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ANALYSIS OF CLIMATE CHANGE AWARENESS AMONG STAFF OF JOSEPH SARWUAN TARKA UNIVERSITY, MAKURDI, BENUE STATE, NIGERIA

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## ABSTRACT

This study assessed climate change awareness among staff at Joseph Sarwuan Tarka University, Makurdi (JOSTUM), Nigeria, using a multistage sampling technique to collate responses from 104 staff across different university cores, Colleges, and Departments. Demographic results show that out of 104 respondents, 61.4% were male and 38.6% were female. The largest age group was 36 - 45 years (23.1%), followed by those aged 26 - 35 (19.2%), and 46 - 50 (21.2%). The majority were Christians (98.2%) and most were married (85.6%). Civil service was the predominant primary occupation (83.7%), while educational attainment was high, with 66.3% holding postgraduate degrees. Most respondents (80.8%) expressed awareness of climate change, though only a small fraction (9.6%) had received formal training on the subject. Awareness of climate change impacts varied, with 28.8% recognizing effects on health and 25.0% aware of broader environmental consequences, while many remained uncertain or unaware. Direct experiences with flood damage were reported by just 11.2% of staff. Multiple regression analysis showed that environmental and anthropogenic factors such as burning, deforestation, agricultural practices, and emissions from generators, industries, and vehicles significantly influenced climate change awareness among staff, explaining approximately 16% of the variance. Respondents perceived temperature changes (51.9%) and impacts on agriculture (33.7%) as the most significant local effects of climate change. While most staff viewed the university positively in promoting climate change awareness (96.7% agreement), formal initiatives and personal mitigation actions varied; tree planting (41.3%) and reducing energy consumption (31.7%) were the most practiced activities. Suggestions to enhance awareness emphasized education, seminars, environmental campaigns, and sustainable campus policies. The findings highlight the importance of expanding climate education and institutional engagement to strengthen understanding and action on climate change within the university community.

**Keywords:** Climate Change Awareness, Joseph Sarwuan Tarka University, Staff Perception, Environmental Impacts, Climate Change Mitigation

## INTRODUCTION

Climate change is widely recognized as an urgent and potentially irreversible threat to human societies and the planet (Sanson and Burke, 2019). It poses an existential threat to humanity, with far-reaching risks to ecosystems and human communities worldwide (Ali and Thakkar, 2023). The health effects of climate change are particularly concerning, as it impacts communicable diseases, heat stress, food and water security, extreme weather events, vulnerable shelter, and population migration (Costello et al., 2011). While climate change is a critical global issue, some researchers argue that developing countries face other immediate priorities affecting human welfare, such as hunger, malnutrition, poverty, and pressing local environmental issues (Munasinghe, 1998). This highlights the complex relationship between climate change and broader sustainable development goals. Additionally, the healthcare sector, while managing the health-related consequences of climate change, is itself a significant contributor to greenhouse gas emissions, responsible for up to 4.6% of global emissions (Tee et al., 2024).

Climate change is causing significant alterations to global weather patterns, resulting in more frequent and severe

extreme weather events, including prolonged droughts, intense rainfall, and shifting temperature regimes (Sarma et al., 2024). These changes have widespread impacts on various sectors, particularly agriculture, water resources, and human health.

In agriculture, climate change poses serious threats to food security, with extreme weather events reducing crop productivity worldwide (Alotaibi, 2023). Projections indicate that climate change, land conversion, and reduced water availability could substantially reduce food production in countries like China (Tong et al., 2016). Climate-resilient agriculture has emerged as a pivotal solution, involving strategies such as diversifying crop varieties, precision agriculture, and implementing soil conservation methods (Sarma et al., 2024).

Water resources are significantly affected by climate change, with projected changes in rainfall patterns and increased frequencies of droughts and floods in some areas (Tong et al., 2016). Extreme weather events can undermine stable drinking water supplies, exacerbating inequities in health and education, especially in marginalized populations (Wang et al., 2022). This highlights the need for innovative approaches to water treatment and management.

Human health is impacted both directly and indirectly by climate change. In the short term, population health is likely to be adversely affected by increases in air temperatures and pollution (Tong et al., 2016). Extreme heat events, particularly in urban areas, pose significant threats to public health, with vulnerable groups such as the elderly being predominantly affected (Mücke and Litvinovitch, 2020). In the longer term, indirect impacts such as changes in food and water availability, decreased mental health, and shifts in infectious disease patterns are expected to grow in importance (Butsch et al., 2023; Tong et al., 2016).

Public awareness and engagement regarding climate change are increasingly recognized as crucial factors for effective mitigation and adaptation efforts. Research indicates that understanding public perceptions and attitudes towards climate change is essential for developing successful policies and strategies to address this global challenge. Studies have shown that public attitudes toward climate change significantly influence climate and energy policies and guide individual mitigation and adaptation behaviors (Marlon et al., 2022). Over the past decade, as scientific certainty about the causes, impacts, and solutions to the climate crisis has increased, diverse policy strategies have been pursued at various levels of governance. However, public engagement and discussions on climate change remain limited (Romsdahl, 2020). Awareness plays a crucial role in addressing climate change, serving as a foundation for effective mitigation and adaptation strategies. Education, both formal and informal, enhances awareness by fostering critical thinking and promoting sustainable practices, equipping individuals with the knowledge and skills necessary to understand the complexities of climate change and engage in informed decision-making (Priatna and Khan, 2024). Universities play a crucial role in addressing climate change through education, research, and institutional actions. Climate change education (CCE) in higher education institutions (HEIs) is essential for raising awareness and preparing future leaders to tackle environmental challenges (Jeong et al., 2021; Priatna and Khan, 2024). Studies have shown that integrating climate change topics into curricula and supporting extracurricular activities can significantly improve students' awareness and willingness to engage in climate change teaching (Demaidi and Al-Sahili, 2021; Jeong et al., 2021). Interestingly, research has revealed some contradictions in students' understanding of climate change. While many students demonstrate a high level of certainty about global warming and express concern, their actual knowledge about its causes can be alarmingly poor (Li and Liu, 2021). Gender disparities have been observed, with female students sometimes showing lower levels of awareness compared to male students, although this gap can be bridged through engineering programs and participation in student societies (Demaidi and Al-Sahili, 2021).

The significance of this study lies in its potential to inform and enhance climate change education, communication, and policy both within Joseph Sarwuan Tarka University and in the broader Nigerian context. First, understanding the level of climate change awareness among university staff is essential for shaping effective institutional strategies that promote sustainability and environmental stewardship on campus. Staff members play a critical role as educators and community leaders; thus, improving their awareness can have a multiplier effect on students and the wider society. Second, by empirically identifying the factors that affect awareness and perception, this study provides valuable evidence that can guide curriculum development, staff training, and targeted awareness campaigns within the university. Third, the localized focus on Makurdi, Nigeria, addresses a gap in the literature, offering context-specific insights that are crucial for developing adaptive strategies tailored to local challenges.

The primary aim of this study was to analyze the level of climate change awareness among staff at Joseph Sarwuan Tarka University, Makurdi, Nigeria. Specifically, the objectives are to assess the overall awareness and understanding of climate change issues among staff, examine the factors influencing their awareness, and explore their perceptions of climate change impacts within the local context. Additionally, the study aims to identify gaps in knowledge and suggest practical strategies for enhancing climate change awareness within the university community.

## MATERIALS AND METHODS

### Study Area

This study was carried out in the Joseph Sarwuan Tarka University, Makurdi (JOSTUM), formerly known as the Federal University of Agriculture, Makurdi, is a prominent public university located in Makurdi, the capital city of Benue State, North Central Nigeria. The university sits at approximately latitude  $7^{\circ} 43' 55.87''$  N and longitude  $8^{\circ} 32' 20.93''$  E and established on January 1, 1988, the institution initially evolved from the Federal University of Technology, which was earlier the Makurdi campus of the University of Jos. The university was renamed in 2019 in honor of Senator Joseph Sarwuan Tarka, a notable Nigerian statesman and advocate for the Middle Belt region. The land spans 8,048 hectares (Manyi *et al.*, 2017). JOSTUM has a large urban campus and serves a diverse student body, with enrollment numbers ranging from 15,000 to 19,999 students. Officially recognized by the National Universities Commission, the university offers a variety of programs in agricultural, scientific, and related disciplines, aiming to advance innovation and service as reflected in its motto. The institutional philosophy centers on democratizing the scientific transformation of Nigerian agriculture, especially to empower small-scale farmers, and providing practical solutions to real-world problems through research and community engagement. Located within Makurdi, a region marked by both rapid urbanization and

significant agricultural activity, JOSTUM is strategically positioned to address environmental and climate challenges central to the region's socio-economic development. The university's academic environment supports research and initiatives that foster sustainability, making it a fitting setting for analyzing climate change awareness among its staff and broader community.

**Experimental Design**

Multistage sampling technique was adopted to select respondents for the study. Three Cores (North, Middle and South) of the university were purposively chosen to obtain a widespread of respondents within the university (Table 1).

In the North Core region 2 Colleges: Administration (Registrar Office with 27 respondents) and the library with 17 respondents were selected. In the Middle Core, the Colleges of Engineering (Department of Mechanical Engineering with 13 respondents) and Food Science and Human Technology (Department of Food Science Technology 26 respondents) and Department of Home Science and Management with 8 respondents) were also picked. Lastly, in the South Core, College of Biological Science was selected while Department of Microbiology with 13 respondents was taken. Overall, the sample size comprised a total of 104 responses (Table 1).

**Table 1: Sampled Colleges and Departments in JOSTUM**

S/No.	University Cores	Department/Unit	Name of Department	F	%	Means
1.	North	Administration	Registrar office	27	26.0	43(41.3)
		Library	Library	17	16.3	
2.	Middle	College of Engineering	Mechanical Engineering	13	12.5	47(45.2)
		Food Technology and Human Ecology	Food Science and Technology	26	25.0	
			Home Science and Management	8	7.7	
3.	South	Biological Science	Microbiology	13	12.5	14(13.5)
<b>Total</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>104</b>	<b>100</b>	<b>104(100)</b>

**Data Collection Method**

A Google Forms semi-structured questionnaire (see appendix) was employed as instrument for data collection. A total of 104 respondents were randomly interviewed across the 3 Cores (North, Middle and South), 5 Colleges/units (Administration, Library, College of Engineering, Food Technology and Human Ecology and Biological Science) and 6 Departments (Registrar office, Library, Mechanical Engineering, Food Science and Technology, Home Science and Management and Microbiology).

**Data analysis**

The analysis used descriptive statistics to outline demographic and socio-economic characteristics of respondents. Inferential Statistics were then employed to explore respondents' awareness of climate change and its impacts. Multiple regression analysis was conducted to assess how selected environmental and anthropogenic factors influence climate change awareness, and the significance of this model was tested using Analysis of Variance (ANOVA). Pearson Correlation coefficients were calculated to examine relationships among emission sources and their association with staff awareness. Additional descriptive analyses detailed perceptions of climate change impacts on forest resources and personal mitigation actions. Finally, regression modeling was used to evaluate predictors of perceived climate change impacts, with model fit indicators and significance levels guiding interpretation of results. These combined statistical methods facilitated a comprehensive understanding of the factors shaping climate

change awareness, perception, and action within the university community.

**RESULTS**

**Demographic Characteristics of Respondents**

Demographic and socio-economic characteristics of 104 respondents in this study are presented in Table 2. Gender distribution reveals 61.5% males and 38.5% females. Age-wise, the majority fall between 36 - 45 years (23.1%) and 46 - 50 years (21.2%). Staff categories consist of 40.4% in the Registry, 20.2% as Librarians, and 39.4% in Academic roles, with an almost equal split between Junior (51.0%) and Senior (49.0%) ranks. Religiously, Christianity predominates at 96.2% compared to Islam at 3.8%. Marital status predominantly reflects the married population (85.6%), followed by singles (12.5%) and a minimal widow count (1.9%). Occupationally, civil servants constitute 83.7%, while 16.3% are involved in teaching. Further analysis reveals that secondary occupations include civil servants (76.9%), farming (7.7%), teaching (14.4%), and a marginal representation of students (1.0%). Educational qualifications indicate 66.3% postgraduate degree, 15.4% with secondary education, 13.5% undergraduates, and 4.8% in non-formal education. Household size distribution showcases clusters in family size of 5-7 individuals (43.3%) and 8-10 (29.8%), with lower sizes in the 1- 4 members (18.3%) and above 10 members (8.7%) categories. Income-wise, 35.6% respondents fall into the low-income bracket, 57.7% into the medium-income, and 6.7% into the high-income category.

**Table 2: Demographic Characteristics of Respondents**

<b>Variables</b>	<b>Category</b>	<b>Frequency</b>	<b>%</b>	<b>Mean±Sdv</b>
<b>Sex</b>	Male	64	61.5	
	Female	40	38.5	
	<b>Total</b>	<b>104</b>	<b>100</b>	
<b>Age Range</b>	26 – 35	20	19.2	
	36 – 45	24	23.1	
	46 - 50	22	21.2	
	51 - 55	19	18.3	<b>46±9.39</b>
	56 - 60	14	13.5	
	61 - 65	5	4.8	
	<b>Total</b>	<b>104</b>	<b>100</b>	
<b>Category of Staff</b>	Registry	42	40.4	
	Liberian	21	20.2	
	Academics	41	39.4	
	<b>Total</b>	<b>104</b>	<b>100</b>	
<b>Staff Rank</b>	Junior	53	51.0	
	Senior	51	49.0	
	<b>Total</b>	<b>104</b>	<b>100</b>	
<b>Religion</b>	Christianity	100	96.2	
	Islam	4	3.8	
	<b>Total</b>	<b>104</b>	<b>100</b>	
<b>Marital Status</b>	Single	13	12.5	
	Married	89	85.6	
	Widow	2	1.9	
	<b>Total</b>	<b>104</b>	<b>100</b>	
<b>Primary Occupation</b>	Civil servant	87	83.7	
	Teaching	17	63.3	
	<b>Total</b>	<b>104</b>	<b>100</b>	
<b>Secondary Occupation</b>	Civil Servant	80	76.9	
	Farming	8	7.7	
	Teaching	15	14.4	
	Student	1	1.0	
	<b>Total</b>	<b>104</b>	<b>100</b>	
<b>Educational Qualification</b>	Secondary	16	15.4	
	Undergraduate	14	13.5	
	Postgraduate	69	66.3	
	Non-formal	5	4.8	
	<b>Total</b>	<b>104</b>	<b>100</b>	
<b>Household Size</b>	1 - 4	19	18.3	
	5 -7	45	43.3	
	8 - 10	31	29.8	
	Above 10	9	8.7	
	<b>Total</b>	<b>104</b>	<b>100</b>	
<b>Income Category</b>	Low income	37	35.6	
	Medium income	60	57.7	
	High income	7	6.7	
	<b>Total</b>	<b>104</b>	<b>100</b>	

**Respondents’ Awareness of Climate Change and its Impacts**

Table 3 presents results on the awareness of climate change and its effects among respondents within a university setting. Among the respondents, 80.8% expressed awareness of climate change, while a notable 3.8% indicated a lack of awareness, and 15.4% remained uncertain. Surprisingly, only 9.6% of university staff reported receiving formal training on climate change, with an overwhelming 90.4% yet to receive such training. Regarding the impact on health, 28.8% acknowledged the effect of climate change on health,

while 45.2% were uncertain, and 26.0% did not perceive a direct influence. Moreover, a quarter (25.0%) of respondents were aware of additional effects beyond health implications due to climate change. However, a higher proportion (36.5%) remained uncertain, and 38.5% were unaware of other impacts. Regarding direct experiences, only 11.2% reported having experienced flood damage in the past five years, while a substantial 67.3% had not encountered such instances. An additional 21.2% remained uncertain about their exposure to flood-related damages.

**Table 3: Respondents’ Awareness of Climate Change and its Impacts**

Statement	Yes		No		Maybe	
	F	%	F	%	F	%
Climate change awareness	84	80.8	4	3.8	16	15.4
Received formal training on climate change as university staff	10	9.6	94	90.4	0	0
Climate change affects your health	30	28.8	47	45.2	27	26.0
Aware of other effects of climate change	26	25.0	38	36.5	40	38.5
Experienced flood damage in the last 5 years	12	11.2	70	67.3	22	21.2

**Model Regression on Climate Change Awareness among JOSTUM Staff**

Multiple regression analysis model yielded an R value of 0.399 and an R<sup>2</sup> of 0.159, indicating that approximately 16% of the variance in staff climate change awareness can be explained by these predictors. The model was statistically significant (F(8, 95) = 2.242, p = 0.031), highlighting the importance of these factors in shaping awareness about climate change among university staff (Table 4).

The ANOVA results on factors influencing climate change awareness among staff in JOSTUM indicate that the regression model, incorporating predictors such as burning, deforestation, natural phenomena, agriculture and emissions from generators, industries, and vehicles, significantly explains differences in climate change awareness among staff members (F(8, 95) = 2.242, p = 0.031). With a total sum

of squares of 86.913 and 103 degrees of freedom, the findings confirm that the collective impact of these environmental and anthropogenic factors on staff awareness is meaningful and statistically significant within the university context (Table 5).

Pearson correlation analysis reveals that staff awareness of climate change is significantly associated with several anthropogenic activities, including vehicle emissions (r = 0.217, p < 0.05). Generator emissions and vehicle emissions are strongly correlated (r = 0.867, p < 0.01), and burning is also significantly related to multiple emission sources (Table 6). These results underscore the interconnectedness of human activities and their combined influence on climate change awareness in the academic setting, highlighting the need for integrated strategies to promote environmental consciousness among university staff.

**Table 4: Regression Model Summary Predicting Climate Change Awareness among University Staff in JOSTUM**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	0.399	0.159	0.088	0.877	0.159	2.242	8	95	0.031

**Table 5: ANOVA Results Assessing the Significance of Predictors on Climate Change Awareness**

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	13.804	8	1.726	2.242	0.031
Residual	73.109	95	0.770		
Total	86.913	103			

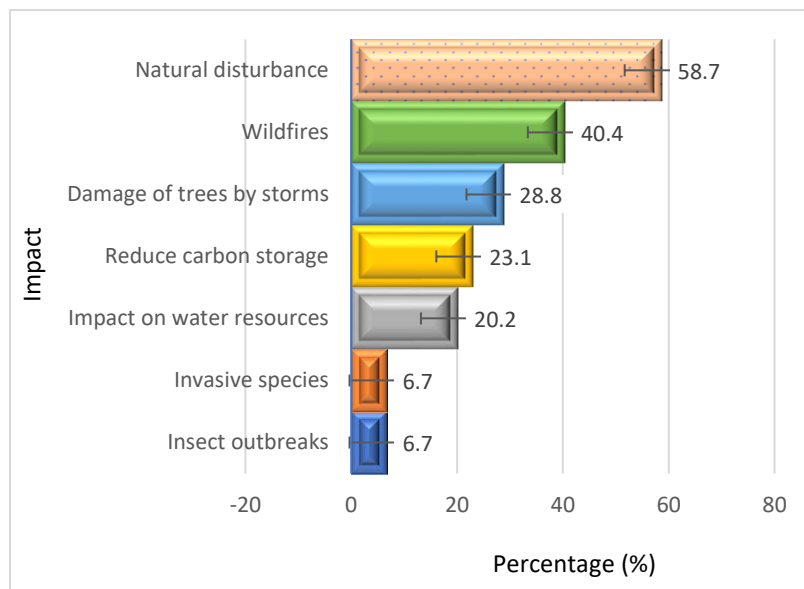
**Table 6: Pearson Correlation Matrix of Environmental Factors and Climate Change Awareness among Staff**

Variables	Climate Change Awareness	Deforestation	Agriculture Activities	Industrial Emissions	Generator Emissions	Vehicles	Natural Phenomena	Burning
Climate change Awareness	1	0.126	0.054	0.160	0.151	*0.217	0.063	0.150
Deforestation	0.126	1	-0.132	0.064	0.000	0.064	0.026	0.063
Agriculture Activities	0.054	-0.132	1	-0.096	*-0.218	-0.096	-0.184	-0.063
Industrial Emissions	0.160	0.064	-0.096	1	0.173	*0.210	0.067	**0.347
Generator Emissions	0.151	0.000	*-.218	0.173	1	**0.867	0.075	**0.273
Vehicles	*0.217	0.064	-0.096	*0.210	**0.867	1	0.067	**0.347
Natural Phenomena	0.063	0.026	-0.184	0.067	0.075	0.067	1	0.064
Burning	0.150	0.063	-0.063	**0.347	**0.273	**0.347	0.064	1

**Respondents’ Perceived Impact of Climate Change on Forest Resources**

Result of respondents’ perceived impact of climate change on forest resources is shown in Figure 1. Approximately 6.7% identified its influence on both insect outbreaks and invasive species within forest ecosystems. Moreover, 20.2% highlighted its impact on water resources, emphasizing climate change's role in altering the availability and quality of water within forested areas. Additionally, 23.1% acknowledged its contribution to reduced carbon storage, indicating concerns about its repercussions on carbon sequestration within forests. The result further

revealed substantial concerns regarding the direct impact of climate change on the structural integrity of forests. Respondents noted a significant impact on tree damage caused by storms, accounting for 28.8% of responses. More prominently, wildfires emerged as a major concern, with 40.4% associating them with climate change. The most significant concern voiced by participants was the perception that climate change substantially triggers natural disturbances within forested regions. An overwhelming 58.7% highlighted climate change as a driving force behind natural disturbances in forests.

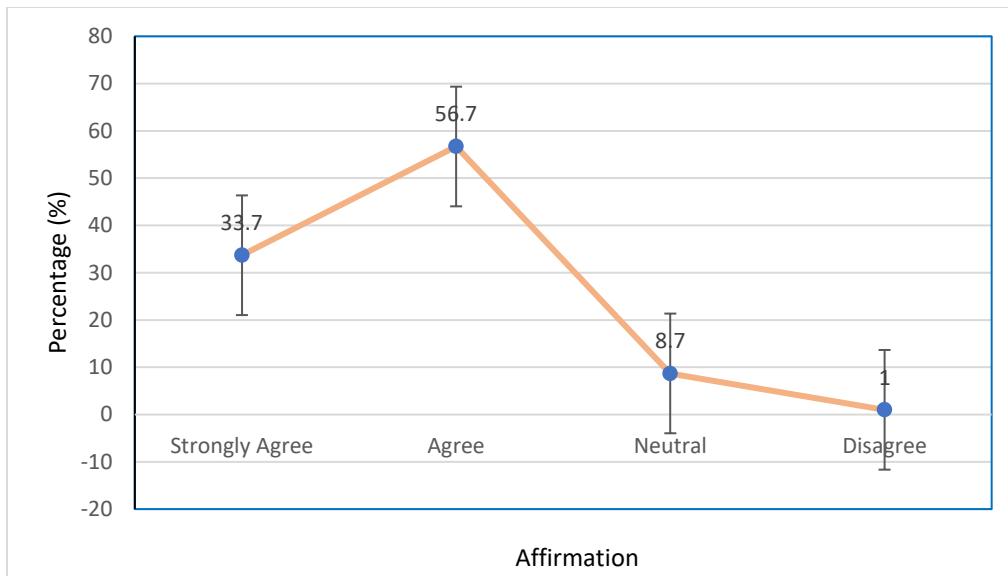


**Figure 1: Respondents’ perceived impact of climate change on forest resources**

**Respondents’ Perception of JOSTUM’s Role in Promoting Climate Change Awareness**

Figure 2 presents respondents’ perceptions concerning JOSTUM staff involvement in fostering climate change awareness. A significant majority of respondents expressed a positive stance, with 33.7% strongly agreeing and 50.7% generally agreeing on the university's active role in promoting awareness

regarding climate change. A smaller yet noteworthy fraction, 8.7%, maintained a neutral standpoint, suggesting an element of uncertainty or impartiality regarding the university's engagement in this domain. Conversely, only 1.0% of respondents disagreed with the university's involvement in advocating for climate change awareness.

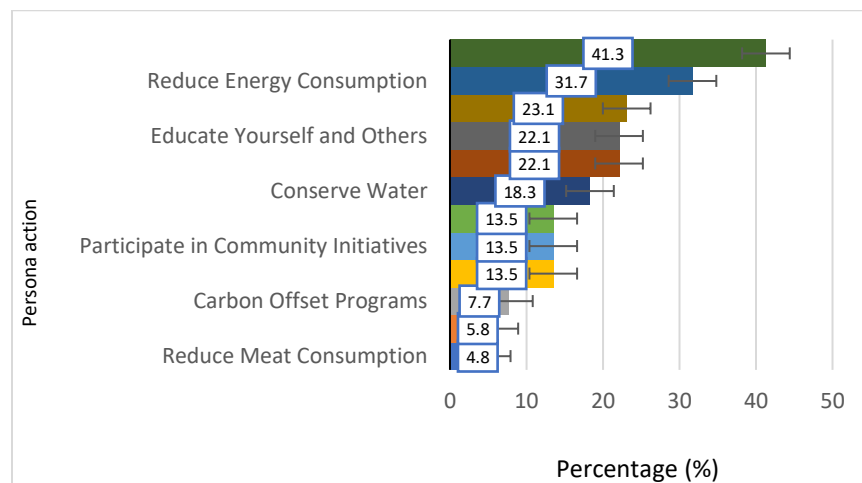


**Figure 2: Respondents’ Perception that JOSTUM has a Role in Promoting Climate Change Awareness**

**Personal Actions for Climate Mitigation Among JOSTUM Staff**

Diverse array of personal actions respondents undertaken to alleviate their environmental footprint and contribute to climate change mitigation are presented in Figure 3. A minority of respondent constituting 4.8%, indicated a commitment to reducing meat consumption as part of their environmental contribution. Slightly higher, 5.8% highlighted the adoption of sustainable transportation practices. Moreover, a considerable number of respondents, at 7.7%, expressed engagement in carbon offset programs. Significantly larger number

demonstrated involvement in practices such as consuming responsibly, participating in community initiatives, and voting for climate action, each accounting for 13.5% of respondents. Stepping into more impactful measures, 18.3% prioritized water conservation, while 22.1% dedicated efforts to both waste reduction and educating themselves and others about environmental issues. Additionally, 23.1% expressed support for renewable energy initiatives. Most respondents (31.7%) indicated an active effort to reduce energy consumption. Most prominently, an impressive 41.3% revealed engagement in planting trees and maintaining green spaces.



**Figure 3: Respondents’ Personal Actions to Reduce Environmental Impact and Contribute to Climate Change Mitigation**

### Enhancing Climate Change Awareness Initiatives among JOSTUM Staff

Table 7 presents results suggestions on initiatives to enhancing climate change awareness among the university's staff and students. Few respondents (6.7%) proposed the promotion of green transportation and advocated for establishing a green fund to bolster environmental initiatives within the university (7.7%). Others advocated for creating an eco-friendly campus design (10.6%) and participating in global climate initiatives and facilitating climate change competitions garnered 11.5% and 12.5%, respectively. Some respondents proposed encouraging student-led sustainability policies and percentage recommended creating a comprehensive campus sustainability policy (14.4%). A significant emphasis was placed on educational and awareness campaigns, with 32.7% advocating for incorporating climate change education into the curriculum. Additionally, 40.4% supported organizing seminars and workshops, and 23.1% suggested hosting environmental awareness campaigns. Majority of respondents suggested establishing a climate change research center (25.0%) and promoting sustainable practices on campus (25.0%).

**Table 7: Suggestion on the Initiatives the University Could Undertake to Enhance Climate Change Awareness among Staff and Students**

S/No.	Suggestion	Frequency	Percentage (%)
1.	Promote green transportation	6	6.7
2.	Establish a green fund	7	7.7
3.	Create an eco-friendly campus design	11	10.6
4.	Participate in global climate initiatives	12	11.5
5.	Facilitate climate change competitions	12	12.5
6.	Encourage student-led sustainability policy	15	14.4
7.	Create a campus sustainability policy	15	14.4
8.	Offer training and certification programs	18	17.3
9.	Hold environmental film screenings and lectures	19	18.3
10.	Host environmental awareness campaigns	24	23.1
11.	Establish a climate change research center	26	25.0
12.	Promote sustainable practices on campus	26	25.0
13.	Incorporate climate change education into curriculum	34	32.7
14.	Organize seminars and workshops	42	40.4

### Perceived Impact of Climate Change in JOSTUM Environment

Results on perceived impacts of climate change within the JOSTUM environment is shown on Figure 4. Temperature changes emerged as the most prominent concern, with a substantial 51.9% of respondents highlighting this impact. Agricultural impacts closely followed, with 33.7% expressing concerns about the consequences of climate change on agricultural practices. Moreover, 32.7% of respondents identified health risks associated with climate change, underscoring concerns about the potential health implications within the JOSTUM environment. Similarly, 31.7% acknowledged extreme weather events as a significant impact of climate change. In contrast, respondents perceived relatively lower impacts related to ecosystem changes (18.3%), changes in precipitation patterns (16.3%), and challenges concerning water resources (14.4%) and sea level rise (13.5%). Lesser concerns were voiced regarding adaptation strategies (8.7%) and socioeconomic challenges (5.8%), signaling a comparatively lower level of concern about these aspects of climate change impact within the JOSTUM environment.

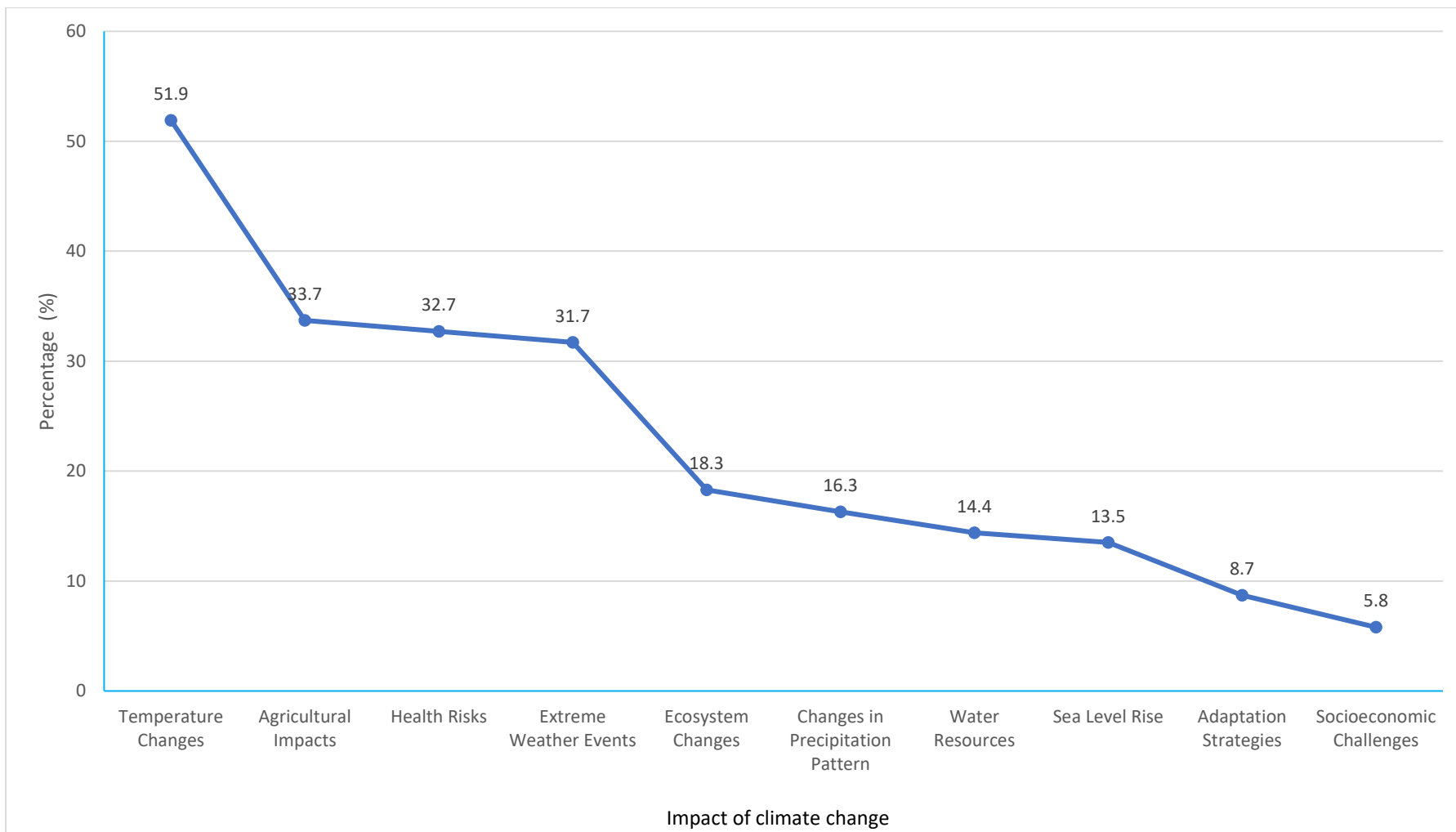


Figure 5: Perceived Impact of Climate Change in JOSTUM Environment

**Pearson Correlation Matrix on Perceived Impacts of Climate Change in among Staff in JOSTUM** Results in Table 8 reveal statistically significant associations among several key impact domains. Socio-economic challenges are strongly correlated with health risks ( $r = .355, p < 0.01$ ), ecosystem changes ( $r = .310, p < 0.01$ ), and sea level rise ( $r = .265, p < 0.01$ ), highlighting the interconnected nature of environmental, economic, and social dimensions of climate change in the Makurdi context. Temperature changes are significantly associated with both health risks ( $r = .219, p < 0.05$ ) and socioeconomic challenges ( $r = .238, p < 0.05$ ), suggesting that direct physical impacts of climate change are perceived to have substantial secondary effects on community wellbeing. The results emphasize the multi-dimensional impacts of climate change and underscore the importance of integrated adaptation strategies for the university and the broader Makurdi environment.

**Model Summary of Predictors for Perceived Climate Change Impacts among University Staff**

The regression model in Table 9 yielded a low  $R^2$  value of 0.074, meaning only 7.4% of the variance in perceived climate change impacts could be explained by the selected predictors. Moreover, the adjusted R Square was negative (-0.031), and the overall model was not statistically significant ( $F(10, 88) = 0.705, p = 0.718$ ), indicating that the combination of predictors, covering aspects such as precipitation change, temperature, weather events, resource use, health risks, and socioeconomic challenges, did not significantly account for differences in perceptions among the university staff. These findings suggest that other unmeasured factors may play a more substantial role in shaping staff perceptions of climate change impacts in Makurdi, Benue State.

**Table 8: Pearson Correlation Matrix on Perceived Impacts of Climate Change in among Staff in JOSTUM**

Variables	Temperature Changes	Water Resources	Agricultural Impacts	Extreme Weather Events	Ecosystem Changes	Health Risks	Socio-economic Challenges	Adaptation Strategies	Sea Level Rise	Changes in Precipitation
Temperature Changes	1	-0.036	-0.082	-0.035	-0.043	0.219*	0.238*	0.022	0.210*	-0.147
Water Resources	-0.036	1	0.047	0.085	0.098	0.127	0.367**	0.066	0.156	0.111
Agricultural Impacts	-0.082	0.047	1	0.174	0.240*	0.194*	0.347**	0.022	0.194*	0.068
Extreme Weather Events	-0.035	0.085	0.174	1	0.230*	0.194	0.231*	0.154	0.150	0.009
Ecosystem Changes	-0.043	0.098	0.240*	0.230*	1	0.201*	0.310**	0.208*	0.178	0.060
Health Risks	0.219*	0.127	0.194*	0.194	0.201*	1	0.355**	0.077	0.206*	-0.031
Socio-economic Challenges	0.238*	0.367**	0.347**	0.231*	0.310**	0.355**	1	0.364**	0.265**	0.337**
Adaptation Strategies	0.022	0.066	0.022	0.154	0.208*	0.077	0.364**	1	0.079	0.049
Sea Level Rise	0.210*	0.156	0.194*	0.150	0.178	0.206*	0.265**	0.079	1	0.054
Changes in Precipitation	-0.147	0.111	0.068	0.009	0.060	-0.031	0.337**	0.049	0.054	1

Note:

\*Correlation is significant at the 0.05 level (2-tailed).

\*\* Correlation is significant at the 0.01 level (2-tailed).

**Table 9: Model Summary of Predictors for Perceived Climate Change Impacts among University Staff**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	0.272	0.074	-0.031	0.510	0.074	0.705	10	88	0.718

**Predictors:** (Constant), Changes in Precipitation Patterns, Extreme Weather Events, Water Resources, Agricultural Impacts, Temperature Changes, Adaptation Strategies, Health Risks, Sea Level Rise, Ecosystem Changes, Socioeconomic Challenges.

## DISCUSSION

Staff categories of JOSTUM are distributed among the registry, librarians, and academic roles. There is an almost equal split between junior and senior ranks. This balanced distribution suggests deliberate human resource planning, likely aimed at maintaining mentorship, succession, and a blend of experience within each department. Such a structure supports both career progression for staff and organizational stability, as junior staff can learn from more experienced colleagues while preparing for more senior roles. The findings on climate change awareness in JOSTUM reveals that while most university respondents are aware of climate change, formal training on the topic among staff is limited. Awareness of climate change's health impacts and other related effects varies, with many respondents uncertain or unaware. Additionally, few have experienced flood damage firsthand, and a significant portion remain unsure about such exposure. Several studies indicate that while general awareness of climate change is high, detailed knowledge of its causes and impacts is often limited among the public. For example, a 2009 survey found that many individuals still had incorrect beliefs about climate change and did not fully appreciate key facts about its causes (Reynolds et al., 2010). Similarly, a study of American public awareness found that while many reported global warmings is harmful to health, few could accurately name specific types of harm or affected populations when asked open-ended questions (Maibach et al., 2015). There is some evidence of improvements in climate change knowledge over time. Compared to a 1992 survey, respondents in 2009 showed higher awareness of some climate change causes and were less likely to conflate it with ozone depletion (Reynolds et al., 2010). Regarding health impacts specifically, a survey of pediatric residents found that while most agreed physicians should discuss climate change health effects with patients, only 21% felt comfortable doing so (Group et al., 2024). This suggests a need for more training on communicating climate-health links. In terms of personal experience, one study found that Floridians were generally unable to detect 5-year temperature increases in their local area, though some could detect precipitation changes (Marlon et al., 2018). This indicates limits to using personal experience alone to understand climate trends.

The multiple regression analysis revealed that the model explains a modest portion of the variance in staff climate change awareness. The results were statistically significant, emphasizing the relevance of the included predictors in influencing awareness about climate change among university staff. This aligns with findings from other studies examining predictors

of climate change awareness and related attitudes. For instance, research on farmers' attitudes towards climate adaptation found that epistemic and response uncertainty explained a large portion of variance in farmers' attitudes towards adaptation and willingness to use climate outlook tools (Singh et al., 2020). Similarly, a study on nursing students' climate change literacy identified perceived faculty knowledge as a significant predictor across multiple domains of climate literacy (Atta et al., 2024). This suggests that climate change awareness, like many attitudinal measures, is likely influenced by a wide range of factors beyond those captured in any single model.

Results on factors influencing climate change awareness among staff at JOSTUM indicate that the regression model, which includes predictors such as burning, deforestation, natural phenomena, agriculture, and emissions from generators, industries, and vehicles, significantly explains variations in climate change awareness among staff members. Several studies have explored determinants of climate change awareness and perceptions among different groups. For instance, Mustafa et al. (2018) investigated factors affecting farmers' awareness of climate change in Pakistan. The study found that farmers' level of awareness is determined by environmental communication networks, socioeconomic factors, institutional factors, and geographic factors (Mustafa et al., 2018). Interestingly, Haq and Ahmed (2020) examined perceptions of university students in Bangladesh regarding climate change. The study found that factors such as students' sex, religious affiliation, involvement in environmental organizations, completion of university courses related to the environment or climate change, academic discipline of study, and experience of extreme weather events in their home locality influenced their perceptions of climate change (Haq and Ahmed, 2020). The findings of this study highlight that climate change awareness among staff at JOSTUM is influenced by multiple anthropogenic factors such as vehicle and generator emissions, burning, and industrial activities, though overall awareness levels are moderate. This underscores the need for targeted and broad-based educational programs to enhance understanding across all staff categories, especially those outside science disciplines. As key influencers within the university, increased staff awareness can foster a culture of environmental responsibility, support sustainable campus operations, and strengthen climate-related policies. Moreover, improving staff knowledge and engagement is critical not only for institutional sustainability but also for contributing to broader national efforts in climate change adaptation and mitigation. Therefore, strategic interventions

including training, awareness campaigns, and policy integration are essential to empower university staff as active participants in addressing climate change challenges.

JOSTUM staff observed that climate change negatively affects forest resources, leading to more insect outbreaks and invasive species, changes in water availability and quality, and a decrease in the carbon storage capacity of forests. These impacts are multifaceted and interconnected, affecting various aspects of forest ecosystems. Insect outbreaks and invasive species are expected to increase due to climate change. Warming temperatures and altered precipitation patterns create favorable conditions for pest populations to expand their ranges and increase in frequency and severity (Baldrian et al., 2023; Hof and Svahlin, 2015). For instance, in Sweden, numerous insect pest species are projected to experience large increases in their potential distribution by 2070, potentially leading to outbreaks in new areas (Hof and Svahlin, 2015). This trend is also observed in North America, where climate warming is expected to increase the frequency and severity of insect outbreaks in forests (Grimm et al., 2013; Mina *et al.*, 2022). Climate change also affects water availability and quality in forest ecosystems. Hydrologic changes related to melting glaciers and rising winter snowlines alter river discharges, impacting both terrestrial and marine ecosystem productivity (Wolken et al., 2011). Additionally, accelerated losses of nutrients from terrestrial ecosystems to receiving waters are caused by winter warming and intensification of the hydrologic cycle (Grimm et al., 2013). These changes have important consequences for water quality and the ecology of streams, rivers, and lakes (Laudon et al., 2011). Interestingly, while climate change generally decreases the carbon storage capacity of forests, some studies suggest that climate warming may initially increase forest productivity and carbon storage in certain regions (Landry et al., 2021; Mina et al., 2022). However, this potential increase is likely to be offset by unexpected impacts of drought and insect outbreaks, which can drastically reduce carbon sequestration (Mina et al., 2022).

Suggestions to improve climate change awareness at JOSTUM include promoting sustainable transportation and creating a dedicated fund for environmental initiatives, though these ideas were proposed by only a few respondents. Promoting sustainable transportation is a crucial aspect of combating climate change and reducing greenhouse gas emissions (Perez, 2023). This can include encouraging the use of electric vehicles, mass transit, and active transportation options like cycling and walking. Such initiatives not only help reduce

emissions but also contribute to creating more livable communities and improving air quality. Creating a dedicated fund for environmental initiatives is an important step towards implementing green finance strategies, which play a vital role in sustainable development and addressing climate change (Fu et al., 2023). This fund could support various projects, such as investing in renewable energy infrastructure or implementing energy conservation measures on campus. Interestingly, while these suggestions are valuable, the fact that they were proposed by only a few respondents indicates a potential lack of widespread awareness or engagement with climate change issues among the JOSTUM community. This aligns with findings from Esakkimuthu and Banupriya (2023), which revealed varying levels of climate change awareness among students, highlighting the need for comprehensive climate change education and targeted awareness campaigns. To enhance the effectiveness of these initiatives, JOSTUM could consider implementing a more holistic approach. This could include integrating green education into the curriculum (Aggarwal, 2023), leveraging ICT solutions to promote sustainable behaviors (Adisa et al., 2024), and engaging students in participatory laboratories focused on environmental protection (Mebane et al., 2023). Additionally, collaborating with local municipalities and recycling bodies to create a micro-ecosystem within the institution, as suggested in Altassan (2023), could further strengthen JOSTUM's environmental initiatives and foster a culture of sustainability.

JOSTUM staff perceived climate change impacts as interconnected across economic, social, and environmental domains, though the specific factors measured explain little of the variation in these perceptions, pointing to the importance of considering additional influences when planning adaptation strategies. Climate change perceptions and adaptation strategies are indeed interconnected across economic, social, and environmental domains. Public attitudes toward climate change influence climate and energy policies and guide individual mitigation and adaptation behaviors (Marlon et al., 2022). However, the factors influencing these perceptions can be complex and varied. For instance, risk perceptions, beliefs about global warming, awareness of climate change adaptation, and perceived efficacy of local governments are key drivers of support for local adaptation policy (Harris and Howe, 2023). Interestingly, there are often contradictions in how climate change is perceived, especially in rural communities. Some residents describe changing climate as evidence of 'climate change', while others term it 'weather variability', suggesting a divide that could hinder local and national policy responses (Buys

et al., 2011). Motivated reasoning can affect the accuracy of local weather perceptions, with pre-existing beliefs about global climate change influencing how people perceive seasonal temperature and precipitation (Howe, 2018).

## CONCLUSION

The study concludes that climate change awareness among Joseph Sarwuan Tarka University staff is generally high but marked by notable gaps in formal training and detailed understanding of its diverse impacts. Key environmental and human activities significantly influence awareness levels, highlighting the importance of addressing these factors in future educational programs. Although the university is recognized as proactive in fostering climate awareness, there is substantial opportunity to broaden and deepen these efforts through enhanced curricula, workshops, and institution-wide sustainability initiatives. Personal engagement in climate mitigation is present but remains limited to a subset of pro-environmental behaviors. The findings suggest that to effectively increase climate change awareness and adaptive capacity, JOSTUM should prioritize comprehensive education, campus sustainability, and community involvement strategies. Moreover, further research is needed to explore additional factors affecting perceptions and to guide targeted interventions tailored to local contexts.

## REFERENCE

Adisa, M. O., Oyedeji, S., and Porras, J. (2024). The Nexus between ICT, Top-down and Bottom-Up Approaches for Sustainability Activities: A systematic mapping study. *Journal of Cleaner Production*, 449, 141768. <https://doi.org/10.1016/j.jclepro.2024.141768>

Aggarwal, D. D. (2023). Green Education for a Sustainable Future. *Journal of Environmental Impact and Management Policy*, 34, 27–30. <https://doi.org/10.55529/jeimp.34.27.30>

Ali, A. H., and Thakkar, R. (2023). Climate Changes through Data Science: Understanding and Mitigating Environmental Crisis. *Mesopotamian Journal of Big Data*, 2023, 125–137. <https://doi.org/10.58496/mjbd/2023/017>.

Alotaibi, M. (2023). Climate Change, its Impact on Crop Production, Challenges, and Possible Solutions. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, 51(1), 13020. <https://doi.org/10.15835/nbha51113020>.

Altassan, A. (2023). Sustainable Integration of Solar Energy, Behavior Change, and Recycling Practices in Educational Institutions: A Holistic Framework for Environmental

Conservation and Quality Education. *Sustainability*, 15(20), 15157. <https://doi.org/10.3390/su152015157>

Atta, M. H. R., Ali, A. F. Z., Sehsah, I., Balha, S. M. I., Elmonem, H. H. A., Hassan, E. H. M., Asal, M. G. R., Abdelrahman, M. M., Elsmalasy, M. F. A., Othman, A. A., El-Sayed, A. A. I., Abdelhay, E. S., Machaly, E. R., Hendy, A., Abdelhay, I. S., Ali, A. A. M., Mohamed, A. Z., Rahman, A. A. A. O. A., Zoromba, M. A., Noha M. I. I., Mira N. A. E., Hanady S. S., Eman A. H., Marwa F. H. M., Hend A. M. A. E., Mohamed A. G., Mervat A. S. and Taha, H. M. A. (2024). Predictors Of Climate Change Literacy in the Era of Global Boiling: A Cross-Sectional Survey of Egyptian Nursing Students. *BMC Nursing*, 23(1). <https://doi.org/10.1186/s12912-024-02315-y>

Baldrian, P., López-Mondéjar, R., and Kohout, P. (2023). Forest Microbiome and Global Change. *Nature Reviews Microbiology*, 21(8), 487–501. <https://doi.org/10.1038/s41579-023-00876-4>

Butsch, C., Brennholt, N., Beckers, L.-M., Nilson, E., Frassl, M., Kwiatkowski, R., and Söder, M. (2023). Health impacts of extreme weather events - Cascading Risks in a Changing Climate. *Journal of Health Monitoring*, 8(Suppl 4). <https://doi.org/10.25646/11652>.

Buys, L., Miller, E., and Van Megen, K. (2011). Conceptualising Climate Change in Rural Australia: Community Perceptions, Attitudes and (in)actions. *Regional Environmental Change*, 12(1), 237–248. <https://doi.org/10.1007/s10113-011-0253-6>

Costello, A., Maslin, M., Johnson, A. M., Ekins, P., and Montgomery, H. (2011). Global Health and Climate Change: Moving from Denial and Catastrophic Fatalism to Positive Action. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 369(1942), 1866–1882. <https://doi.org/10.1098/rsta.2011.0007>.

Demaidi, M. N., and Al-Sahili, K. (2021). Integrating SDGs in Higher Education Case of Climate Change Awareness and Gender Equality in a Developing Country According to RMEI-TARGET Strategy. *Sustainability*, 13(6), 3101. <https://doi.org/10.3390/su13063101>.

Esakkimuthu, K., and Banupriya, S. (2023). Awareness about Climate Change among Students: A Sustainable Future. *ComFin Research*, 11(4), 1–6. <https://doi.org/10.34293/commerce.v11i4.6677>

- Fu, C., Lu, L., and Pirabi, M. (2023). Advancing green finance: a review of sustainable development. *Digital Economy and Sustainable Development*, 1(1). <https://doi.org/10.1007/s44265-023-00020-3>
- Grimm, N. B., Nadelhoffer, K., Pairis, A., Gonzalez, P., Bierwagen, B., Chapin, F. S., Schimel, J., Raymond, P. A., Luo, Y., Melton, F., Williamson, C. E., and Groffman, P. M. (2013). The Impacts of Climate Change on Ecosystem Structure and Function. *Frontiers in Ecology and the Environment*, 11(9), 474–482. <https://doi.org/10.1890/120282>
- Haq, S. M. A., and Ahmed, K. J. (2020). Perceptions about Climate Change Among University Students in Bangladesh. *Natural Hazards*, 103(3), 3683–3713. <https://doi.org/10.1007/s11069-020-04151-0>
- Harris, B. S., and Howe, P. D. (2023). What Factors are Associated with Public Support for Climate Change Adaptation Policy in the U.S.? *Environmental Research Communications*, 5(9), 091003. <https://doi.org/10.1088/2515-7620/acf4e1>
- Hof, A. R., and Svahlin, A. (2015). The potential Effect of Climate Change on the Geographical Distribution of Insect Pest Species in the Swedish Boreal Forest. *Scandinavian Journal of Forest Research*, 31(1), 29–39. <https://doi.org/10.1080/02827581.2015.1052751>
- Howe, P. D. (2018). Perceptions of Seasonal Weather are Linked to Beliefs about Global Climate Change: Evidence from Norway. *Climatic Change*, 148(4), 467–480. <https://doi.org/10.1007/s10584-018-2210-6>
- Jeong, J. S., Sánchez-Cepeda, J. S., González-Gómez, D., Yllana-Prieto, F., and Conde-Núñez, M. C. (2021). Improving Climate Change Awareness of Preservice Teachers (PSTs) through a University Science Learning Environment. *Education Sciences*, 11(2), 78. <https://doi.org/10.3390/educsci11020078>
- Jeong, J. S., Sánchez-Cepeda, J. S., González-Gómez, D., Yllana-Prieto, F., and Conde-Núñez, M. C. (2021). Improving Climate Change Awareness of Preservice Teachers (PSTs) through a University Science Learning Environment. *Education Sciences*, 11(2), 78. <https://doi.org/10.3390/educsci11020078>
- Laudon, H., Högberg, P., Lucas, R. W., Bishop, K., Futter, M. N., Ågren, A., Egnell, G., Sponseller, R. A., and Ring, E. (2011). Consequences of More Intensive Forestry for the Sustainable Management of Forest Soils and Waters. *Forests*, 2(1), 243–260. <https://doi.org/10.3390/f2010243>
- Li, Y.-Y., and Liu, S.-C. (2021). Examining Taiwanese Students' Views On Climate Change And The Teaching of Climate Change in the Context of Higher Education. *Research in Science andamp; Technological Education*, ahead-of-print(ahead-of-print), 515–528. <https://doi.org/10.1080/02635143.2020.1830268>
- Manyi M. M., Akaangee L. M. and Onah I. E. (2017). Personal Protective Practices Against Mosquito Bites by Undergraduate Students of Federal University of Agriculture Makurdi, North Central Nigeria. *American Journal of Entomology*. 1(2): 27-30. doi: 10.11648/j.aje.20170102.11
- Marlon, J. R., Wang, X., Rosenthal, S., Howe, P. D., Bergquist, P., Mildenerger, M., Maibach, E., and Leiserowitz, A. (2022). Change in US State-Level Public Opinion about Climate Change: 2008–2020. *Environmental Research Letters*, 17(12), 124046. <https://doi.org/10.1088/1748-9326/aca702>
- Marlon, J. R., Wang, X., Rosenthal, S., Howe, P. D., Bergquist, P., Mildenerger, M., Maibach, E., and Leiserowitz, A. (2022). Change in US State-Level Public Opinion About Climate Change: 2008–2020. *Environmental Research Letters*, 17(12), 124046. <https://doi.org/10.1088/1748-9326/aca702>
- Mebane, M. E., Barni, D., Francescato, D., and Benedetti, M. (2023). Promoting Climate Change Awareness with High School Students for a Sustainable Community. *Sustainability*, 15(14), 11260. <https://doi.org/10.3390/su151411260>
- Mina, M., Messier, C., Duveneck, M. J., Fortin, M.-J., and Aquilué, N. (2022). Managing for the Unexpected: Building Resilient Forest Landscapes to Cope with Global Change. *Global Change Biology*, 28(14), 4323–4341. <https://doi.org/10.1111/gcb.16197>
- Mücke, H.-G., and Litvinovitch, J. M. (2020). Heat Extremes, Public Health Impacts, and Adaptation Policy in Germany. *International Journal of Environmental Research and Public Health*, 17(21), 7862. <https://doi.org/10.3390/ijerph17217862>
- Munasinghe, M. (1998). Climate Change Decision-Making: Science, Policy and Economics. *International Journal of Environment and Pollution*, 10(2), 188. <https://doi.org/10.1504/ijep.1998.005270>
- Mustafa, G., Latif, I. A., Bashir, M. K., Shamsudin, M. N., and Daud, W. M. N. W. (2018).

- Determinants of Farmers' Awareness of Climate Change. *Applied Environmental Education and Communication*, 18(3), 219–233. <https://doi.org/10.1080/1533015x.2018.1454358>
- Perez, T. C. (2023). A Mini-Review of the Environmental Footprint of Lithium-Ion Batteries for Electric Vehicles. *Journal of Computers, Mechanical and Management*, 2(3), 43–52. <https://doi.org/10.57159/gadl.jcmm.2.3.23068>
- Priatna, D., and Khan, S. M. (2024). The Importance of Education and Role of Educational Institutions in Climate Change Mitigation and Achieving UN SDG 13 Climate Action. *Indonesian Journal of Applied Environmental Studies*, 5(1), 1–5. <https://doi.org/10.33751/injast.v5i1.10559>
- Priatna, D., and Khan, S. M. (2024). The Importance of Education and Role of Educational Institutions in Climate Change Mitigation and Achieving UN SDG 13 Climate Action. *Indonesian Journal of Applied Environmental Studies*, 5(1), 1–5. <https://doi.org/10.33751/injast.v5i1.10559>
- Romsdahl, R. J. (2020). Deliberative framing: Opening Up Discussions for Local-Level Public Engagement on climate change. *Climatic Change*, 162(2), 145–163. <https://doi.org/10.1007/s10584-020-02754-x>
- Sanson, A. V., and Burke, S. E. L. (2019). Climate Change and Children: An Issue of Intergenerational Justice (pp. 343–362). Springer. [https://doi.org/10.1007/978-3-030-22176-8\\_21](https://doi.org/10.1007/978-3-030-22176-8_21)
- Sarma, H. H., Nath, H., Borah, S. K., Das, B. C., Sultana, N., and Dutta, N. (2024). Innovative Approaches for Climate-Resilient Farming: Strategies against Environmental Shifts and Climate Change. *International Journal of Environment and Climate Change*, 14(9), 217–241. <https://doi.org/10.9734/ijecc/2024/v14i94407>
- Singh, A. S., Prokopy, L. S., and Eanes, F. (2020). Climate Change Uncertainty among American Farmers: an Examination of Multi-Dimensional Uncertainty and Attitudes towards Agricultural Adaptation to Climate Change. *Climatic Change*, 162(3), 1047–1064. <https://doi.org/10.1007/s10584-020-02860-w>
- Tee, N. C. H., Yeo, J.-A., Choolani, M., Poh, K. K., and Ang, T. L. (2024). Healthcare in the Era of climate Change and the Need for Environmental Sustainability. *Singapore Medical Journal*, 65(4), 204–210. <https://doi.org/10.4103/singaporemedj.smj-2024-035>
- Tong, S., Hanna, E., Green, D., Butler, C. D., Hu, W., Wang, Z., Bambrick, H., Berry, H. L., and Ebi, K. (2016). Climate Change, Food, Water and Population Health in China. *Bulletin of the World Health Organization*, 94(10), 759–765. <https://doi.org/10.2471/blt.15.167031>
- Wang, D., Jarin, M., Xie, X., and Chen, Y. (2022). Increasingly frequent Extreme Weather Events Urge The Development of Point-of-Use Water Treatment Systems. *Npj Clean Water*, 5(1). <https://doi.org/10.1038/s41545-022-00182-1>
- Wolken, J. M., Rupp, T. S., Verbyla, D. L., Kruse, J. J., Hennon, P. E., Barrett, T. M., Sullivan, P. F., Conn, J. S., Euskirchen, E. S., Chapin, F. S., Hanley, T. A., D'Amore, D. V., Yarie, J., McGuire, A. D., Hollingsworth, T. N., Schuur, E. A. G., Kielland, K., Beever, E. A., Fresco, N., Sarah F. T., Lisa K. C., Patterson, T. (2011). Evidence and Implications of Recent and Projected Climate Change in Alaska's Forest Ecosystems. *Ecosphere*, 2(11), art124. <https://doi.org/10.1890/es11-00288.1>