KNOWLEDGE, AWARENESS, AND PERCEPTIONS OF CLIMATE CHANGE AMONG FORESTRY STUDENTS IN NIGERIA

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Abstract

The study examined climate change knowledge, awareness, and perceptions among forestry students in Nigeria, recognizing the pressing global concerns regarding climate change and its impact on various sectors. This research employed a well-structured e-questionnaire administered through Google Forms to gather insights from 293 respondents, including Bachelor's, Master's, and PhD forestry students across Nigerian universities offering forestry courses. Data was summarized with charts, frequency, and tables. The demographic analysis revealed that 40.27% of the respondents were male, 59.73% were female and 45.73% were within the 20-25 age group. About 71.67% of students first encountered climate change through social media, underscoring the influential role of digital platforms in environmental awareness. Causes of climate change identified by the respondents included deforestation (40%), urbanization (13%), and combustion of fossil fuels (15%), among others. The primary impacts of climate change on the environment were perceived as forest degradation (41%) and loss of forest cover (39%). Moreover, a noteworthy portion of respondents expressed deep concern about climate change's effects on Nigeria's forests, economy, and their future careers in forestry. The study also revealed that a substantial proportion of respondents had taken courses on climate change (78.84%) and could calculate their carbon footprint (54.27%). Mitigation strategies such as afforestation/tree planting (67.58%) and strict policy implementation (16.38%) emerged as prominent solutions. This research underscores the importance of strengthening climate change education among forestry students in Nigerian universities, advocating for the introduction of comprehensive climate change courses across academic levels to equip future forestry professionals with the knowledge and tools needed to address climate-related challenges effectively.

Key Words: *Climate change, forestry, mitigation strategies, deforestation, afforestation*

Introduction

Climate change is a global phenomenon that affects various aspects of our daily lives. It is caused by human activities, such as the burning of fossil fuels, deforestation, and land-use changes, which result in the emission of greenhouse gases that trap heat in the Earth's atmosphere (Karl and Trenberth, 2003; Nema *et al*., 2012). The impacts of climate change are evident in Nigeria, where extreme weather events such as floods and droughts have become more frequent and severe (Amadi and Udo, 2015). These events have significant consequences for agriculture, water resources, and human health, among others (Adesiji *et al*., 2013; Ebele and Emodi, 2016; Abdulkadir *et al*., 2017; Ogbuabor and Egwuchukwu, 2017; Akanbi *et al*., 2022).

The forestry sector, which plays a critical role in mitigating climate change, is not exempted from its impacts. In Nigeria, the forestry sector has been facing significant challenges such as deforestation, degradation, and loss of biodiversity, which are exacerbated by climate change (Aigbe and Oluku, 2012; Akinbile *et al*., 2018; Buba *et al*., 2020). Deforestation is a significant driver of climate change, as it results in the release of carbon dioxide into the atmosphere (Bala *et al*., 2007; Arshad *et al*., 2014: Nunes, 2023).

Forests play a critical role in mitigating climate change, as they act as carbon sinks, absorbing carbon dioxide from the atmosphere and storing it in trees and soil (Popoola *et al*., 2012; Alemu, 2014; Nunes *et al*., 2020). They also provide other ecosystem services, such as biodiversity conservation, water regulation, and soil conservation (MEA, 2005). Sustainable forest management practices, such as afforestation, reforestation, and conservation, can contribute significantly to reducing greenhouse gas emissions and enhancing the capacity of forests to store carbon (Ameray *et al*., 2021).

Forestry education plays a critical role in promoting sustainable forest management practices and mitigating the impacts of climate change because it provides students with the knowledge and skills necessary to manage forest resources sustainably and address the challenges facing the forestry sector (Sadowska and Lulek, 2020). The awareness and perception of forestry students on climate change are crucial in addressing the challenges facing the forestry sector in Nigeria because they can influence their behaviour and decision-making, which ultimately affects the sustainability of forest management practices (Jama *et al*., 2023).

The relationship between forestry and climate change is complex, involving several factors that encompass both the effects of climate change on forests and the role of forests in mitigating climate change (Khaine and Woo, 2015). The fifth assessment report of the Intergovernmental Panel on Climate Change (IPCC) extensively discusses the diverse impacts of climate change on forests, which include disruptions to forest ecosystems, heightened vulnerabilities to forest fires and pests, as well as alterations in the distribution and composition of species (IPCC, 2014). These transformations have significant consequences for biodiversity, the provision of ecosystem services, and the livelihoods of communities reliant on forests for various purposes. For example, prolonged periods of drought can result in

an upsurge in tree mortality rates and degradation of forest ecosystems as observed in various regions worldwide (Carnicer *et al*., 2011; Anderegg *et al*., 2015; Young *et al*., 2017). Such impacts not only diminish the ability of forests to sequester carbon effectively but also lead to the release of previously stored carbon into the atmosphere, thereby exacerbating the challenges posed by climate change (Allen *et al*., 2010).

Several studies have examined the knowledge, awareness, and perception of climate change among various groups in Nigeria, such as farmers (Adesiji *et al*., 2013; Aderinoye-Abdulwahab and Abdulbaki, 2021; Madaki *et al*., 2023) and health practitioners (Akinyemi and Gree, 2017; Kolapo *et al*., 2022; Michael and Dankyau, 2022) among others. However, little is known about the knowledge, awareness, and perception of forestry students in Nigeria on climate change. Forestry students are an essential group to study, as they are the future leaders of the forestry sector and will play a critical role in promoting sustainable forest management practices and mitigating the impacts of climate change. This study therefore assessed the knowledge, awareness, and perception of forestry students in Nigeria on climate change with a view to contribute to the academic discourse on climate change knowledge, awareness, and perception among forestry students in developing countries like Nigeria. With the roles of forests in mitigating climate change, this research will add to the existing literature on climate change knowledge, awareness, and perception. Furthermore, it may eventually assist in effective policy formulation and implementation in the forestry sector.

Materials and Methods
Study Area
Nigeria is a country located in West Africa, bordered by Niger to the north, Chad to the northeast, Cameroon to the east, Benin to the west, and the Gulf of Guinea to the south. With a population of over 200 million people, Nigeria is the most populous country in Africa and one of the most populous countries in the world. Nigeria is a federal republic comprising 36 states and the Federal Capital Territory spread across six geo-political zones. The country has a diverse cultural and ethnic makeup, with over 250 ethnic groups and languages.

Nigeria presently has a total of 260 universities recognized by the National University Commission, 51 of which are federal, 62 are state, and 147 are private (National University Commission, 2023). However, only 41 of these universities presently offer forestry at either undergraduate or postgraduate levels or both (Table 1).

Table 1: Nigerian universities offering forestry programmes

Geopolitical zone	University	Acronym
North East	Federal University Gashua	FUGASHUA
	Federal University Kashere	FUK
	Federal University Wukari	FUW
	Modibbo Adama University of Technology	MAUTECH
	University of Maiduguri	UNIMAID
North Central	Federal University Lafia	FULAFIA
	Ibrahim Badamasi Babangida University	IBBU
	Nasarawa State University	NSUK
	Joseph Sarwuan Tarka University Markudi	JOSTUM
	University of Ilorin	UNILORIN
North West	Ahmadu Bello University	ABU
	Bayero University Kano	BUK
	Federal University Dutse	FUD
	Federal University Dutsin-ma	FUDMA
	Kano State University of Science and Technology	KUST
	Kebbi State University of Science and Technology, Aliero	KSUSTA
	Usmanu Danfodiyo University, Sokoto	UDUS
South East	Alex Ekweme Federal University	AE-FUNAI
	Chukwuemeka Odumegwu Ojukwu University	COOU
	Federal University of Technology Owerri	FUTO
	Imo State University	IMSU
	Micheal Okpara University of Agriculture, Umudike	MOUAU
	Nnamdi Azikiwe University	NAU
South South	Benson Idahosa University	BIU
	Cross River University of Technology	CRUTECH
	Delta State University	DELSU
	Federal University Otuoke	FUO
	Rivers State University	RSU
	University of Benin	UNIBEN
	University of Calabar	UNICAL
	University of Port Harcourt	UNIPORT
	University of Uyo	UNIUYO
South West	Adekunle Ajasin University	AAUA
	Bowen University Iwo	BUI
	Ekiti State University	EKSU
	Federal University of Agriculture Abeokuta	FUNAAB
	Federal University of Technology Akure	FUTA
	Federal University Oye-Ekiti	FUOYE
	Olabisi Onabanjo University	OOU
	Olusegun Agagu University of Science and Technology	OAUSTECH
	University of Ibadan	UI

Source: NUC (2023)

Data Collection

The study employed a well-structured e-questionnaire using Google Forms which was sent to students through social media platforms (such as WhatsApp and Telegram) to elicit information from

students. All students studying forestry in Nigerian universities (Bachelor's, master's, and PhD) were the target population. However, only 293 students responded to the survey between May 13, 2023, and September 18, 2023. The questionnaire consists of several sections addressing different issues such as the demographic information of respondents, general climate change awareness, respondents' perception of climate change, and respondents' climate change knowledge.

Data Analysis

Data from the questionnaire was first cleaned on Microsoft Excel and analyzed using SPSS (version 20). The information was summarized with charts and frequency.

Results and Discussion
Demographic Information

Table 1 shows the demographic characteristics of the respondents in the study. One hundred and eighteen which represents 40.27% of the respondents were male and 175 (59.73%) were female. Most of the respondents (45.73%) were between the age of 20-25, 2.73% were less than 20 years, 35.83% were between 26-30 years, 12.30% were between 31-40 years while 3.41% were above 40 years of age. Age 20-25 years was the dominant which signifies youthful age and prospective work force in years to come. Adebayo *et al*. (2022) also observed about 60% of forestry students were within 20-25 years. Most (68.26%) of the respondents were undergraduate students

studying for a bachelor's degree, 24.91% were master's students and 6.83% were at PhD level. This aligns with FAO (2020) data that shows that there are always more people studying forestry at the undergraduate level than graduate level in every part of the world. This also explains why 66.55% of the respondents were generalists. The forestry curriculum for undergraduate in Nigeria is designed to expose students to general concepts of forestry. Students begin to narrow down to specific fields at master's and PhD levels. The university of most of the respondents is domiciled in the southwestern part of Nigeria (47.78%), about 12.63% of the universities of the respondents are in South-South, 2.73% are in the Southeast, 5.80% are in the Northwest and Northeast while 25.26% are in North Central Nigeria. Majority of the universities are domiciled in Southwestern Nigeria because southwestern Nigeria has the highest number of universities in Nigeria. It domiciles about 30% of Nigerian universities (Moshood and Adeleke, 2022). Most of the respondents (66.55%) were generalists studying general forestry, 2.73% were studying wildlife management and wood and fibre science, 5.80% were studying forest economics and governance, 3.75% were studying Remote Sensing and Geographic Information Systems, 4.10% were studying forest biometrics and inventory, 2.05% were studying forest operations while 12.29% were studying forest biology/silviculture.

Table 2: Demographic information of respondents in the study

Demographic Characteristics	Frequency (n=293)	Percentage (%)
Gender		
Male	118	40.27
Female	175	59.73
Age		
<20 years	8	2.73
20 – 25 years	134	45.73
26 – 30 years	105	35.83
31 – 40 years	36	12.30
> 40 years	10	3.41
Level of study		
Bachelor's degree	200	68.26
Masters	73	24.91
PhD	20	6.83
Geopolitical zone of the university		
North East	17	5.80
North Central	74	25.26
North West	17	5.80
South East	8	2.73
South South	37	12.63
South West	140	47.78
Area of specialization		
Forest Biology/Silviculture	36	12.29
Forest Operations	6	2.05
Forest Biometrics and Inventory	12	4.10
Remote Sensing and Geographic Information Systems	11	3.75
Forest Economics and Governance	17	5.80
Wood and Fibre Science	8	2.73
Wildlife Management	8	2.73
Generalist	195	66.55

Figure 1 shows the universities (and domicile geopolitical zones) of the respondents in the study. The Southwest and the South South had the highest number of universities with the University of Ibadan (UI) recording the highest number of respondents (66). This was followed by the University of Ilorin (UNILORIN) recording 50 respondents. The Federal University of Technology Akure (FUTA), Federal University of Agriculture Abeokuta (FUNAAB), and University of Benin (UNIBEN) recorded 35, 22, and 14 respondents, respectively. Federal University Gashua (FUGASHUA), Federal University Kashere (FUK), Bayero University Kano (BUK), Alex Ekweme Federal University (AE-FUNAI), Chukwuemeka Odumegwu Ojukwu University (COOU), Imo State University (IMSU) and Benson Idahosa University (BIU) recorded no respondents in the study.
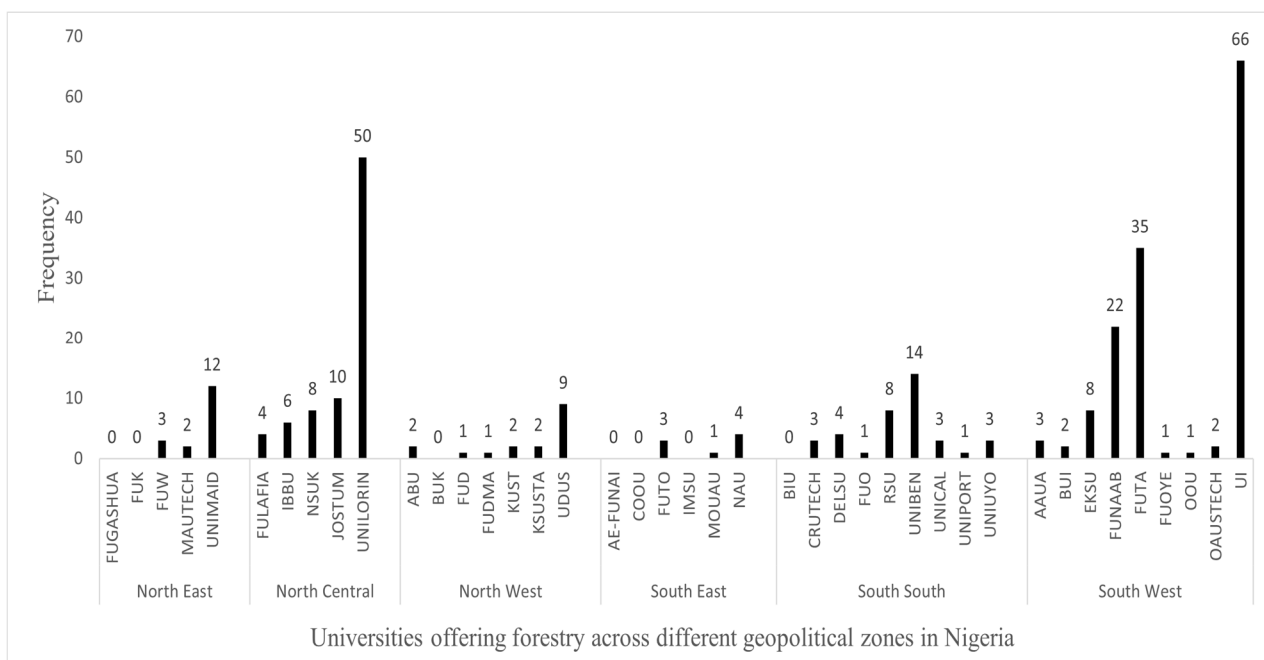
Fig. 1: Universities of respondents in the study and their respective geopolitical zones

Climate Change Awareness

Table 3 presents the awareness of the respondents on climate change. About 92.15% of respondents were very familiar with climate change, 7.85% were barely familiar and none of the respondents were not familiar with climate change. About 74.06% of the respondents had heard about climate change before enrolling in a forestry degree while 25.94% did not hear about climate change until after enrolling in a forestry degree. Most of the respondents (71.67%) first learnt about climate change on social media while others first learnt about climate change through other means such as in class (14.33%), on television/radio, and in a text (4.78%) among others. The results revealed that forestry students in Nigeria generally possess a high level of awareness of climate change, with a significant portion acquiring this knowledge through digital platforms like social media. Social media has been identified as an important source for climate change information. Ogunjimi *et al*. (2016) observed that 98.3% of the respondents in a study heard about climate change through social media. The academic environment also plays a role in increasing awareness among some students (Rafiq *et al*., 2022). This information is crucial for understanding the knowledge landscape and can inform educational strategies and climate change communication efforts among this group.

Table 3: Awareness of respondents on climate change

Question	Frequency (n=293)	Percentage (%)
How familiar are you with the term 'climate change'?		
Not familiar	0	0.00
Barely familiar	23	7.85
Very familiar	270	92.15
Have you heard about climate change before you enrolled in a degree in forestry?		
Yes	217	74.06
No	76	25.94
How did you first learn about climate change?		
In a text (book, journal articles, conference paper, etc)	14	4.78
In a training/workshop/conference	9	3.07
In class	42	14.33
On social media	210	71.67
From a friend	4	1.37
On Television/Radio	14	4.78

Causes of Climate Change

Presented in Figure 2 is the respondents' opinion about the major causes of climate change. Deforestation is what 40% of the respondents opined as the major cause of climate change. Urbanization was believed to be the major cause of climate change by 13% of the respondents, bush burning was also opined by 13% of the respondents as the major cause of climate while 15%, 11%, and 8% of the respondents' believed combustion of fossil fuel, unsustainable agriculture, and release of toxic chemicals to the atmosphere respectively were the major causes of climate change. These findings suggest that forestry students in Nigeria have a diverse understanding of the major causes of climate change, with a significant emphasis on deforestation, fossil fuel combustion, and unsustainable agriculture. This is in consonance with the findings of Mazo and San Juan (2019). Deforestation leads to the release of stored carbon dioxide and reduces the planet's capacity to absorb greenhouse gases, contributing significantly to climate change (Ali *et al*., 2014). Urbanization has a significant impact on climate change because it leads to increased energy consumption, emissions from transportation, and changes in land use (Carmin, 2012). Additionally, the burning of bushes releases carbon dioxide and other pollutants into the atmosphere. Furthermore, fuel combustion is a primary driver of climate change, releasing carbon dioxide. Unsustainable agriculture practices also contribute to issues like deforestation, soil degradation, and greenhouse gas emissions (Oelbermann, 2010). However, it's worth noting that the release of toxic chemicals, while causing local environmental damage, is not a major factor in global climate change. This understanding is reflected in the choice of just 8% of the respondents.
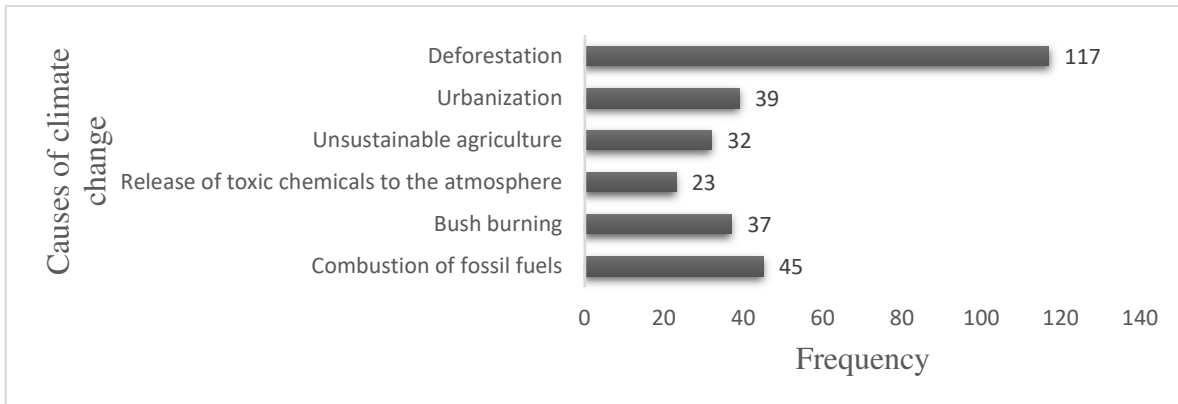
Fig. 2: Respondents' opinion on the major causes of climate change

Impacts of Climate Change

The respondents gave their opinion on the impacts of climate change on the environment (Figure 3). One hundred and twenty respondents (about 41%) of the respondents opined that forest degradation is the major impact climate change has on the environment, 114 respondents (39%) opined that it is loss of forest cover, 22 respondents (7.5%) believed it increases intensity of wildfires, 28 respondents (9.6%) believed it to be changes in species distribution while 9 respondents (3.1%) mentioned other effects as the major impacts of climate change on the environment. It can be deduced from the responses that the students understood that climate change can lead to increased temperatures, droughts, and pests, which can contribute to the degradation of forests. This perception reflects the importance of forests in Nigeria's ecosystem and the awareness of their vulnerability to climate change (Okon *et*

al., 2021). The recognition by 39% of respondents that climate change leads to the loss of forest cover is closely related to forest degradation. The two are interconnected, as forest degradation can ultimately result in reduced forest cover. This perception underscores the importance of preserving forested areas in the face of climate change. Furthermore, climate change can lead to more frequent and severe wildfires due to higher temperatures and altered precipitation patterns (Halofsky *et al*., 2020). Also, climate change can disrupt ecosystems and alter the distribution of plant and animal species (Sarah *et al*., 2020) as identified by 9.6% of the respondents. The 3.1% who mentioned other effects as major impacts could be considering a range of less common but still significant consequences of climate change, such as ocean acidification and disruptions to water resources.
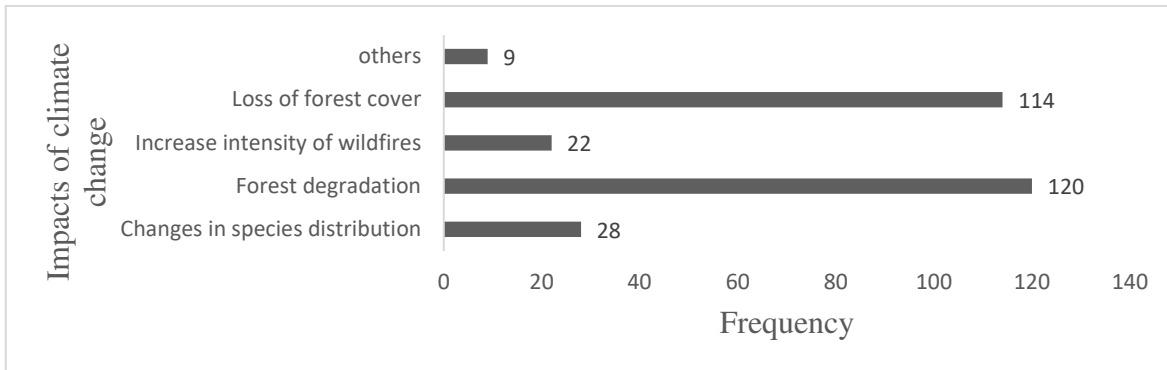
Fig. 3: Respondents' responses on the impacts of climate change

Perceptions of Climate Change

The respondents' perception of climate change is captured in Table 4. About 92.83% of the respondents were very concerned about climate change while 7.17% were barely concerned. Most of the respondents believed that climate change is a significant threat to Nigeria's forest (97.27%), a threat to Nigeria's economy (93.86%), and will affect their future career in forestry (74.74%), while a small fraction of the respondents believed otherwise. The fact that most of the respondents expressed a very high level of concern about climate change demonstrates the significance of this issue among forestry students in Nigeria. This level of concern suggests that they recognize the potential impacts of climate change and its relevance to their field of study and future careers. While most respondents were highly concerned about climate change, a small fraction expressed only minimal concern about climate change. This disparity in concern levels could be due to variations in awareness, personal beliefs, or the perceived relevance of climate change to their lives. Similarly, an overwhelming majority of the respondents believed that climate change poses a significant threat to Nigeria's forests. This perception is well-founded, as climate change can lead to increased temperatures, altered precipitation patterns, and the proliferation of pests, all of which can harm forest ecosystems (Onyekuru and Marchant, 2017). Furthermore, the recognition by majority of the respondents that climate change threatens Nigeria's economy reflects an understanding of the broad-ranging economic impacts of climate change, including disruptions to agriculture, infrastructure, and natural resources. The acknowledgment by many respondents that climate change will affect their future careers in forestry demonstrates a forward-thinking perspective. They likely anticipate changes in forestry practices, conservation efforts, and policy measures influenced by climate change awareness. Keenan (2015) noted that climate change presents a significant risk and challenges and forest managers. It is apparent that the respondents perceived climate change as a substantial threat to both the environment and the economy, as well as its potential impact on their future careers in forestry. This awareness is crucial for shaping informed decision-making, education, and policy development to address the challenges posed by climate change in Nigeria's forestry sector.

Table 4: Perception of respondents on climate change

Question	Frequency (n=293)	Percentage (%)
How concerned are you about climate change?		
Not concerned	0	0.00
Barely concerned	21	7.17
Very concerned	272	92.83
Do you think climate change is a significant threat to Nigeria's forests?		
Yes	8	2.73
No	285	97.27
Do you think climate change is a threat to Nigeria's economy?		
Yes	18	6.14
No	275	93.86
Do you think climate change will affect your future career in forestry?		
Yes	74	25.26
No	219	74.74

Climate Change Knowledge

Presented in Table 5 is the respondents' knowledge of climate change. One hundred and eight six of the respondents (63.48%) of the respondents were very confident of their knowledge of climate change, 30.38% were barely confident and 6.14% were not confident. Most of the respondents (78.84%) have taken a course on climate change while 21.16% of them have not taken any course on climate change. The results also show that 54.27% could calculate their carbon footprint, 31.40% could not, and 14.33% were not sure whether they could calculate it or not. When they were asked for their opinion on what they think can be done to mitigate the effect of climate change, 67.58%, 16.38%, 10.92%, and 5.12% mentioned afforestation/tree planting, strict policy implementation, increased awareness and education, and landscape rehabilitation, respectively. Most of the respondents expressed a high level of confidence in their knowledge of climate change which indicates that forestry students in Nigeria

feel well-informed about this critical environmental issue. A few of the respondents who stated that they were barely confident in their knowledge of climate change suggests that there is a group of students who may need additional education and awareness-building on the topic. Similarly, a fraction of the respondents admitted to not being confident in their knowledge of climate change. These individuals may require more intensive education and exposure to climate change concepts and solutions. A significant majority of the respondents have taken a course on climate change. This is a positive sign, as it indicates that many forestry students in Nigeria have been formally educated on the subject, potentially contributing to their confidence in climate change knowledge (Madaki *et al*., 2023). Although most respondents have taken a climate change course, there is still a notable percentage who have not. This highlights an opportunity for curriculum development and outreach to ensure that all forestry

students receive education on climate change. A little over half of the respondents indicated that they could calculate their carbon footprint. This demonstrates a practical understanding of personal environmental impact assessment, a valuable skill in addressing climate change. The majority emphasized afforestation and tree planting as a key approach. Other strategies mentioned include strict policy implementation, increased awareness and education, and landscape rehabilitation. These responses reflect a recognition of the multi-faceted nature of climate change mitigation efforts (Ubong *et al*., 2022). These results indicates that while a significant proportion of forestry students in Nigeria have received education on climate change and feel confident in their knowledge, there is still room for improvement in enhancing awareness and addressing the varying levels of confidence among students. Additionally, the respondents' suggestions for climate change mitigation strategies reflect their understanding of the importance of actions like afforestation and policy implementation in combatting climate change.

Table 5: Respondents' climate change knowledge

Question	Frequency (n=293)	Percentage (%)
How confident are you in your knowledge of climate change?		
Not confident		
Barely confident	18	6.14
Very confident	89	30.38
	186	63.48
Have you taken any courses that cover climate change or global environmental issues?		
Yes	231	78.84
No	62	21.16
Do you know how to calculate your carbon footprint?	159	54.27
Yes	92	31.40
No	42	14.33
Not sure		
What do you think can be done to mitigate the effect of climate change?		
Increased awareness and education		
Afforestation/tree planting	32	10.92
Strict policy implementation	198	67.58
Landscape rehabilitation	48	16.38
	15	5.12

Conclusion

This study was conducted to assess the knowledge, awareness, and perception of climate change among forestry students in Nigerian universities. From the study, the level of knowledge, awareness, and perception of the respondents was relatively high, and this may be due to the

high interconnection of forestry to climate change. It was also revealed that most of the respondents heard about climate change from the internet/social media which shows the importance of the internet in disseminating climate-related information. It is therefore important to strengthen the knowledge of climate change among forestry students in Nigerian universities and introduce courses that address the fundamentals of climate change at all levels.

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