employed a narrative-based approach to examine the impacts and adaptation strategies related to climate change in 19 rural sites across Pakistan. The results indicate that climate

change awareness is particularly low in the provinces of Sindh and Punjab, while areas like Gilgit, Hunza, and Chitral exhibit higher awareness levels due to their reliance on natural resources and direct experiences with climate change effects (Geese, 2017). According to UNDP findings, over 50% of rural respondents recognize temperature changes and altered weather patterns as significant climate change consequences. In contrast, many urban residents report no substantial environmental changes, likely due to their access to better cooling systems and transportation options. Communities in mountainous regions may possess greater knowledge about climate change due to their close connection with nature and the direct impacts they face, such as changing agricultural patterns, water scarcity, and increased natural disasters. Crop failures, food insecurity, and the rising frequency and intensity of floods are major climate change impacts reported by mountain residents. Notably, only 11% of respondents from these areas indicated that climate change had no impact on their lives (UNDP, 2021). Mountain communities actively seek to understand and adapt to changes through traditional ecological knowledge, often engaging in conservation efforts like reforestation and biodiversity preservation.

Gender dynamics also influence climate change perceptions. Educated women are generally more motivated to reduce carbon dioxide emissions, while those with limited education often lack resilience due to restricted resources and awareness. Gender differences in climate concern correlate with GDP levels, with women in wealthier regions expressing greater concern for environmental and social issues (Shaheen, 2015). Women's active engagement in environmental matters enhances their awareness and concern regarding climate change, illustrating the importance of considering gender perspectives in climate action and policy development.

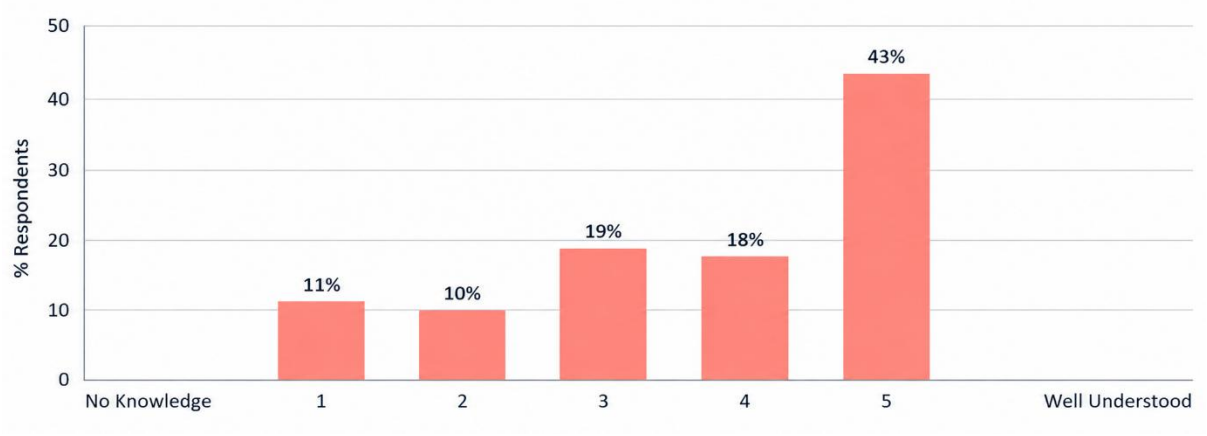


Figure 3. Self-Reported Level of Climate Change Awareness among Rural Women in Pakistan

Figure 3 indicates that climate change awareness among rural women in Pakistan is notably high, with over 43% demonstrating a strong understanding of climate change, and only 11% reporting a lack of information. Nationally, however, only 27% of respondents can explain climate change and global warming—this is below the regional average of 36%, placing Pakistan among the lowest in awareness compared to other countries in the region. Gender disparities also emerge in recognizing health hazards as a climate consequence. Among women, 44% identify an increase in health hazards as linked to climate change, while only 26% of men make this connection, highlighting a gendered awareness gap regarding climate-related health risks (UNDP, 2021).

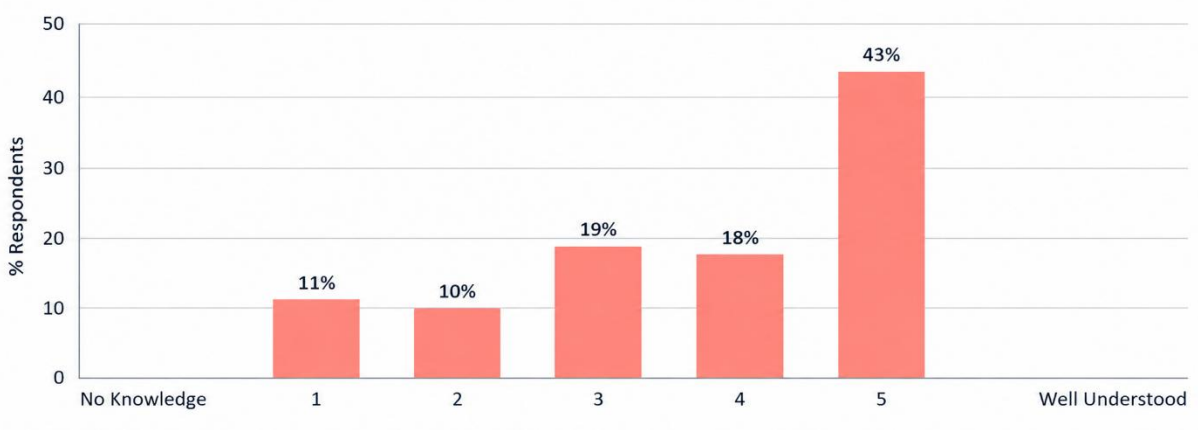


Figure 4. Level of Understanding of Climate Change among Urban Women in Pakistan

In urban areas of Pakistan (Figure 4), over 47% of women have a strong understanding of climate change, with only 5% reporting limited awareness. Both men and women in urban areas show similar levels of climate knowledge, likely due to improved access to information sources and urban occupational settings that facilitate awareness. Urban women, in particular, benefit from diverse information channels, which may contribute to their heightened understanding. In contrast, rural women's direct exposure to climate effects through agricultural work provides a practical perspective on climate change. Nationwide, however, only 25% of Pakistan's population can explain climate change and global warming, highlighting a gap in comprehensive climate education (UNDP, 2021).

4.1 Perception Based on Climate Change Impacts

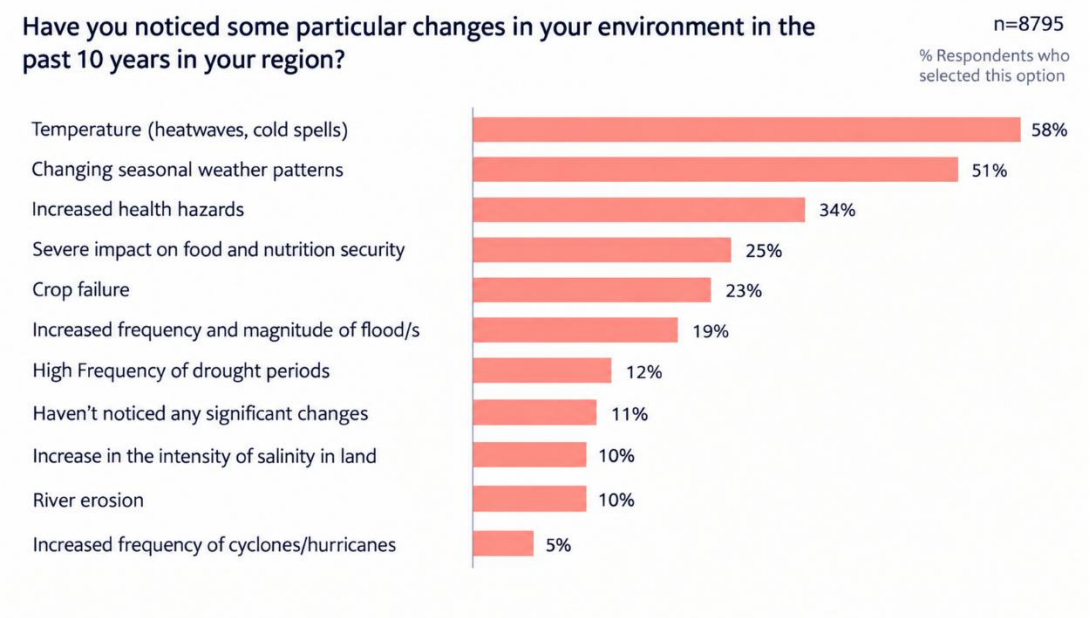


Figure 5. Environmental Changes Noticed by Respondents in Their Own Region over the Past Ten Years

Figure 5 suggests that over half of the respondents view temperature changes (58% respondents) and shifting weather patterns (51%respondents) as the primary impacts of climate change. Other significant effects include crop failures, food security threats, and the rising frequency and severity of floods. Interestingly, only 11% of respondents felt there was no climate change impact. This perspective is shared across genders, though with a notable distinction: about 15% of men indicated no observed climate change, compared to only 10% of women, reflecting a slightly higher climate impact awareness among women (UNDP, 2021).

5. CONCLUSION

In conclusion, education levels and environmental awareness are closely tied to economic stability, with political instability in Pakistan hindering official awareness efforts. While social media is a potent means for spreading information, financial constraints limit its reach. Gender plays a role in climate engagement, as women tend to adopt environmentally conscious behaviors more readily. Climate concerns are generally higher among women in wealthier nations, reflecting a correlation between gender, GDP, and climate awareness. Economically strong countries possess more resources, enabling a greater focus on climate issues. According to a study by the Ministry of Climate Change, Viamo, and UNDP, 43% of young Pakistanis with internet access are highly informed on climate matters, with the Clean Green Pakistan Index being the most recognized government initiative. High awareness exists in some parts of Pakistan, though regions like Sindh and Punjab show lower levels.

Age influences climate change awareness, particularly among farm households, where older farmers often display a deeper understanding of climate shifts. About 70.8% of Pakistani farmers acknowledge climate change, yet many remain uncertain about its effects. Awareness factors include education, farming experience, access to markets and credit, and the availability of extension services and adaptation strategies. The nation's vulnerability, weak institutions, and limited climate awareness reduce its capacity to address climate challenges effectively. To improve this, engaging the public and stakeholders is essential. National-level outreach and media campaigns can significantly raise awareness of climate threats and necessary adaptation and mitigation steps. Increasing climate education across institutions can build resilience, and government support, alongside citizen engagement and awareness campaigns, could shift the country's capacity to respond to climate challenges.

5.1 Recommendations

The government should make climate change a part of the curriculum at all educational levels, from primary school to university, ensuring that age-appropriate material covers essential topics like climate science, its impacts, and actionable solutions. Educators, especially those in under-resourced areas, need targeted training to develop the skills and knowledge required to teach these subjects effectively. A strengthened partnership between the government and media organizations would allow for broader and more impactful climate awareness campaigns, encouraging both information-sharing and engagement. Using diverse multimedia tools, such as videos, infographics, and comic books, could make climate information more engaging and accessible to a wide audience. Promoting gender equality in climate change initiatives is crucial. Ensuring equal rights and opportunities for all genders, including transgender individuals, would allow for a more inclusive approach to climate education and action. Empowering students as agents of change would strengthen climate initiatives within academic settings. Media, literature, research projects, and field trips, especially in climate education programs, could nurture a generation actively committed to addressing environmental challenges.

Collaborating with local organizations, schools, and leaders would create climate education programs that are culturally relevant and address specific community needs. Engaging local community members in the planning and implementation stages can help make these programs more effective and locally accepted. Educational materials should be made accessible by offering them in local languages and using clear, simple language with visuals that aid comprehension. Experiential learning, through workshops, field trips, and hands-on activities, provides tangible connections to climate and environmental concepts, making abstract issues more real and memorable. Universities, research institutions, NGOs, and even businesses could form partnerships to pool resources and expertise, enhancing the quality and reach of climate education efforts. These partnerships could also bridge the gap between academic knowledge and industrial practices, helping industries reduce greenhouse gas emissions through timely, research-informed actions.

Climate change should be presented with a forward-looking perspective, emphasizing its long-term effects and the importance of lifelong learning. Teachers can support this shift by providing

foundational knowledge in the classroom while organizing workshops to discuss current climate and environmental issues. Individuals can play a significant role by using social media to share information and inspire positive climate actions within their communities. Communicating in simple, accessible language, free from overly technical terms, would help researchers and volunteers spread awareness effectively and make climate issues more comprehensible to the general public.

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Author Contribution Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Abdullah Khalid	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

No conflict of interest.

Informed Consent

Not Applicable.

Ethical Approval

Not Applicable.

Data Availability

The data that support the findings of this study are available from the corresponding author on reasonable request.

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