Stimulating Environmental Protection Through Utilizing Statistical Methods for Climate Resilience and Policy Integration

(Executive Summary)

Sanaa Kaddoura

College of Technological Innovation, Zayed University, Abu Dhabi, UAE
sanaa.kaddoura@zu.ac.ae

1. Introduction

The United Arab Emirates (UAE) has become a prominent example of commitment to addressing climate change, particularly in managing greenhouse gas (GHG) emissions and implementing climate adaptation strategies. This focus is evident in the UAE's National Climate Change Plan, which seeks to minimize climate risks and bolster the country's adaptive capacity to the evolving climate landscape [1]. These efforts highlight the importance of aligning technological advancements with environmental oversight to ensure climate challenges are met with practical solutions. The plan emphasizes the need for preparedness and robust risk management strategies, ensuring the UAE remains resilient in climate-related disruptions.

Climate change, driven by the increasing concentration of GHG in the atmosphere, has led to rising global temperatures, the intensification of extreme weather events, and widespread disruption of ecosystems. These environmental shifts have far-reaching consequences that extend to nearly every aspect of life, from food production and resource availability to public health and economic stability. The pervasive effects of climate change are not confined to one region or sector but threaten the foundations of societies worldwide. It exacerbates inequalities, strains physical and mental health, and undermines the stability of social, economic, and environmental systems. As a result, the need for sustainable solutions to combat climate

change has never been more pressing [2]. Integrating sustainability measures across various sectors is imperative to mitigate the impacts of climate change and build a more resilient future.

In the UAE, the integration of digital technologies has become central to policymaking, catalyzing sustainable economic transformation. These technologies are crucial in addressing climate change by optimizing resource use and enhancing adaptation strategies. However, how individuals engage with and respond to climate change, particularly as temperatures rise and extreme weather events become more frequent, significantly influences the effectiveness of these efforts. Understanding public perceptions of climate change is essential to addressing this global challenge effectively. People's views on climate change are shaped by various factors, including cultural beliefs, personal experiences, and the political and social contexts in which they live. Studying these perceptions helps craft targeted communication strategies, design education programs, and shape policies informed by scientific knowledge and resonating with the public.

Identifying key barriers to action, address common misconceptions, and develop culturally and socially relevant interventions by exploring how people perceive climate change is crucial. A deep understanding of public perceptions can also help bridge the gap between scientific knowledge and public understanding, fostering more informed decision-making and encouraging widespread engagement with climate action. Acknowledging the diversity of perspectives on climate change is vital for inspiring collective action, developing sustainable solutions, and ensuring that policies are effective and inclusive. Ultimately, this approach aims to foster positive behavioral changes and encourage broader support for initiatives to combat climate change and achieve a sustainable future.

The primary objective of this research is to examine UAE residents' perceptions of climate change. This study will explore how individuals perceive climate risks, their experiences with extreme weather conditions, their perceived capacity to adapt to climate impacts, their behaviors, and their support for climate policies. By utilizing a questionnaire distributed across various cities in the UAE, targeting individuals of different ages, genders, and nationalities, this research will provide valuable insights into the factors influencing climate change awareness and behavior. The study aims to identify gaps in public knowledge, assess public support for climate policies, and uncover the potential barriers to more widespread climate action. The findings will inform the development of policies and strategies to increase public awareness and foster proactive climate adaptation behaviors, thus supporting the UAE's long-term climate goals. Statistical analyses of the collected data will be performed to comprehensively understand the factors

shaping climate change perceptions in the UAE. Understating the people perception will allow integrate appropriate polcies.

2. Research Question(s)

i. **RQ1:** How do UAE individuals of varying ages and educational backgrounds perceive climate change and the necessity for a sustainable society?
ii. **RQ2:** Does the level of environmental knowledge or awareness of climate change influence individuals' behaviors and participation in climate action initiatives?
iii. **RQ3:** How would understanding how people perceive climate change affect managing current and future risks?

3. Research Methods

Approach

This research adopts a quantitative approach, employing a structured questionnaire to gather data on the perceptions of climate change among residents of the UAE. To generate actionable insights, the study identifies patterns in risk perception, adaptive capacity, mitigation behaviors, policy support, and demographic influences.

Data Collection

Data was collected through a questionnaire comprising 23 questions to explore key dimensions of climate change perception. The questionnaire assessed participants' experiences with extreme weather events, their awareness of climate risks, perceived adaptive capacity, mitigation behaviors, and levels of support for climate-related policies. These correspond to the five measures of the questionnaire. To capture the influence of demographic factors, additional questions addressed gender, age, and education. Furthermore, an additional question was included to examine whether participants had undergone prior environmental or climate change education to understand its impact on behavior and perception.

The questions utilized a 5-point Likert scale, ranging from (1) "strongly disagree (SD)" to (5) "strongly agree (SA)," to gauge the degree of agreement or alignment with various statements. Each measure is tailored to cover specific questions. The measures are divided into groups A, which aim to ask perception questions, and B, which includes questions about the behavior. The questionnaire measures can be described as the following:

- Experience: Participants were asked questions informed by Kayode et al. [3], capturing their experiences during the April 2024 flood and how it impacted their personal lives, families, and communities. Table 1 includes the questions of this measure represented by items A1 to A5.
- Risk Perception: Questions explored participants' awareness of health, family, and community risks due to climate change. Table 1 includes the questions of this measure represented by items A6 to A10. These questions were adopted from Diakakis et al. [4].
- Perceived Adaptive Capacity: This section focused on participants' knowledge and beliefs regarding their ability to adapt to climate challenges. Table 1 includes the questions of this measure represented by items A11 to A15. These questions were meticulously crafted from Acquah [5].
- Mitigation Behaviors: Questions examined the participants' climate-related actions in daily life and during specific events. These questions were thoroughly implemented to target individuals in the UAE. Table 2 includes the questions of this measure represented by items B1 to B5.
- Policy Support: The extent of agreement with climate-related policies was assessed to understand participants' levels of support for environmental initiatives. These questions were designed to meet the study's unique requirements, ensuring relevance to the UAE. Table 2 includes the questions of this measure represented by items B6 to B8.

The questionnaire was distributed online using Google Forms and available in English and Arabic to ensure accessibility. Measures were taken to restrict responses to individuals residing within the UAE, excluding non-residents from participation.

Analytical Techniques and Policy Integration

The collected data was analyzed using statistical techniques to ensure robust and reliable insights. Each measure's descriptive statistics, including mean and standard deviation, were calculated to summarize central tendencies and variability. The reliability of the measures was assessed to confirm their effectiveness in capturing the intended constructions. As suggested by Hair [6], the reliability of a construct could be confirmed with an alpha value > 0.6. Demographic data were analyzed to identify potential correlations or differences in climate change perceptions based on gender, age, and education level. Then suggest policies based on the statistical results.

4. Key Findings

Table 1 provides a statistical analysis of Group A questions related to climate change perception, including experiences, risk perception, and perceived adaptive capacity. The table outlines the percentage of

participants responding to each item on the 5-point Likert scale and the mean and standard deviation for each question. The findings reveal that a substantial proportion of participants selected neutral responses, with the average mean scores between 1.78 and 4.28. Most mean scores exceed 2.7, indicating that participants predominantly responded with neutral, agree, or disagree options rather than SD or SA. An exception is question A5, which highlights that the participants largely agreed there was no loss of lives during the flood. The standard deviation for the questions is close to 1, with the highest standard deviation reported at 1.36. The reliability of the questionnaire is affirmed by a Cronbach's alpha greater than 0.6 for all three measures, experience, risk perception, and perceived adaptive capacity, demonstrating the validity and consistency of the questions. The results further indicate that most participants exhibit a heightened perception of climate change risks, substantial firsthand experience with the recent flood, and a strong perceived adaptive capacity. These insights underscore the participants' awareness of climate-related challenges and readiness to adapt to potential impacts.

Table 1. Questionnaire items for the three measures in Group A.

Measure	SD	Disagree	Neutral	Agree	SA	Mean	Standard Deviation	Cronbach's alpha
Experience								
A1. The flood damaged the roads in your city and it has caused severe damage?	19.93	21.65	33.68	16.49	8.25	2.71	1.20	0.8221
A2. The flood disrupted the movements in your city such that you were not able to move.	20.62	21.31	23.02	23.02	12.03	2.85	1.32	
A3. The flood caused extensive inundation of the community (e.g., residential areas, public spaces)	17.53	16.49	32.30	21.31	12.37	2.95	1.26	
A4. The flood caused a significant loss of valuable properties (e.g., cars, jewelry, or apartments)	27.83	18.56	21.65	17.53	14.43	2.72	1.41	
A5. The flood resulted in the loss of any family members or loved ones and it has high loss impact on the community	63.57	13.06	11.69	4.81	6.87	1.78	1.23	
Risk Perception								
A6. Climate change will have a noticeably negative impact on my health	12.03	17.52	27.49	22.34	20.62	3.22	1.29	0.878
A7. Climate change will have a noticeably negative impact on my financial situation	20.27	18.90	30.93	18.90	11.00	2.81	1.26	
A8. Climate change will have a noticeably negative impact on the environment in which my family and I live	13.40	16.15	25.43	19.25	25.77	3.28	1.36	
A9. Climate change may lead to changes in weather patterns and extreme weather events	7.22	10.65	18.56	26.80	36.77	3.75	1.25	
A10. Climate change may lead to increased flood frequency	7.56	14.78	21.31	28.86	27.49	3.54	1.25	
Perceived Adaptive Capacity								

A11. I am aware that climate change is a real phenomenon	4.47	5.50	15.12	18.21	56.70	4.17	1.15	0.8863
A12. I believe that climate change is an important topic.	3.09	5.16	12.37	19.24	60.14	4.28	1.06	
A13. Climate change is primarily caused by human activities.	3.78	5.84	26.80	20.62	42.96	3.93	1.13	
A14. Climate change is occurring due to the emission of gases from industrial activities and the burning of fossil fuels.	4.81	6.18	23.37	21.31	44.33	3.94	1.17	
A15. Recycling waste is essential for reducing climate change.	4.81	5.84	19.93	21.65	47.77	4.02	1.16	

Table 2 presents a detailed statistical analysis of the measures in Group B, which focuses on mitigation behaviors related to climate change. The table includes the percentage distribution of participants' responses across each item on the 5-point Likert scale and the mean, median, and reliability score. The responses for mitigation behavior show a wide distribution across the Likert scale, with a mean consistently greater than 2.6. This indicates that most participants exhibit agreement or active participation in mitigation behaviors. The standard deviation for this measure ranges between 1.30 and 1.40, indicating moderate variability in responses. This variability suggests that while many participants are aligned in their agreement or participation, there is still some divergence in the levels of commitment or frequency of these behaviors. The mitigation behavior measure demonstrates a Cronbach's alpha of 0.7997, establishing its reliability and validity. The policy support measure reveals that participants' responses are concentrated in the "SA" category, consistently reflecting the highest percentage across all questions. This trend suggests widespread support for climate-related policies among the participants. The mean values for the policy support questions reinforce this finding, with the lowest mean reported for question B6 at 3.93. This indicates that most participants either agree or SA with the proposed policies. The standard deviation for all questions is approximately 1, signifying relatively low response variability. This consistency implies a consensus among participants regarding the importance and acceptance of climate-related policies. The Cronbach's alpha of 0.9115 shows that this measure is valid and reliable.

Table 2. Questionnaire items for measures in Group B

Measure	SD	Disagree	Neutral	Agree	SA	Mean	Standard Deviation	Cronbach's alpha
Mitigation Behavior								
B1. I regularly check and remove electrical cables and appliances from sockets during heavy rainfall.	14.78	16.15	21.99	19.93	27.15	3.29	1.40	0.7997
B2. I have taken steps to ensure that my electrical wiring is protected from potential water damage.	11.0	17.18	24.74	23.71	23.37	3.31	1.30	
B3. I encourage my neighbors to take preventive actions, such as elevating electrical appliances, to reduce flood risks.	20.62	17.18	28.52	17.53	16.15	2.91	1.35	

B4. I am knowledgeable about physical steps to take for flood mitigation, such as installing flood barriers.	26.46	20.96	24.40	14.43	13.75	2.68	1.37	
B5. I participate in community clean-up activities that focus on preventing blockages such as clearing blockages in my area	33.68	17.52	26.46	9.97	12.37	2.50	1.37	
Policy Support								
B6. It is important to integrate climate change and sustainability topics into the UAE school curriculum to enhance students' ability to address climate-related challenges.	4.12	9.62	19.25	22.68	44.33	3.93	1.18	0.9115
B7. It is important to offer grants to universities and research institutions for studying climate change and innovative technologies to advance climate solutions in the UAE.	2.75	6.87	18.90	25.77	45.71	4.05	1.08	
B8. It is important to develop national or regional climate literacy standards to ensure that UAE students gain the necessary knowledge and skills to effectively address climate issues.	2.75	5.84	19.59	26.12	45.70	4.06	1.06	

Table 3 provides a statistical summary of the demographic data collected from participants. The results indicate that most respondents were female, unemployed, enrolled in a bachelor's degree program, single, and aged between 18 and 25. The high unemployment rate is largely attributed to the significant proportion of participants pursuing their Bachelor's degrees. Additionally, the analysis reveals that most respondents were from Abu Dhabi, representing 82.13% of the total participants. This demographic distribution highlights the characteristics of the sample population, offering valuable context for interpreting the study's findings on climate change perceptions and behaviors.

Table 3. Demographic statistics.

Gender	**Number**	**Percentage**	**Employment Status**	**Number**	**Percentage**
Female	228	78.35	Employed	79	27.15
Male	63	21.65	Unemployed	199	68.38
			Self-employed	13	4.47
Education			**Age**		
Less than high school	6	2.06	18-25	240	82.47
High school	61	20.96	26-35	20	6.87
Enrolled in Bachelor's degree	149	51.20	36-45	19	6.53
Bachelor's degree	59	20.28	46-55	8	2.75
Master's degree	6	2.06	56-64	4	1.38
Doctoral Degree	10	3.44			
Residency			Marital		
Abu Dhabi	239	82.13	Married	23	7.90
Dubai	46	15.81	Single	167	57.39
Sharjah	2	0.69	Divorced	2	0.69
Fujairah	2	0.69	No Response	99	34.02
Ras Al Khaimah	1	0.34			

Ajman	1	0.34

RQ1: How do UAE individuals of varying ages and educational backgrounds perceive climate change and the necessity for a sustainable society?

Figure 1 shows the percentage distribution of responses that agree with the policy support question and regularly engage in mitigation behaviors across five age groups (18–25, 26–35, 36– 45, 46–55, and 56–64) for questions categorized into two groups: mitigation behaviors (B1 to B5) and policy support (B6 to B8). The 26-35 and 46–55 age groups show the highest engagement percentage in these mitigation behaviors, B1 and B2. Young age group 18–25 and old age group 56–64 exhibit comparatively lower engagement. In mitigation behavior, B3 participation drops significantly for all age groups except for the 56-64 group, who reported the highest percentage in B3. This suggests that these behaviors might be more challenging or less prioritized. The age group 26-35 also reported the highest percentage of mitigation behaviors, B4 and B5. The two age groups, 18-25 and 36-45, have less participation than others. In policy support, all groups have reported a high percentage of support above 60%, with the highest always reported by age group 56-64.

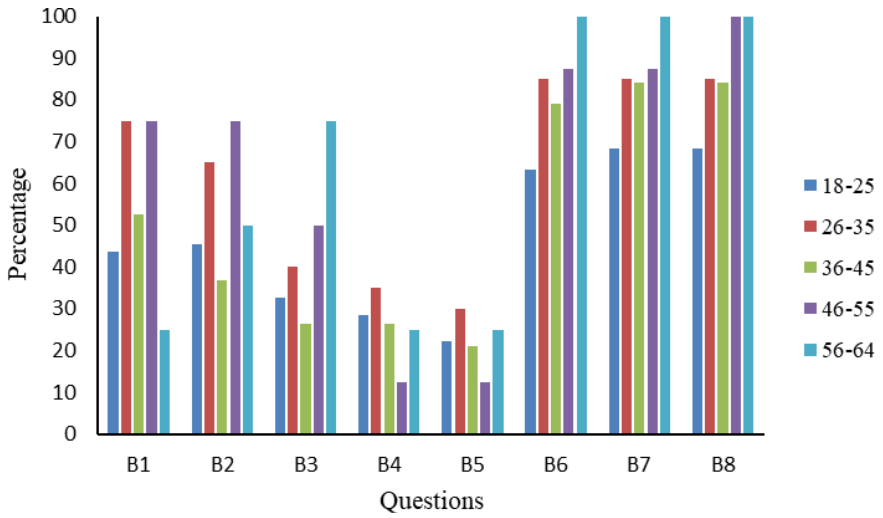

Figure 1. Percentage of distribution of responses for participants across age groups.

Figure 2 shows the percentage of responses that agreed with climate change policies and performed different mitigation behaviors across different education levels. Respondents with lower educational attainment ("Less than High School") show the highest engagement in mitigation behaviors (B1 and B2), followed by individuals enrolled in a Bachelor's degree. Interestingly, Master's degree holders tend to report lower engagement than the "Less than High School" group in these behaviors. The mitigation behavior (B3, B4, and B5) engagement levels drop significantly for all educational levels, with relatively slight variation across the groups. However, respondents with a Bachelor's degree and

High school show slightly higher engagement than those holding a Master's degree and Doctoral degree. Support for policy measures is highest among respondents with a doctoral degree and near-universal agreement (close to 100%). Master's degree holders follow closely, showing similarly high levels of policy support. Individuals with "Less than High School" education still demonstrate strong support but lag behind the more highly educated groups.

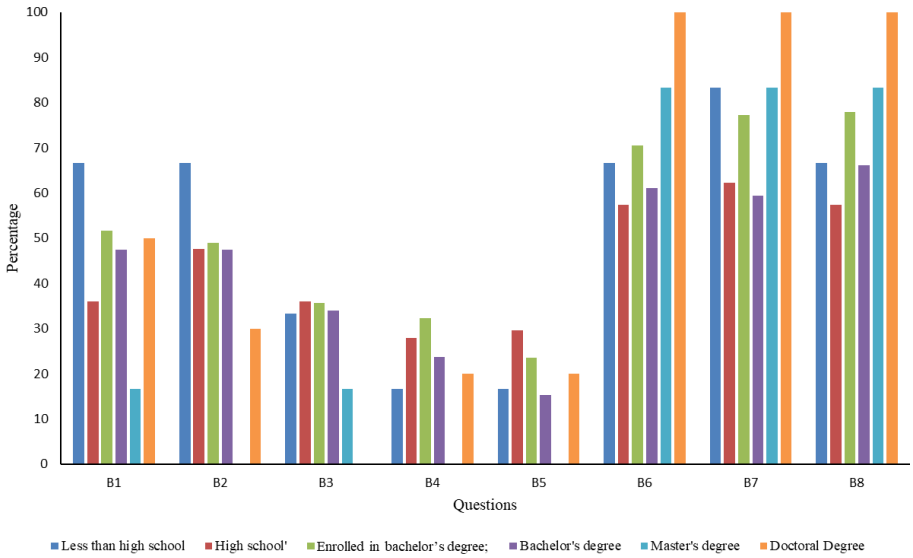

Figure 2. Percentage of distribution of responses for participants across different educational levels.

RQ2: Does the level of environmental knowledge or awareness of climate change influence individuals' behaviors and participation in climate action initiatives?

Figure 3 displays a bar chart illustrating the percentage of individuals who agree with the policy support questions and regularly engage in mitigation behaviors. The data is divided into two groups: those who have taken an environmental course or possess environmental knowledge (labeled as "Yes") and those who have not (labeled as "No"). The chart reveals that individuals with prior exposure to environmental education are generally more likely to perform regular mitigation behaviors than those without such exposure, except for behavior B3. Although higher knowledge tends to perform mitigation behavior, the percentage of participants who perform these behaviors is less than 50%. Similarly, regarding policy support, individuals with prior environmental knowledge show a greater tendency to endorse policies addressing climate change.

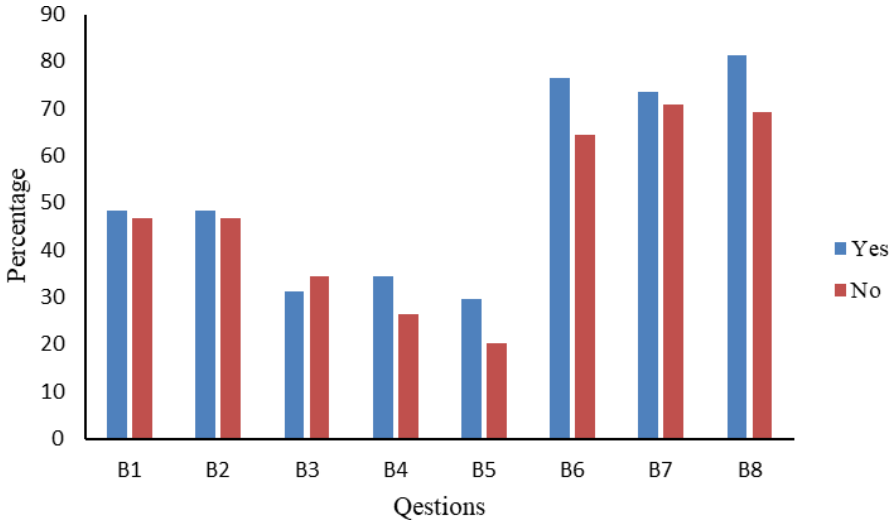

Figure 3. Percentage of distribution of responses for participants taken or not taking courses about climate change.

5. Implications

The questionnaire results indicate that most participants responded to the survey questions with neutral, agree, or SA. Participants demonstrated high levels of risk knowledge, perceived adaptive capacity, and personal experience with flooding. Additionally, some participants had previously taken climate change-related courses. Most respondents supported climate change policies, indicating their willingness to accept proposed measures to mitigate or control climate change. However, these factors do not significantly influence their engagement in mitigation behaviors despite their high knowledge, education levels, or age. Even among individuals who have experienced extreme weather events and reported property losses, such experiences have not noticeably altered their behavior.

Similarly, participants who have completed environmental courses or received climate change education show low engagement in mitigation behaviors. Interestingly, individuals with advanced education levels, such as Master's or Doctoral degrees, also exhibit low participation in mitigation behaviors. This trend is especially pronounced among Master's degree holders, who reported no engagement in specific behaviors such as B2, B4, and B5. This highlights a disconnect between knowledge, education, and actual behavioral change, suggesting the need for more effective strategies to translate awareness and education into tangible climate action.

RQ3: How would understanding how people perceive climate change affect managing current and future risks?

Understanding how people perceive climate change is critical for managing current and future risks, as it directly influences the development of effective strategies, policies, and interventions. Tailoring communication strategies to address public perceptions can ensure messages resonate with diverse audiences, such as emphasizing local and immediate impacts to motivate those who view climate change as a distant threat. Insights into perceptions also enable targeted interventions to address specific behaviors or attitudes that hinder climate action, such as implementing educational programs or incentives to encourage engagement in mitigation efforts. Additionally, understanding public perceptions supports the design of widely accepted policies, as people are more likely to back initiatives when they recognize the risks of inaction and the benefits of mitigation strategies like renewable energy investments or conservation measures. From a risk management perspective, aligning adaptation strategies with public concerns ensures that efforts are more effective and relevant to communities, such as prioritizing infrastructure improvements in areas vulnerable to flooding. Addressing misconceptions and fostering long-term public engagement is essential for sustaining behavioral changes and policy adherence, which is critical for managing future climate risks. Integrating behavioral insights into policy frameworks helps bridge the gap between knowledge and action, ensuring a collective and sustainable approach to combating climate change.

The findings highlight a critical gap between knowledge, education, and the adoption of mitigation behaviors, presenting several practical implications:

- Practitioners and policymakers should focus on designing and implementing targeted interventions beyond increasing awareness or providing education. While participants possess high knowledge and education levels, these do not translate into actionable behavior. Behavioral interventions such as incentives or social norm campaigns could encourage individuals to engage in specific climate mitigation actions.
- Education programs, including environmental courses and climate change training, should incorporate hands-on, practical components that encourage active participation in mitigation behaviors. For instance, integrating community projects, case studies, or direct- action initiatives into climate education may foster greater behavioral engagement.
- Policymakers should focus on creating climate policies tailored to local needs, cultural contexts, and economic conditions to ensure widespread participation and effectiveness, such as promoting a transition to sustainable energy sources such as solar power.

Since age and personal experiences do not significantly drive behavioral changes, stakeholders should consider leveraging these factors through tailored messaging. For example, campaigns targeting older age groups could emphasize their roles as role models, while messages for younger generations could highlight collective action and peer influence.

6. Conclusion

This research highlights a significant gap between knowledge, education, and adopting climate mitigation behaviors. While participants demonstrated high levels of risk knowledge, perceived adaptive capacity, and policy support, these attributes did not translate into meaningful behavioral change. Even those with advanced education, personal experiences with extreme weather events, or climate-related training exhibited low engagement in mitigation behaviors. These findings suggest that increasing awareness or education cannot drive proactive climate action. Instead, more comprehensive strategies are required to address the psychological, social, and structural barriers preventing behavior change. The research underscores the importance of aligning policy frameworks, educational initiatives, and community engagement efforts to bridge the knowledge- action gap and promote sustainable behavioral patterns effectively.

Future research should focus on identifying the psychological and socioeconomic factors that hinder or motivate mitigation behaviors, such as perceived efficacy, convenience, or social norms. Investigate how experiential or applied educational programs influence long-term behavior changes, as opposed to theoretical or informational approaches. Study the potential of emerging technologies in promoting and tracking climate mitigation behaviors, such as mobile apps, gamification, and AI-driven tools.

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