

# Computer Science Professionals' Perspectives on Technology's Role in Climate Action

Baale, A. A<sup>1</sup>, Abdulsalami, B. A<sup>2\*</sup>, Adeyeye, A. M<sup>3</sup>, Jenyo, A. A<sup>4</sup>, Adeyemo I. A<sup>5</sup>

Ladoke Akintola University of Technology, Ogbomoso, Nigeria

\*Corresponding Author

DOI: <https://dx.doi.org/10.51584/IJRIAS.2026.110130004>

Received: 14 January 2026; Accepted: 20 January 2026; Published: 02 February 2026

## ABSTRACT

This study examines how computer science professionals in South-West Nigeria perceive the role of technology in climate action. The study employed a quantitative research approach using a structured questionnaire and hybrid sampling techniques of random sampling and snowball sampling. Data were collected from 60 lecturers and industry professionals and analyzed through descriptive statistics, correlation, and regression to test four hypotheses.

The results demonstrate that computer science professionals are highly aware of climate change and optimistic about technology, particularly low-carbon and new technologies. However, systemic obstacles like cost, infrastructure, and policy gaps limit this optimism. Hypothesis testing reveals a psychosocial pathway in which awareness promotes positive attitudes, but perceived barriers weaken these attitudes, decreasing motivation to act and restricting actual participation in sustainable actions. Professionals nevertheless exhibit high levels of intrinsic motivation and widespread consensus regarding the significance of institutional support, such as professional associations and industry-academia cooperation.

The study concludes that computer science professionals are important and eager contributors to climate action, but increasing awareness, reducing implementation barriers, and bolstering institutional support are necessary to fully realize their contribution. With suggestions to include climate technology into curricula and encourage multi-stakeholder partnerships, the findings help leaders, educators, and policymakers leverage technological skills for climate solutions. To improve generalizability, future studies are urged to use bigger, multinational samples.

**Keywords:** SDG, Climate change, Technology, Computer Professionals.

## Background of the Study

Climate change represents one of the most pressing global environmental challenges of our time. It is characterized by long-term shifts in temperature and weather patterns, driven predominantly by human activities since the 1800s (IPCC, 2021). According to the United Nations (UN), Climate change refers to long-term alterations in temperatures and weather patterns, alterations that can be natural, due to changes in the sun's activity, large volcanic eruptions or human activities. The primary cause is the burning of fossil fuels, which releases greenhouse gases (GHGs) like carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) and fluorinated gases into the atmosphere. Agriculture, oil and gas operations, energy, industry, transport, buildings and land use are among the main sectors causing GHGs (Fagodiya *et al.*, 2023). These emissions act as a blanket, trapping heat and leading to global warming.

The concentration of CO<sub>2</sub> in the atmosphere has reached approximately 415 parts per million (ppm), the highest level in at least 800,000 years. The consequences are already evident: increased acidity of the world's oceans (NOAA, 2020), rising global temperatures; increasingly severe weather events; ocean acidification; and rising sea levels (WMO, 2025). The global climate predictions show that temperatures are expected to continue at or near record levels in the next five years, increasing climate risks and impacts on societies, economies and sustainable development (WMO, 2025). In response, climate action aims to mitigate GHG emissions and build

resilience against these impacts. Technology is a critical enabler in this effort, powering innovations in renewable energy, smart infrastructure, and climate modeling.

Within this context, Computer Science professionals are uniquely positioned to develop the technological solutions necessary for climate action. They have the expertise to create sophisticated algorithms, design energy efficient systems and harness big data to understand climate patterns better. However, a potential barrier exists: many tech professionals may have low awareness of climate issues. Therefore, this study seeks to investigate the awareness, attitudes, and knowledge of computer science professionals regarding climate change and the role of technology in addressing it. The goal is to identify barriers and opportunities to better integrate their expertise into global climate response efforts.

## Research Objectives

To achieve the overall aim of this study, the following research objectives have been established:

- i. To assess the awareness, knowledge, and attitudes of Computer Science professionals regarding climate change impacts and technological solutions.
- ii. To identify the barriers perceived by Computer Science professionals to the adoption of climate-friendly technologies.
- iii. To determine which low-carbon technologies Computer Science professionals believe hold the most potential for achieving climate goals.
- iv. To quantify the willingness of Computer Science professionals to participate in future climate initiatives and to analyze the factors influencing their engagement.

## LITERATURE REVIEW

### The Concept and Dimensions of Climate Change

Climate is fundamentally defined as the long-term statistical profile of atmospheric conditions such as temperature, humidity, wind, and precipitation in a specific region, typically assessed over a 30-year period as per World Meteorological Organization standards (Neil et al., 2023). Climate change, therefore, represents a significant and persistent variation in these averages or in the distribution of weather events around these averages, leading to an increased frequency of extremes (IPCC, 2021). This phenomenon is not merely an environmental issue but a complex, intergovernmental challenge with profound implications for global ecological, socio-political, and economic systems (Leal et al., 2021).

The manifestations of contemporary climate change are unequivocal. The primary indicators include a sustained increase in global mean surface temperatures, which have risen approximately 1.1°C above pre-industrial levels (WMO, 2021), the accelerated retreat of ice sheets and glaciers, and a corresponding rise in global sea levels (Michel et al., 2021). These systemic changes confirm that climate change is a pervasive global trend, characterized by comprehensive long-term shifts in climatic parameters.

### Anthropogenic Drivers: The Primary Causes of Contemporary Climate Change

While climate change can be driven by natural factors such as volcanic activity and solar cycles, the overwhelming scientific consensus attributes the accelerated changes observed since the industrial revolution to anthropogenic sources (IPCC, 2021). The principal driver is the emission of greenhouse gases (GHGs), notably carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O), which alter the Earth's energy balance.

The structure of these human-induced emissions reveals a diverse portfolio of sources. According to U.S. Environmental Protection Agency data (2021), the primary sectors contributing to GHG emissions are electricity generation (25%), transportation (28%), industrial processes (23%), agriculture (10%), and commercial and residential activities (13%). This sectoral breakdown underscores that the global energy system, heavily reliant on the combustion of fossil fuels, is the cornerstone of the problem (Asongu et al., 2020). Furthermore, land-use

changes, particularly deforestation and agricultural expansion, represent a critical secondary source, simultaneously reducing the planet's carbon sink capacity and releasing stored carbon.

Emerging research also highlights the climate impact of energy-intensive digital technologies. For instance, the operational energy demands of certain blockchain applications, such as Bitcoin, have been found to produce CO<sub>2</sub> emissions comparable to the annual output of small industrialized nations, introducing a novel and growing source of emissions within the global economy (Stoll et al., 2019).

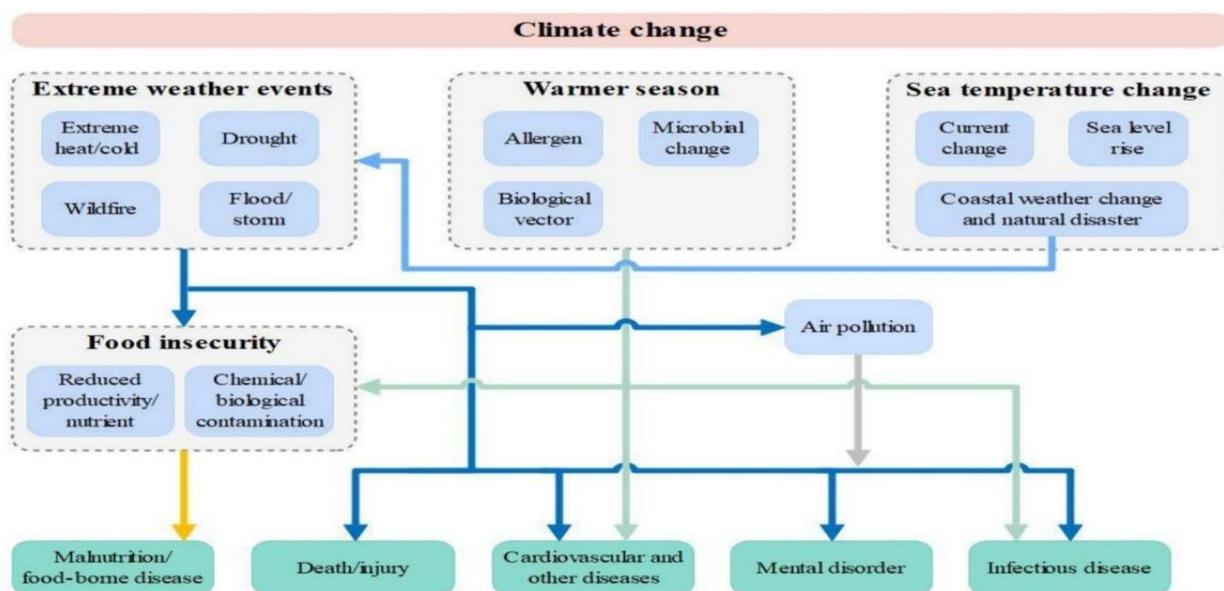
### The Multifaceted and Cascading Impacts of a Warming World

The consequences of climate change are already manifesting through an increased intensity and frequency of extreme weather events, including severe heatwaves, prolonged droughts, and intense precipitation, with immediate and devastating impacts on populations, infrastructure, and ecosystems (Clarke et al., 2022). These impacts, however, extend far beyond immediate weather disasters, triggering cascading effects across biological and human systems.

#### Key documented impacts include:

- i. **Ecological Shifts:** Terrestrial and marine ecosystems are undergoing significant stress, forcing species migration and increasing the risk of extinction, particularly in sensitive regions like the Arctic and coral reef ecosystems. Concurrently, ocean acidification—a direct result of absorbed atmospheric CO<sub>2</sub> poses a grave threat to marine biodiversity and fisheries (IPCC, 2021).
- ii. **Systemic Risks to Human Society:** The warming climate threatens global food security by disrupting agricultural yields and favors the spread of pests and tropical diseases into new, warmed regions. While some high-latitude regions may experience temporary agricultural benefits, the global net effect is projected to be negative, potentially leading to economic instability and displacement of populations.
- iii. **Complex Health Consequences:** The health impacts of climate change (Figure 1) are a critical area of concern. While numerous studies have established direct links between heatwaves and increased mortality from cardiovascular and respiratory diseases (Zhao et al., 2019), a significant gap remains in the literature. As noted by Murray et al. (2020), there is a pressing need to move beyond single exposure studies. The complex pathways and synergistic effects arising from interactions between multiple climatic variables (e.g., heat and humidity) and non-environmental factors are not yet fully understood. Elucidating these pathways is crucial for developing robust public health strategies for mitigation and adaptation.

Figure 1: Main pathways between climate change and health outcomes.



(Source: ScienceDirect, 2022)

## Climate Action: The Framework for Global Response

In response to the escalating climate crisis, the international community has established climate action as a central pillar of sustainable development, enshrined as Sustainable Development Goal 13 (SDG 13). Climate action encompasses a dual-pronged approach: *Mitigation*, which involves reducing greenhouse gas (GHG) emissions at their source, and *Adaptation*, which entails adjusting to current and anticipated climate impacts (UN, 2015). The overarching objective is to build systemic resilience and integrate climate change measures into the core of national and sub-national policymaking, strategic planning, and budgetary processes.

A key governance mechanism in this effort is the National Adaptation Plan (NAP) process, overseen by the United Nations Environment Programme (UNEP). The NAP process is a continuous, country-driven endeavor with two primary aims: first, to substantially reduce climate-related vulnerabilities by building adaptive capacity and resilience; and second, to mainstream adaptation into all relevant sectors and development strategies. The urgency of these actions is underscored by climate projections, which indicate that without decisive intervention, the global average surface temperature is likely to surpass 3.0°C above pre-industrial levels this century, with devastating consequences (IPCC, 2021).

## Global Warming as the Engine of Change

The primary driver of contemporary climate change is global warming, a phenomenon characterized by a long term increase in the Earth's average surface temperature. This warming is a direct consequence of the enhanced greenhouse effect, caused by the accumulation of anthropogenic GHGs in the atmosphere (Anderson *et al.*, 2020). Global warming acts as the engine that disrupts historical weather patterns and energy balances, thereby manifesting as the broader set of changes defined as climate change.

The impacts of this warming are systemic and far-reaching. It directly amplifies the frequency and intensity of extreme weather events, including droughts, heatwaves, and heavy precipitation (Clarke *et al.*, 2022). Furthermore, it triggers a cascade of secondary effects, such as sea-level rise, coastline degradation, and disruptions to agricultural productivity, which in turn threaten food security, freshwater availability, and public health (Santra, 2019). Understanding global warming as the core mechanistic driver is essential for targeting both mitigation and adaptation strategies effectively.

## The Role of Technological Innovation in Climate Adaptation

To navigate the impacts already set in motion by global warming, technological innovation is a critical enabler of adaptation. Invention and deployment in this domain focus on reducing vulnerability and enhancing the capacity of social, economic, and ecological systems to cope with change. The literature identifies several key areas where technology plays a pivotal role:

- i. **Resilient Food and Water Systems:** Technologies for climate-resilient agriculture (Srivastav *et al.*, 2020) and intelligent water management (Xiang *et al.*, 2021) are vital for securing essential resources under changing climatic conditions.
- ii. **Protective Infrastructure:** Innovations in flood protection, early warning systems, and climate-resilient urban planning are crucial for safeguarding communities and assets.
- iii. **Informed Decision-Making:** Advanced climate modeling, data analytics, and remote sensing provide the foundational knowledge for proactive risk management and policy development.
- iv. **Sustainable Foundations:** The deployment of renewable energy (Olabi *et al.*, 2022) and ecosystem restoration (Strassburg *et al.*, 2020) not only contributes to mitigation but also underpins long-term adaptive capacity by reducing dependency on vulnerable, carbon-intensive systems.

However, the development of technology is insufficient without equitable access. A critical challenge lies in ensuring that these innovations reach vulnerable and marginalized populations who are often disproportionately affected by climate impacts. Ongoing research, development, and multi-stakeholder collaboration spanning governments, industry, and civil society are therefore imperative to advance just and effective climate adaptation.

Adaptation Technology is the practical application of innovation to build resilience against climate impacts, spanning agriculture, water, infrastructure, and data systems. A major focus is on ensuring these solutions are accessible and equitable.

## Related Works

A growing body of literature explores the intersection of technology, human factors, and systemic change in climate action. Previous research can be broadly categorized into studies focusing on technological innovation, those examining human perception and adaptation, and frameworks for simulation and integration. Key contributions are reviewed below to situate the present study within the existing scholarly discourse.

## Technological Innovations for Mitigation and Adaptation

A significant strand of research focuses on the development and application of specific digital technologies to reduce emissions and enhance resilience. In the realm of mitigation, studies have investigated the role of advanced digital tools in decarbonizing industrial processes. For instance, Anastasia and Maxim (2022) demonstrated that strategic deployment of technologies like Big Data, Artificial Intelligence (AI), and Blockchain could significantly contribute to emission reductions within the oil and gas sector. Similarly, Michael *et al.* (2020) proposed a conceptual framework establishing Blockchain as a socio-technical tool for enhancing supply chain integration and transparency, thereby enabling more effective carbon footprint tracking and emission minimization.

Concurrently, research on adaptation technologies highlights their critical role in building systemic resilience. Ling *et al.* (2022) underscored the value of data-driven strategies, showing how Big Data analytics improve disaster preparedness, enhance real-time response, and optimize recovery resource allocation. In the energy sector, Suman (2021) documented the dual mitigative and adaptive benefits of renewable energy technologies, citing the case of Nepal where their adoption directly reduced CO<sub>2</sub> emissions by 221,129 tons while enhancing energy security.

## Human Dimensions and Behavioural Factors in Climate Action

Beyond technological tools, the success of climate initiatives is deeply contingent on human factors. Research into the behavioral and perceptual drivers of adaptation is therefore crucial. A micro-level study by Chandan *et al.* (2021) in rural India revealed that while 80% of farmers perceived climate changes and chose to adapt, their specific decisions were significantly influenced by socio-economic variables such as age, gender, education, and land ownership. This finding emphasizes that technological solutions must be designed and deployed with a nuanced understanding of the target demographic's context and constraints.

A global study by Vlasceanu *et al.* (2024) found that behavioral interventions can modestly improve climate beliefs but have weak effects on effortful actions. The results reveal a persistent gap between intention and sustained behavioral change. This underscores the need for technology-driven tools to support long-term climate commitments. A review on AI and climate modelling by Zhao *et al.* (2025) highlights that AI advances climate modeling but most models lack behavioral and social dimensions. The authors propose integrating AI with IoT and interpretable frameworks that include human interaction. They conclude that future climate technology must merge computational intelligence with human awareness and inclusivity.

## Integrative Frameworks and Simulation for Systemic Change

Bridging the gap between technology and human action, other works have developed integrative frameworks and simulation tools. Rooney-Varga *et al.* (2020) designed a Climate Action Simulation, an interactive approach that educated participants on the dynamics of the climate-energy system. The study found that such experiential learning not only increased knowledge of necessary policies but also fostered greater personal and emotional engagement with the climate crisis, highlighting the importance of educational tools in driving behavioral and societal change.

Mathison *et al.* (2025) introduced Probabilistic Regional Impacts from Model patterns and Emissions (PRIME), a rapid-assessment tool that links emission scenarios to regional impacts. PRIME delivers faster and probabilistic estimations of regional climate consequences, bridging gaps between global models and local decision-making. While the tool enables flexible scenario analysis, it sacrifices physical detail and may underrepresent non-linear

processes or cascading risks. Despite these limitations, the tool exemplifies how integrative simulation tools can support timely policy decisions under uncertainty.

## Identified Research Gap

Collectively, these studies affirm the critical role of technology in climate mitigation and adaptation and acknowledge the importance of human perception. However, a discernible gap exists concerning the professionals who are central to developing these very technologies, specifically, those in the field of Computer Science. While research has focused on end-users (e.g., farmers) or large corporations, there is a lack of inquiry into the awareness, perceptions, and willingness to act among the technical experts responsible for building digital climate solutions. This study seeks to address this gap by investigating the attitudes and knowledge of Computer Science professionals, thereby identifying how to better mobilize this critical cohort in the global climate response.

## METHODOLOGY

### Research Design

This study utilized a descriptive research design to achieve its objectives. Specifically, a non-experimental quantitative approach involving surveys was employed to understand perceptions and attitudes without influencing variables.

### Population of the Study

The target population for this study are Computer Science lecturers and professionals across different universities in South-West, Nigeria. These include both public and private institutions recognized by the National Universities Commission (NUC). In total, these universities employed approximately 100 computer science lecturers in total.

### Sample Size Determination

The sample size for this study was calculated using the Yamane (1967) formula (equation 1.1) at a 10% margin of error. Based on a population of 100 respondents, a sample size of 50 participants was obtained (equation 1.2).

$N$

$$n = \frac{N}{1 + N(e)^2} \quad (1.1)$$

where:  $n$  = desired sample size;  $N$  = population size (100); and  $e$  = level of precision (0.05).

$$n = \frac{100}{1 + 100 * (0.1)^2} = 50$$

In order to account for possible non-response and enhance data robustness, additional responses were collected even though the intended sample size was 50. This led to a final sample of 60 respondents.

### Sampling Procedure and Participant Recruitment

A simple random sampling technique was employed to ensure each computer science lecturer in the identified universities had an equal probability of selection, thereby enhancing the representativeness of the sample. The sampling frame was constructed by compiling a comprehensive list of all computer science lecturers from official university websites and staff directories. Each lecturer on the alphabetically sorted list was assigned a unique identification number (1 to  $N$ ). A computer-generated random number sequence was then used to select 50 participants without replacement.

The selected lecturers were contacted via email with an invitation to participate in the study, which included a link to the online questionnaire. To mitigate non-response bias, a protocol involving two follow-up reminder emails was implemented for non-respondents.

In order to improve response adequacy, an additional 10 participants were recruited through snowball sampling, where existing respondents referred eligible participants. This resulted in a total sample size of 60 respondents.

### **Data Collection Instrument**

A structured self-administered questionnaire, comprising both closed and open-ended questions, was developed as the primary data collection instrument. The questionnaire was designed to quantitatively capture perspectives across five key domains, all measured using a standardized 5-point Likert scale (from 1=Strongly Disagree to 5=Strongly Agree):

**Section A:** Awareness and Knowledge of climate change impacts, causes, and technological solutions.

**Section B:** Attitudes towards the role of technology in climate action.

**Section C:** Perceptions of barriers hindering the adoption of climate-friendly technologies.

**Section D:** Agreement on the potential of specific low-carbon technologies to contribute to climate goals.

**Section E:** Willingness to Engage in future climate initiatives, and the influence of key drivers and supports.

This uniform scaling allows for comparative analysis across constructs and facilitates robust statistical testing.

### **Validity and Reliability**

To ensure the instrument's rigour, a multi-stage validation process was undertaken. Content validity was established through review by three subject matter experts (PhDs with over 15 years of combined research experience in climate change and technology). They assessed the questionnaire for clarity, relevance, and comprehensiveness in representing the target constructs. Their feedback led to minor refinements in wording for improved precision.

Subsequently, face validity was assessed through cognitive interviews with five (5) computer science lecturers who were not part of the final sample. They evaluated the questionnaire for structure, flow, readability, and completion time. Their input was used to enhance the overall clarity and user-friendliness of the final instrument.

### **Data Collection Procedure**

Upon receiving ethical approval, data collection was conducted over a four-week period. A hybrid distribution strategy was employed to maximize the response rate. Initially, participants were contacted via email with a link to the online questionnaire. For a subset of the sample, where feasible, in-person visits were made to university campuses to briefly introduce the study and establish rapport, though the primary mode of data collection remained the online questionnaire.

A systematic follow-up protocol was executed one week after the initial contact, involving reminder emails and, where possible, phone calls to non-respondents. The online survey portal was deactivated after the four-week window, concluding the data collection phase.

### **Data Analysis**

Quantitative data analysis was performed using the IBM Statistical Package for the Social Sciences (SPSS version 28). The dataset was first screened for missing values, outliers, and adherence to statistical test assumptions. Descriptive statistics (frequencies, percentages, means, standard deviations) were computed to summarize the sample characteristics and responses to the Likert-scale items.

For inferential analysis, non-parametric tests were deemed appropriate for the ordinal data from the Likert scales. Spearman's rank-order correlation was used to examine the strength and direction of relationships between key ordinal variables (e.g., between awareness levels and willingness to engage). The analysis was conducted with a significance level ( $\alpha$ ) set at 0.05.

## Ethical Considerations

All participants were provided with a participant information sheet detailing the study's purpose, procedures, and their rights. Informed consent was obtained electronically prior to commencing the questionnaire. Anonymity and confidentiality were guaranteed; all identifying information was removed prior to analysis, and data were stored securely on password-protected servers in accordance with institutional data retention policies, which mandate destruction after five years. Participants were informed of their right to withdraw at any time without penalty.

## RESULTS AND DISCUSSION

### Data Collection Response Rate

The targeted sample size was predetermined to be 50 respondents. Ultimately, a total of 60 complete and valid responses were received. The apparent response rate exceeding 100% is attributed to the snowball sampling effect, where initial recipients proactively shared the survey within their professional networks. While it is expected that the random sampling component will enhance representativeness, the snowball sampling component may introduce selection bias, though eligibility criteria were strictly enforced and the same instrument is used for all participant.

This high level of engagement underscores the salience of the research topic within the community.

To assess potential non-response bias, a comparative analysis was conducted between early and late respondents (a standard proxy for non-respondents) on key demographic variables, including professional designation (academic vs. non-academic) and years of experience [1, 2]. Independent samples t-tests (for continuous variables) and chi-square tests (for categorical variables) revealed no statistically significant differences ( $p < 0.05$ ), suggesting that the obtained sample is representative of the target population and that non-response bias is not a primary concern for this study.

### Demographic Profile of Respondents

The demographic characteristics of the respondents (N=60) are summarized in Table 1. The profile encompasses key variables including gender, field of expertise, professional designation. The distribution of participants' years of experience, which showed considerable range, is presented in detail in Table 2. This distribution is critical for contextualizing the study's findings and understanding the sample's composition.

**Table 1. Demographic Profile of Survey Respondents (N=60)**

Variable	Category	Frequency	Percentage
Gender	Male	33	55.0%
	Female	27	45.0%
Field of Expertise	AI/ML	24	40.0%
	Software Engineering	12	20.0%
	Web Design	07	11.7%
	Others	17	28.3%
Professional Designation	Academics/ Researcher	25	41.6%
	Industry Professional	35	58.3%

As illustrated in Table 1, the sample comprised a mix of academic (41.6%) and industry (58.3%) professionals, ensuring a balance between theoretical and applied perspectives. The field of AI/ML (40.0%) was predominant, reflecting the current focus of computational approaches to climate challenges. A gender distribution of 55% male and 45% female was observed. While this indicates a deviation from perfect parity, it is a notably more balanced representation than the broader computer science workforce. Historically, technology-driven domains such as engineering, computing, and environmental modeling have been male-dominated due to entrenched gender norms, differential access to STEM education, and occupational segmentation (UNESCO, 2023). However, the relatively small gender gap in this dataset suggests a positive shift toward gender inclusivity, as more women increasingly participate in climate technology, sustainability research, and digital innovation initiatives (UNESCO, 2024).

**Table 2: Distribution of Respondents by Years of Experience**

Years of Experience	Frequency (n)	Percentage (%)
0-5	15	25.0%
6-10	18	30.0%
11-15	12	20.0%
16- 20	07	11.7%
>20	08	13.3%

The distribution of professional experience among respondents, detailed in Table 2, and depicted by the bar chart in Figure 2, indicates a highly varied and seasoned cohort. The years of experience range from 0 to 35, demonstrating a wide spectrum of perspectives from early-career to veteran professionals. A significant portion of the sample possesses substantial experience, with many respondents reporting ten (10) or more years in the field. This depth and diversity of expertise enhance the credibility of the collected data, as the findings are informed by professionals with extensive, hands-on understanding of the intersection between computer science and climate action.

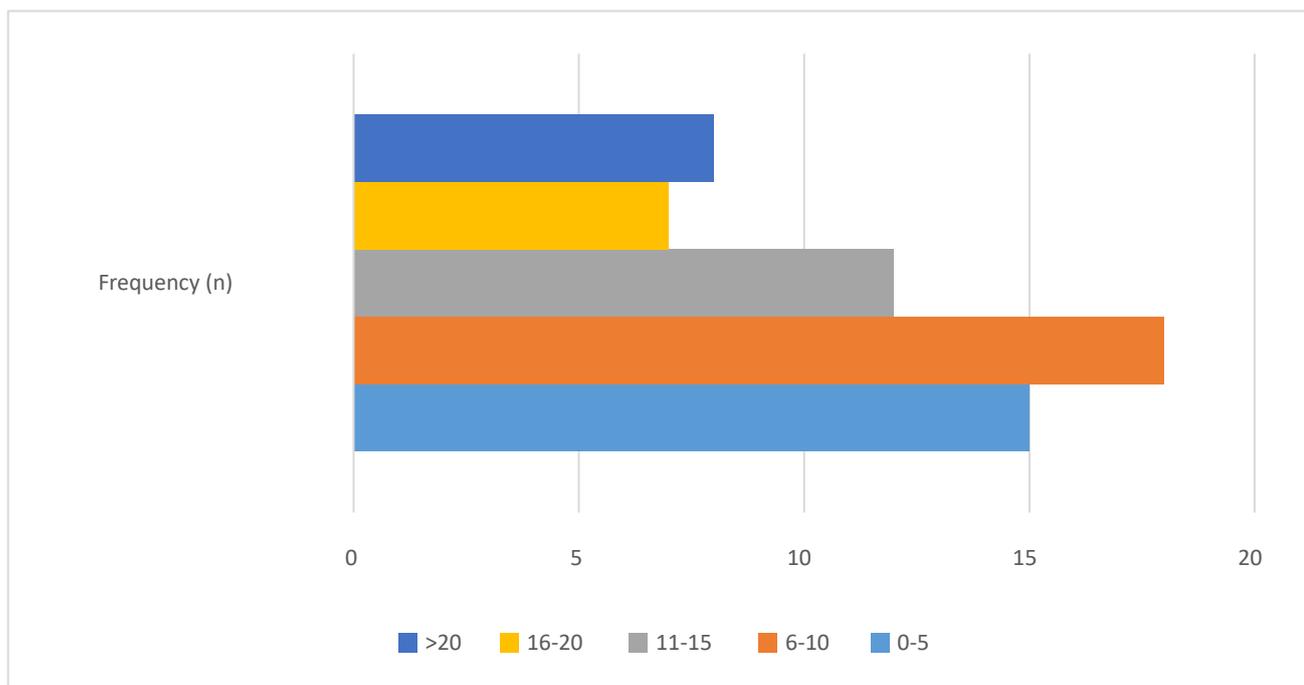


Figure 2: Bar Chart showing the Years of Experience in Field distribution of respondents

## Awareness of Climate Change

To gauge the foundational understanding of the respondents, the survey assessed respondents' awareness of climate change itself, including its causes, impacts, and the potential role of technology. The results indicate a generally high level of awareness among computer science professionals.

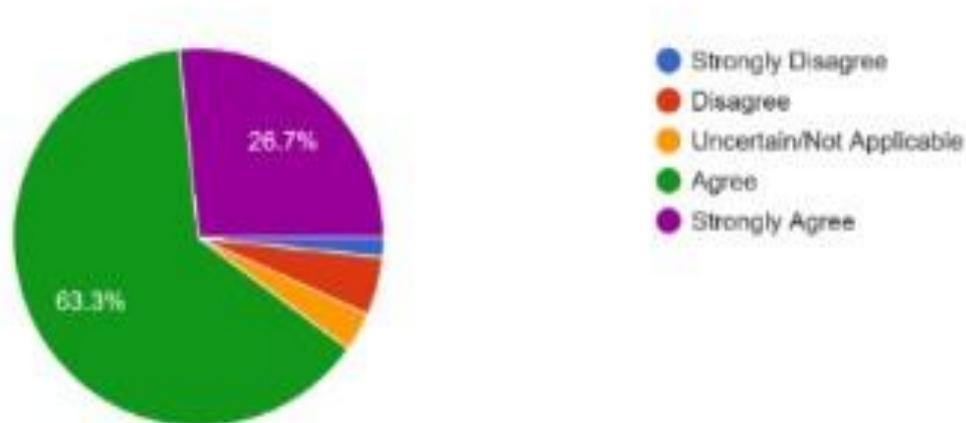
As depicted in Figure 3, a strong majority of respondents (63.3%) reported a high level of knowledge about climate change and its causes. Furthermore, they expressed considerable familiarity with the general ways technology can aid in climate mitigation and adaptation (65% agreement), demonstrating a clear understanding of the interconnection between their field and the climate challenge (60% agreement).

However, this confidence did not extend to more specific or emerging areas of the field. Respondents were less certain about their knowledge of emerging low-carbon technologies, with only half (50%) feeling their knowledge was up-to-date. Similarly, just over half (53.3%) felt well-informed about the latest developments in climate technology. This gap is compounded by a notable uncertainty regarding the reliability of their information sources, with only 45% expressing confidence in them.

Summarily, while a solid foundational awareness of climate change and technology's broad role exists, the findings point to a need for more accessible, up-to-date information on specific technological advancements and reliable channels for ongoing knowledge.

I have a high level of knowledge about climate change and its causes.

60 responses



**Figure 3: Pie chart showing the measure of Awareness and Understanding**

## Attitudes towards Technology's Role

The survey also measured attitudes toward technology's role in climate action, revealing strongly positive and supportive views among respondents.

As shown in Figure 4, the findings show an overwhelming consensus that technology can play a major role in addressing climate change, reflecting a high degree of optimism and confidence in its potential. This conviction is coupled with a strong belief in the critical importance of technology expertise for driving climate initiatives forward.

Crucially, this is not seen as an abstract concept; a majority of respondents strongly felt that addressing climate change is a direct part of their professional responsibilities within the technology sector. This indicates a sense of personal commitment and a view of themselves as active agents in developing solutions, underscoring a readiness to integrate climate action into their work.

I strongly agree that technology can play a major role in addressing climate change.

46 responses

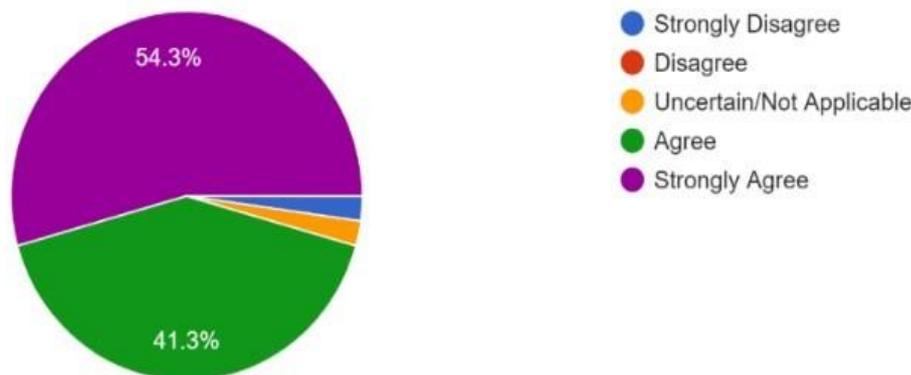


Figure 4: Pie chart showing the measure of Attitudes and Belief of respondents

### Perceptions of Technological Solutions

Respondents' perceptions of technological solutions were gauged using a five-point Likert scale, assessing their awareness, interest, confidence, and optimism. The results, summarized in Table 3, reveal strong overall optimism. An overwhelming majority (88.3%) agreed or strongly agreed that emerging technologies could be "transformational," and a similar proportion (88.4%) affirmed that technology will play a "large role in climate change response."

Slightly lower, though still substantial, levels of agreement were observed for the effectiveness of "specific low carbon technologies" (83.3% agree/strongly agree) and the potential of "different technologies" in general (75% agree/strongly agree). This gradation suggests that while faith in the overarching role of technology is high, confidence becomes somewhat more tempered when considering specific, established technological pathways.

Table 3: Table showing the perceptions of technological solutions of respondents

Statement	Strongly Disagree	Disagree	Uncertain/Not Applicable	Agree	Strongly Agree
I think different technologies show very promising potential for climate goals.	2 (3.3%)	4 (6.7%)	9 (15%)	34 (56.7%)	11 (18.3%)
I think specific low-carbon technologies will be highly effective.	0 (0%)	3 (5%)	7 (11.7%)	33 (55%)	17 (28.3%)
I think certain emerging technologies could be transformational.	1 (1.7%)	0 (0%)	6 (10%)	26 (43.3%)	27 (45%)
I think technology will play a large role in climate change response.	3 (5%)	2 (3.3%)	2 (3.3%)	25 (41.7%)	28 (46.7%)

In general, the findings indicate a strong, positive perception of technology's potential, with the highest confidence reserved for its broad, transformative role.

## Barriers to Technology Adoption

To understand the challenges in implementing these technologies, respondents evaluated the significance of various barriers, including cost, infrastructure, knowledge, and regulatory issues. The results indicate a clear recognition of systemic hurdles, though a notable discrepancy exists between general and personal challenges.

The most significant barrier, agreed or strongly agreed upon by 73.9% of respondents, was the "significance of different barriers to mainstreaming climate-friendly technologies." This suggests a widespread perception of formidable systemic obstacles. In contrast, the statement regarding personal experience "I have encountered many difficulties in implementing climate tech solutions" was the least agreed-with item, with only 34.8% in agreement. This divergence implies that respondents are more acutely aware of the general, macro-level barriers to adoption than they are of having faced directly prohibitive challenges in their own specific contexts.

## Hypothesis Testing

This study tested four sequential hypotheses concerning the perceptions and behaviors of computer science professionals regarding technology and climate action. The correlation and regression analysis of the sample data supported all the four hypotheses, revealing a clear psychosocial pathway from awareness to action.

## Hypotheses and Integrated Findings

- **Hypothesis 1 posited a positive correlation between climate change awareness and positive attitudes toward technology's role.** This was strongly supported. The analysis confirmed that professionals with a higher awareness of climate implications held significantly more positive attitudes. They demonstrated greater recognition of technology's potential to mitigate emissions and enhance adaptation, alongside stronger interest and confidence in developing technological solutions.
- **Hypothesis 2 proposed a significant relationship between these attitudes and the perception of barriers to adoption.** This relationship was also confirmed. Attitudes toward technology's role were significantly influenced by perceived obstacles. Respondents who identified severe barriers such as financial constraints, inadequate infrastructure, insufficient policy support, and limited technical knowledge were notably less optimistic about the feasibility and effectiveness of technological climate solutions.
- **Hypothesis 3 stated a strong association between these perceived barriers and the willingness to engage in sustainable practices.** The analysis supported this link, indicating that perceived barriers are a critical moderating factor. Professionals who viewed the adoption barriers as more severe reported lower levels of willingness to engage in climate-conscious development, adopt climate-friendly technologies, or participate in sustainability initiatives.
- **Hypothesis 4 predicted a positive correlation between this willingness and actual involvement in sustainable activities.** This final link in the chain was confirmed. A strong positive correlation was found between expressed willingness and reported action. Respondents with higher willingness were significantly more likely to be involved in activities such as using renewable energy, implementing energy-efficient systems, and advocating for sustainable policies.

These findings illustrate a coherent model. Awareness fosters positive attitudes, but these attitudes are tempered by perceived systemic barriers. The weight of these barriers, in turn, directly impacts the professional's willingness to act, which is the strongest predictor of their actual involvement in sustainability practices. This underscores that while cultivating awareness is crucial, overcoming practical implementation barriers is equally critical for translating positive attitudes into concrete climate action.

## Additional Qualitative Findings

In addition to the quantitative data, open-ended survey responses provided valuable contextual insights into the perspectives of computer science professionals. The analysis of these qualitative comments revealed several emergent themes that complement the statistical findings.

**Acknowledgment of Anthropogenic Climate Change:** Respondents explicitly recognized the human role in climate change, with one noting that "human activities can change the climate." This aligns with the scientific consensus and underscores a foundational awareness among participants.

**The Need for Awareness and Education:** The concept of "enlightenment" was raised, suggesting a perceived need for broader awareness campaigns and educational initiatives about both climate change and the specific technological solutions available.

**Skill Development for Sustainability:** A direct call to "improve technology skills for environmental benefits" highlights a gap and an opportunity. This points to a desire for targeted education and training that equips professionals to apply their expertise directly to environmental challenges.

**Anticipation of Practical Impact:** Respondents expressed optimism about the potential for impact, with one stating the project "will seriously help in the area of climatic conditions." This indicates a belief in the practical applicability and relevance of the research focus.

Collectively, these responses enrich the quantitative data by highlighting a strong undercurrent of recognition for the problem, a clear demand for more education and skills, and a belief in the potential for meaningful action.

## Summary of Key Findings

The key findings of this study are summarized below across the core investigative themes.

**Awareness and Understanding:** Respondents demonstrated a high self-reported awareness of climate change and technology's potential, with 63.3% to 71.7% agreeing or strongly agreeing with related statements.

**Attitudes and Beliefs:** The survey revealed a profound sense of optimism and responsibility among respondents. There was near-universal consensus (93.3%) on technology's major role in combating climate change, coupled with a strong belief (88.3%) in the importance of their own professional expertise for these initiatives. This professional commitment is further nuanced, as a large majority (81.7% to 86.7%) recognized that their engagement is shaped by a range of influencing factors.

**Perceived Technological Solutions:** Perceptions of technological solutions were overwhelmingly positive, with confidence increasing as technologies became more specific or forward-looking. While 75% of respondents saw broad potential in different technologies, agreement rose for the high effectiveness of specific low-carbon technologies (83.3%) and peaked for the transformational potential of emerging technologies (88.3%). This optimism was capped by a near-unanimous consensus (88.4%) on technology's significant overall role in climate change response.

**Barriers to Adoption:** The survey revealed a clear recognition of both the impediments to climate technology and its potential solutions. While a large majority of respondents agreed on the significance of mainstreaming barriers (85%) and the pressing nature of associated challenges (78.3%), there was an even stronger consensus (90%) that specific policy interventions would be extremely effective in accelerating innovation.

**Engagement in Climate Action:** The survey revealed a strong potential for engagement, though current participation is moderate. While 53.3% of respondents reported past or potential future involvement in climate tech initiatives, an overwhelming majority (91.7%) identified specific factors that would encourage their participation. Notably, professional bodies were seen as highly impactful by 96.7% of respondents. Furthermore, 66.7% actively advocate for technology's role in climate action within their networks, and 86.7% highlighted collaboration and training as essential for building competency. The critical importance of ecosystem support was underscored by the near-universal agreement (98.3%) on the value of industry-academia partnerships for scaling innovations.

## Limitation of Study

The inclusion of snowball-sampled participants may decrease the sample's representativeness because respondents were selected in part through referral networks. Despite this drawback, a respectable degree of

representativeness was maintained because the snowball component made up a small proportion of the overall sample and was only utilized to augment the original random sample.

Also, this study used self-reported data, which could be skewed by recall and social desirability. Furthermore, the cross-sectional design limits the interpretation of causality and fails to record shifts in participants' perceptions over time.

In order to improve the robustness and generalizability of findings, future study may use longitudinal research designs and use objective data sources or mixed approaches.

## CONCLUSION AND RECOMMENDATIONS

This study successfully delineated the perceptions of computer science lecturers regarding technology's role in climate action. It revealed a cohort with high awareness and strong optimism about technological potential, particularly for renewable energy and data-driven solutions. However, this optimism is tempered by a clear recognition of significant barriers, with cost and infrastructure being predominant. A key finding is that professional willingness to contribute is driven more by internal motivation than external incentives, underscoring a deep-seated sense of responsibility.

### The findings yield several significant implications:

**For Policy and Strategy:** The results provide a critical evidence base for informed decision-making. Understanding which technologies professionals trust and what barriers they perceive allows policymakers and institutional leaders to craft more effective strategies and allocate resources efficiently.

**For Education and Training:** The identified knowledge and skill gaps present a direct mandate for curriculum developers and professional bodies. Targeted education and training initiatives are needed to equip the next generation of technologists with the specific competencies required for climate solution development.

**For Innovation and Collaboration:** The strong belief in technology's potential, coupled with the highlighted importance of internal drivers, is a powerful catalyst for innovation. This mindset can be harnessed to foster stronger cross-sector collaboration between the technology industry and environmental initiatives, accelerating the development and scaling of viable solutions.

Computer science professionals are not merely implementers but crucial stakeholders in the climate action ecosystem. By engaging their expertise, addressing the barriers they identify, and nurturing their intrinsic motivation, stakeholders can more effectively channel technological innovation toward achieving urgent climate mitigation and adaptation goals.

Universities and business could improve climate action through coordinated education, training, and skill development based on the study's conclusions. While business offers focused professional training and awareness initiatives, universities can incorporate sustainability and climate change into their courses. Mentorship, industry-academia collaborations, and professional networks that promote participation and knowledge sharing can all help to increase engagement. Through practical exposure and pilot projects, both sectors should encourage the use of low-carbon and developing technologies, while removing obstacles through supportive legislation and advocacy campaigns. Together, these actions will increase capacity, encourage participation, and convert professional optimism and awareness into significant climate action.

## REFERENCES

1. Anderson J.T., Guo Z., You Y., Gasparini A., Overstreet C.H., Feng Z., et al. (2020). Potential impact of projected future climate extremes on major crop production in the United States. *Science Advances*, 6(1), eaav3312.
2. Murray, C.J.L., A.D. Lopez, K. A. GBD 2010 collaborators. (2020). Global burden of diseases injuries and risk factors study 2010 (GBD 2010): results from a comprehensive assessment of over 200 conditions. *Lancet*, 376(9741), 2141–2151.
3. Fagodiya, O. S., Owolabi, O. E., & Olanrewaju, G. O. (2023). A review of greenhouse gas emissions and the role of renewable energy for sustainable development in Africa. *Sustainability*, 15(3), 1422.

4. Intergovernmental Panel on Climate Change (IPCC). (2021). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S. B. Gulev, L. Mundywiler, T. Andrews, M. Drögemeyer, et al. (Eds.)]. Cambridge University Press.
5. Leal F. W., Azul, A. M., Neiva, F., & Azeiteiro, U. M. (Eds.). (2021). *Climate Change Risks and Adaptation Strategies for Different Landscapes*. Springer, Cham.
6. Mathison, C., Burke, E. J., Munday, G., Jones, C. D., Smith, C. J., Steinert, N. J., Wiltshire, A. J., Huntingford, C., Kovacs, E., Gohar, L. K., Varney, R. M., & McNeill, D. (2025). A rapid-application emissions-to-impacts tool for scenario assessment: Probabilistic Regional Impacts from Model patterns and Emissions (PRIME). *Geoscientific Model Development*, 18(17), 1785–1808. <https://doi.org/10.5194/gmd-18-1785-2025>
7. Michel, D., Ablain, M. K., & Havet, I. (2021). Indicators to Monitor Climate Change. In Leal Filho, W., Azul, A. M., Neiva, F., & Azeiteiro, U. M. (Eds.), *Climate Change Risks and Adaptation Strategies for Different Landscapes* (pp. 203-225). Springer, Cham.
8. National Oceanic and Atmospheric Administration (NOAA). (2020). Ocean Acidification. <https://www.noaa.gov/ocean-acidification>
9. National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI). (2020, August 4). What is the difference between weather and climate?
10. Neil C. et al. (2023). *The Cambridge dictionary*
11. Olabi, A. G., Wilberforce, T., Ramadan, M., & Al-Sagheer, A. H. (2022). Renewable energy and climate change: a review. *Renewable and Sustainable Energy Reviews*, 156, 114193.
12. Rooney-Varga J. N., Florian K., John D. Sterman, A. P. Jones, M. P., & Kenneth R. (2020). "The climate action simulation." *Simulation & Gaming* 51(2),114-140.
13. Santra, P. (2019). Climate change and its impacts on ecosystems and agriculture of India. *Climate Change and Environmental Security in South Asia*, 11.
14. Srivastav, C. S., Gupta, S. K., & Kumar, S. (2020). Climate-smart agriculture for sustainable agri- food systems in South Asia. *Singapore Journal of Tropical Geography*, 41(3), 423-447.
15. Strassburg, B. B., Beyer, H. L., Mooney, A., Pellegrini, T., Balmford, A., Creedon, E. M., ... & Young, L. (2020). Global conservation land targets are feasible but require bolder measures. *Science*, 370(6515), eabc5988.
16. Stoll, C., Klawitter, A., & Wachsmuth, G. (2019). The carbon footprint of Bitcoin. *Joule*, 3(7), 11647-1662.
17. Suman, A. (2021). "Role of renewable energy technologies in climate change adaptation and mitigation: A brief review from Nepal." *Renewable and Sustainable Energy Reviews* 151 111524.
18. UNESCO. (2023, November). UNESCO in action for gender equality: solutions and statistics. <https://unesco.se/wpcontent/uploads/2023/11/UNESCO-in-Action-for-Gender-Equality.pdf>
19. UNESCO. (2024, October). "Changing the Equation": A report on gender disparities in STEM occupations in G20 countries. [https://articles.unesco.org/sites/default/files/medias/fichiers/2024/10/PR\\_G20\\_UNESCO\\_calls\\_for\\_great\\_gender\\_equality\\_in\\_science\\_en.pdf](https://articles.unesco.org/sites/default/files/medias/fichiers/2024/10/PR_G20_UNESCO_calls_for_great_gender_equality_in_science_en.pdf)
20. UN Inter-agency Task on Financing for Development. (2019). *Technology roadmap for financing the Sustainable Development Goals*. United Nations. [UN Inter-agency Task on Financing for Development, 2019]
21. United Nations Development Programme (UNDP). (2023). *Climate Action* <https://www.undp.org/eurasia/ourfocus/environment>
22. World Meteorological Organization (WMO). (2025). *State of the Climate in 2025* [https://library.wmo.int/doc\\_num.php?explnum\\_id=11178](https://library.wmo.int/doc_num.php?explnum_id=11178)
23. Xiang, K., Ding, J., Yang, H., & Wang, Z. (2021). A review of performance evaluation methods for urban water management systems. *Environmental Science and Pollution Research*, 28(32), 45503-45523.
24. Vlasceanu, M., Santos, L. R., Bain, P. G., Becker, J., Bernhard, R., Bigman, Y. E., ... & Muthukrishna, M. (2024). Addressing climate change with behavioral science: Global evidence on the effectiveness of 11 interventions.
25. *Nature Human Behaviour*, 8(5), 1012–1026. <https://doi.org/10.1038/s41562-024-01973-6>

26. Zhao, X., Chen, Q., & Li, M. (2025). Artificial intelligence in energy and climate modelling: Advances, challenges, and future directions. *Applied Energy*, 358, 122415.  
<https://doi.org/10.1016/j.apenergy.2025.122415>