



Article

Climate Change Awareness and Mitigation Strategies among Students and Residents of Bulacan, Philippines: A Socio-Educational Perspective

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Abstract

This study assessed climate change awareness, accessibility to climate information, and knowledge of mitigation strategies among students and residents in selected municipalities of Bulacan. Using a descriptive quantitative design, data were gathered from 1,601 students of Bulacan State University–Bustos Campus (during 2nd semester of 2023–2024) and 214 residents. Respondents were selected through random and voluntary sampling using a Google Form-based survey. Results revealed no significant differences based on gender, area of residence, and family income of the respondents. However, significant differences were observed among students in terms of climate change awareness, accessibility to information, and mitigation strategies. Among residents, only accessibility to information showed significant differences; awareness and mitigation strategies did not. Both groups were generally aware of climate change and its mitigation, with moderate access to information. Given the disparities in information accessibility, the study recommends continued integration of climate-related topics in the curriculum and strengthening extension programs to improve public awareness and response to climate issues in Bulacan.

Keywords: Awareness, Climate Change, Information, Mitigation

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Introduction

Climate change is one of the most complex, urgent, and pressing challenges confronting humanity in the 21st century. It has become a significant threat to international peace, public health, and global stability—disrupting ecosystems, exacerbating socio-economic inequalities, and increasing the frequency and severity of natural disasters (IPCC, 2023). It is the defining crisis of our time, happening even more quickly than we feared (UN, 2020). Defined by long-term shifts in temperature, precipitation, and other atmospheric conditions, climate change is driven primarily by human activities such as the burning of fossil fuels, deforestation, and industrial agriculture (Abbass et al., 2024; UN, 2024).

The world is now warming faster than at any point in recorded history. Warmer temperatures over time are changing weather patterns and disrupting the usual balance of nature. This poses many risks to humans and all other life forms on Earth. The effects of climate change heighten competition for resources such as land, food, and water, fueling socio-economic tensions and, increasingly often, leading to mass displacement. Among the most important effects of climate change are hotter temperatures, more severe storms, increased drought, warming, rising oceans, loss of species, insufficient food, more health risks, poverty, and displacement (UN 2024).

The primary driver of climate change is the increase in greenhouse gas (GHG) emissions, most notably carbon dioxide, methane, and nitrous oxide. These gases are produced mainly by burning fossil fuels for energy and transportation, deforestation, and industrial agriculture (UNEP, 2024). Everyday human activities—how people consume energy, travel, produce food, and manage waste—contribute to the steady buildup of these gases in the atmosphere. Alarmingly, studies have shown that a significant portion of emissions comes from individual consumption and household behavior, especially in wealthier nations and communities (UNDP, 2024).

Climate change does not affect all communities equally. Vulnerable populations—especially in developing countries like the Philippines—are more likely to suffer from its impacts due to limited adaptive capacity and resource access. The variability of rainfall caused by climate change has significantly impacted the country, especially in the agriculture sector. The study of Agbay, V. C. A., Sanchez, P. A. J., Camus, D. R. D., Aquino-Cando, J. O., Barroga, E. M. N., & Velasco, A. B. (2023) stated that local farmers from Angat, Bulacan, Philippines had been affected by drought causing their crop production decreased for more than 50% of their usual harvest. Most farmers have experienced the effects of floods, especially those near the Angat River, where overland flow occurs. Aside from damaged infrastructures and

properties, they also experienced water-borne diseases like diarrhea and skin infections.

In this context, education serves as a transformative force and can be a powerful tool in addressing and enabling effective adaptation to climate change. Higher education institutions (HEIs) are uniquely positioned to shape environmentally literate and socially responsible citizens through curriculum development, community outreach, and research initiatives (Feinstein & Mach, 2019). Education plays an important role in changing people's behavior, values, and attitudes. Young people in the classrooms can learn about the impacts of climate change and how to mitigate and adapt to it. They can be motivated to act and support environmental sustainability (UNESCO, 2022). Universities can serve as innovation hubs—generating knowledge, piloting solutions, and disseminating climate adaptation strategies to the students and nearby communities. As Rosales (2024) mentioned in his study, the curriculum will impart knowledge about climate change and foster a sense of responsibility and stewardship among students.

Everyone, especially college students, has a role and part to play in the fight against climate change. Many young adults nationwide want to get involved but do not know how (American Forests, 2020). Students, in particular, play a vital role in this transformative process. They can be part of the solutions to reducing greenhouse gas emissions. They are the ones who can tell people in the community about the technologies that would reduce the number of greenhouse gases being added to the atmosphere, actions to be taken to save energy and slow climate change and explore ways people can prepare for climate change (Agboola and Emmanuel, 2016). As future leaders and active members of society, they can advocate for sustainability, model responsible behavior, and influence community action (American Forests, 2020). However, meaningful participation requires that students and residents alike be equipped with adequate awareness, accurate accessibility to information from different sources, and practical knowledge of climate change mitigation and adaptation strategies. As Agboola and Emmanuel (2016) emphasized, fostering climate literacy at the grassroots level enhances the capacity for collective climate action.

Most importantly, the issue of climate change calls upon governments, global citizens, and international organizations to take urgent and meaningful research and actions to mitigate the risk of climate challenges, encouraging stakeholders to collaborate and proactively on mitigation and adaptation programs (South Asia Disasters, 2024).

This study was conducted to evaluate the climate change awareness of students from Bulacan State University–Bustos Campus and residents from selected municipalities in Bulacan, Philippines. It aims to determine their level of access to climate-related information and identify the mitigation practices they are familiar with or currently applying. By evaluating these factors, the research intends to inform the development and integration of responsive climate change educational programs, extension activities, and community-based interventions. Ultimately, the research aspires to cultivate and build more informed and proactive citizens, supporting local sustainability and global environmental goals. Educating the students and the residents through assessment of their climate change awareness, investigating their access to information on climate change, and identifying and developing mitigation and adaptation strategies in coping with climate change is very timely and vital to make the students and the community where they are living more informed in decisions making sustainable changes in the behavior and lifestyle.

It is our planet, and while we recognize that it is currently in crisis, we also understand that viable solutions are within reach. Significant progress is already underway, including the expansion of green energy and the strengthening of food security. The benefits of these efforts are evident in creating green jobs, improving air quality, and developing more resilient and sustainable economies (United Nations, 2024).

Methodology

This study employed descriptive quantitative research design. Descriptive research can be quantitative, as it involves collecting numerical data to statistically analyze a population sample's characteristics. Such data helps reveal patterns, relationships, and trends over time and are commonly gathered using tools such as surveys, polls, and experiments (Heath, 2023).

This research aimed to assess the level of climate change awareness and determine the influence of variables such as family monthly income, gender, and area of residence among students of Bulacan State University–Bustos Campus and residents from selected municipalities of Bulacan. The study also examined the accessibility of climate change-related information and evaluated the respondents' knowledge of mitigation strategies to identify areas for development to strengthen adaptation and coping mechanisms in response to climate change.

The respondents of the study included 1,601 students enrolled at Bulacan State University–Bustos Campus during the second semester of the academic year 2023–2024 and 214 residents from selected municipalities in Bulacan province. The student

was drawn from ten academic programs, namely: Bachelor of Elementary Education (BEEd), Bachelor of Secondary Education (BSEd), Bachelor of Technology and Livelihood Education (BTLEd), Bachelor of Physical Education (BPEd), Bachelor of Science in Information Technology (BSIT), Bachelor of Industrial Technology (BIT), Bachelor of Science in Computer Engineering (BSCE), Bachelor of Science in Industrial Engineering (BSIE), Bachelor of Science in Entrepreneurship (BSE), and Bachelor of Science in Business Administration (BSBA).

The community respondents resided in various municipalities of Bulacan, specifically Bustos, Baliwag, Angat, San Rafael, Pulilan, and Plaridel. A combination of random and voluntary sampling methods was employed to select both students and residents. Participation was facilitated through a Google Form-based survey.

To gather the necessary data, this study adapted validated instruments. The questionnaire developed by Agboola and Emmanuel (2016) on Awareness of Climate Change and Sustainable Development among Undergraduates from two selected universities in Oyo State, Nigeria, served as a model for assessing climate change awareness, access to climate change information, and knowledge of mitigation strategies among the respondents.

The questionnaire consisted of 25 items related to the concept of climate change and 17 items pertaining to sources of climate-related information. To further assess mitigation-related knowledge and perceptions, this study also utilized a validated instrument from Pitpitunge (2013) titled Students' Perceptions about Climate Change, which included 15 statements focusing on strategies to mitigate the effects of climate change.

The data collected on climate change awareness and mitigation strategy knowledge were analyzed using frequency counts and mean scores based on a 5-point Likert scale. The descriptive statistical results were summarized and interpreted according to predefined scale descriptions presented in Table 1.

Table 1. Level of Climate Change Awareness

Scale	Range	Description
5	4.51- 5.00	Very Aware
4	3.51- 4.50	Aware
3	2.51-3.50	Moderately Aware
2	1.51- 2.50	Less Aware
1	1.0-1.50	Not Aware

Accessibility to sources of information on climate change was analyzed using frequency and mean statistics based on responses collected through a 5-point Likert scale, as shown in Table 2.

Table 1. Level of Climate Change Awareness

Scale	Range	Description
5	4.51- 5.00	Very accessible
4	3.51- 4.50	Accessible
3	2.51-3.50	Moderately Accessible
2	1.51- 2.50	Poorly accessible
1	1.0-1.50	Not accessible

The Independent Samples t-test was employed to determine whether there were statistically significant differences between two unrelated groups—in this case, the respondents' gender and area of residence—in relation to their climate change awareness, knowledge of mitigation strategies, and access to information.

In addition, a One-Way Analysis of Variance (ANOVA) was utilized to compare the means of more than two independent groups to determine significant differences. Specifically, the ANOVA was applied to examine whether respondents' family monthly income, as well as the academic programs of students and the municipalities of the residents, were significantly associated with variations in climate change awareness, accessibility to climate information, and familiarity with mitigation strategies. These statistical analyses helped identify group-based disparities in the key variables under study across the selected population in Bulacan, Philippines.

Results and Discussion

The following tables present the mean results obtained from respondents regarding climate change awareness, accessibility to climate change information, and awareness of mitigation strategies.

Table 3 assessed the level of climate change awareness among BulSU-Bustos students. The grand mean of 4.44 indicated that the students were generally "Aware" of climate change. Analyzing the mean scores across different academic programs revealed that BSEd students had the highest mean score of 4.56, while BIT students had the lowest mean score of 4.24 on climate change awareness. Students were considered "Very Aware" of key survey items, such as the fact that climate change is happening, that they are already experiencing its impacts, and that it requires immediate and urgent attention. Additionally, they recognized that climate change

poses a threat to sustainable development and contributes to increasing surface temperatures.

Table 3. Students Awareness on Climate Change

Rank	Program	Mean Score	Interpretation
1	BSED (Secondary Ed.)	4.56	Very Aware
2	BPED (Physical Ed.)	4.54	Very Aware
3.5	BS Entrepreneurship	4.49	Aware
3.5	BSBA (Business Admin)	4.49	Aware
5.5	BEED (Elementary Ed.)	4.43	Aware
5.5	BTLED (Tech-Livelihood)	4.43	Aware
5.5	BSCPE (Comp. Eng'g)	4.43	Aware
5.5	BSIE (Ind'l Eng'g.)	4.43	Aware
9	BSIT (Info Tech)	4.37	Aware
10	BIT (Ind'l Tech)	4.24	Aware

Table 4 assessed the climate change awareness of residents in selected municipalities of Bulacan. The grand mean of 4.38 indicated that residents were generally “Aware” of climate change issues. Analyzing the mean scores across municipalities, it was found that residents of Pulilan had the highest mean score of 4.50, while residents of Bustos had the lowest mean score of 4.25 on climate change awareness.

The survey results showed that residents were “Very Aware” of several key points: climate change is occurring; they are already experiencing its impacts and there is an urgent need for immediate action; climate change poses a threat to sustainable development and contributes to rising surface temperatures; and climate change increases the intensity of extreme weather events such as heat waves, tornadoes, hurricanes, and heavy rainfall.

Table 4. Residents by Municipality Awareness on Climate Change Awareness

Rank	Municipality	Mean Score	Interpretation
1	Pulilan	4.50	Very Aware
2	San Rafael	4.42	Aware
3	Plaridel	4.41	Aware
4	Angat	4.36	Aware
5	Baliwag	4.33	Aware
6	Bustos	4.25	Aware

The students and residents in the nearby municipalities accessed four main sources of information on climate change: Education, Media and Home, Seminars and

Workshops, and Information Technology. Table 5 presents the accessibility of these information sources specifically for the students.

Table 5. Accessibility of the Students to Climate Change Information

Rank	Program	Mean Score	Interpretation
1	BPED (Physical Ed.)	3.55	Accessible
2.5	BSED (Secondary Ed.)	3.43	Accessible
2.5	BSBA (Business Admin)	3.43	Accessible
4	BEED (Elementary Ed.)	3.38	Moderately Accessible
5	BS Entrepreneurship	3.34	Moderately Accessible
6	BTLED (Tech-Livelihood)	3.29	Moderately Accessible
7	BSIT (Info Tech)	3.28	Moderately Accessible
8.5	BSIE (Ind'l Ed.)	3.30	Moderately Accessible
8.5	BSCPE (Comp. Eng'g)	3.30	Moderately Accessible
10	BIT (Ind'l Tech)	3.22	Moderately Accessible

The overall mean of 3.35 indicated that students could “Moderately Access” information on climate change from the four identified sources. This suggests that while students gained knowledge about climate change, the extent of their access was moderate. Analysis of the survey responses showed that documentaries on television and information from the Internet and World Wide Web received the highest mean scores, with 3.52 and 3.58, respectively, both described as “Accessible.” Conversely, the lowest mean scores were recorded for school pamphlets and reading materials, seminars/workshops, and excursions/field trips among students from different programs. Among the programs, BPED students had the highest mean score of 3.55, classified as “Accessible,” while BIT students had the lowest mean score of 3.22, described as “Moderately Accessible.”

On the other hand, Table 6 presents the accessibility of climate change information sources among residents in selected municipalities. The grand mean of 3.38, also described as “Moderately Accessible,” indicates that residents accessed climate change information from various sources to a limited extent. The highest-rated sources were the Internet and World Wide Web, and multifunctional mobile phones, with mean scores of 3.55 and 3.51, respectively, both described as “Accessible.” The

lowest mean scores were from school pamphlets and reading materials, excursions/field trips, and seminars/workshops related to climate change issues.

Table 6. Accessibility of the Residents to Climate Change Information

Rank	Municipality	Mean Score	Interpretation
1	Pulilan	3.51	Accessible
2	Baliwag	3.42	Accessible
3	Plaridel	3.39	Moderately Accessible
4	San Rafael	3.37	Moderately Accessible
5	Angat	3.34	Moderately Accessible
6	Bustos	3.22	Moderately Accessible

It was found that residents of Pulilan municipality had the highest mean score of 3.51, while residents of Bustos municipality had the lowest mean score of 3.22 in terms of accessibility to climate change information.

BulSU-Bustos students were found to be “Very Aware” of the four key mitigation and adaptation strategies items in the survey questionnaire. These items included the role of tree planting in carbon dioxide sequestration, the contribution of recycling practices to mitigating climate change impacts, the reduction of harmful gases through recycling materials, and the avoidance of plastics by reusing bags and bottles. Additionally, students expressed being “Aware” of the remaining twenty-six items regarding mitigation and adaptation strategies.

The lowest mean scores among these strategies were related to the use of biofuels such as ethanol and other renewable energy alternatives (as outlined in RA 9367), the shift in livelihood from fishing to farming among people in coastal areas, awareness that certain paper products, like paper bags, do not produce greenhouse gases even when burned; recycling of materials that do not emit carbon dioxide; and the practice of placing endangered species in sanctuaries.

These five strategies represent areas that can serve as a foundation for developing more targeted activities to promote deeper insights and enhance students’ awareness on effective ways to mitigate climate change.

From Table 7, the grand mean of 4.35 indicated that students were generally “Aware” of mitigation and adaptation strategies for climate change. Students from the BSEd, BPED, and BSBA programs obtained the highest mean scores regarding their awareness of these strategies, while students from the BIT program recorded the lowest mean scores.

Table 7. *Awareness of the Students on Climate Change Mitigation Strategies*

Rank	Program	Mean Score	Interpretation
1	BSED (Secondary Ed.)	4.44	Very Aware
1	BPED (Physical Ed.)	4.44	Very Aware
1	BSBA (Business Admin)	4.44	Very Aware
4	BEED (Elementary Ed.)	4.38	Very Aware
5	BSIE (Ind'l Ed.)	4.36	Very Aware
5	BSCPE (Comp. Eng'g)	4.36	Very Aware
7	BSIT (Info Tech)	4.29	Very Aware
8	BTLED (Tech-Livelihood)	4.37	Very Aware
9	BS ENTREPRENEURSHIP	4.31	Very Aware
10	BIT (Ind'l Tech)	4.15	Aware

Table 8 presents the awareness of residents in the nearby municipalities concerning climate change mitigation and adaptation strategies. The grand mean of 4.28 signified that residents were “Aware” of the various strategies to cope with climate change. Analysis of the survey responses revealed that certain mitigation strategies received lower mean scores, including shifting livelihoods from fishing to farming for coastal communities; promotion by the Philippine government of biofuels like ethanol and other renewable energy sources and natural gas (RA 9367); understanding that recycled materials do not produce carbon dioxide; recognizing that paper products such as paper bags do not emit greenhouse gases even when burned; and the practice of collecting endangered species and placing them in sanctuaries.

Although these strategies were categorized as “Aware,” there is potential for further development through activities, seminars, and training to raise the residents’ level of understanding and engagement with mitigation efforts. Notably, only one item was rated “Very Aware”: the mitigation strategy involving tree planting activities that aid carbon dioxide sequestration. The remaining twenty-nine items received an “Aware” rating.

Table 8 also showed that residents of Pulilan municipality had the highest mean score regarding awareness of climate change mitigation strategies. In contrast, residents of Bustos municipality had the lowest mean score in this regard.

Table 8. *Awareness of the Residents on Climate Change Mitigation Strategies*

Rank	Municipality	Mean Score	Interpretation
1	Pulilan	4.48	Very Aware
2	San Rafael	4.33	Very Aware
3	Plaridel	4.32	Very Aware
4	Angat	4.28	Very Aware
5	Baliwag	4.18	Aware
6	Bustos	4.11	Aware

In this study, the gender of students from different programs and residents from nearby municipalities was assessed in relation to their awareness, mitigation practices, and sources of information on climate change using an independent samples t-test. This analysis aimed to determine whether there were significant differences based on gender in both groups (ASC, 2025). A p-value less than 0.05 from the t-test indicates statistical significance.

The results showed that the p-values for awareness, mitigation, and sources of information were 0.211, 0.067, and 0.235 respectively. Since all p-values exceeded the 0.05 threshold, it was concluded that there is no significant difference between males and females in both the student and resident groups regarding their climate change awareness, mitigation practices, and access to information.

Table 9. Significant Difference with respect to Gender of the Respondents

		Statistics	p
Awareness	Mann-Whitney U	135785	0.211
Mitigation	Mann-Whitney U	132852	0.067
Source of Information	Mann-Whitney U	136112	0.235

Note. $H_a \mu \text{Female} \neq \mu \text{Male}$

Table 10 shows the p-values obtained for respondents' area of residence (rural or urban) in relation to the variables studied, which were 0.052, 0.782, and 0.315, respectively. At the 0.05 level of significance, these results indicate that there is no significant difference based on area of residence among the respondents.

Table 10. Significant Difference with respect to Area of Residence

		Statistics	df	p
Awareness	Student's t	1.944	1067	0.052
Mitigation	Student's t	-0.277	1067	0.782
Source of Information	Student's t	1.006	1067	0.315

Note. $H_a \mu \text{Rural} \neq \mu \text{Urban}$

Table 11 assessed whether family monthly income had a significant effect on the climate change awareness of the respondents. The obtained p-values were 0.725, 0.734, and 0.716, all of which exceed the 0.05 level of significance. Therefore, it was concluded that family monthly income had no significant difference on the respondents' climate change awareness.

Table 11. Significant Difference with respect to Family Monthly Income

	F	df1	df2	p
Awareness	0.567	5	114	0.725
Mitigation	0.555	5	111	0.734
Source of Information	0.578	5	113	0.716

The students of BulSU-Bustos campus were enrolled in ten programs. Using One-Way Anova, the students were assessed in terms of their awareness to climate change, accessibility to climate change information and knowledge in mitigation strategies. Table 12 described the significant difference of the students with respect to the given areas. It was observed that with the p-value of 0.002 in awareness, <.001 in mitigation and 0.018 in source of information, all were below in the significant level of 0.05. Therefore, there is “Significant difference” among students under different programs.

Table 12. Significant Difference of the Students regarding awareness of climate change, access to information sources, and knowledge of mitigation strategies

	F	df1	df2	p
Awareness	3.13	9	144	0.002
Mitigation	5.99	9	143	<.001
Source of Information	2.32	9	143	0.018

Regarding the residents, Table 13 shows the p-values for the assessed mean scores on climate change awareness, mitigation, and sources of information across different municipalities. The results indicate that only accessibility to climate change information demonstrated a significant difference among residents from different municipalities. In contrast, no significant differences were observed in terms of awareness and mitigation practices among the residents.

Table 13. Significant Difference of the Residents regarding Awareness of Climate Change, Access to Climate Change information sources and knowledge of climate change mitigation strategies

	F	df1	df2	p
Awareness	1.72	5	445	0.128
Mitigation	1.88	5	446	0.096
Source of Information	3.05	5	444	0.010

Climate change and sustainability education should provide personally relevant and meaningful content, employing active and student-centered teaching approaches that empower children and young people. It should also incorporate

participatory and creative methods drawn from multiple disciplines, addressing the scientific, social, ethical, and political complexities involved (Rushton et al., 2023).

The concept of global citizenship education is defined as education that enables learners, regardless of age, to take active roles both locally and globally in building more secure, inclusive, nonviolent, and tolerant societies (Leite, 2022). Within university and community settings, a global citizen is expected to adopt educational approaches and initiatives that disseminate knowledge about the impacts of climate change. This encourages young people to develop the knowledge, skills, and values necessary to engage meaningfully with the world and contribute to a sustainable future for all.

Conclusion

This study revealed that both students of Bulacan State University–Bustos Campus and residents from selected municipalities of Bulacan are generally aware of climate change issues and the corresponding mitigation and adaptation strategies. Their access to climate change information is moderate, sourced from formal education, media, home discussions, seminars and workshops, and digital platforms.

No significant differences in climate change awareness, access to information, or mitigation strategies were observed based on gender, area of residence, or family monthly income from both students and residents. However, significant differences were found among students from different academic programs in terms of awareness, access to information, and mitigation strategies. Among residents, only access to information showed significant variation; awareness and mitigation practices were similar across groups.

In light of these findings, the study recommends continuous integration of climate change topics and mitigation strategies into academic curricula to strengthen students' awareness and understanding. It also encourages promoting digital literacy and expanding access to reliable climate change information through online platforms and social media for both schools and communities. Developing and facilitating community-based climate action projects—such as tree planting, waste reduction campaigns, recycling initiatives, energy efficiency programs, and creative activities like poster and slogan making—are highly encouraged. Extension programs and seminars focused on “Climate Change Awareness and Mitigation Strategies” should be implemented to enhance knowledge and active participation among students and residents. Lastly, similar studies should be conducted in other municipalities of Bulacan to gather broader insights for targeted interventions.

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Conflicts of Interests

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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