Journal of Infrastructure, Policy and Development 2024, 8(6), 3861.
https://doi.org/10.24294/jipd.v8i6.3861

Article

Appraising the impact of climate change on construction activities: Are the Nigerian practitioners prepared?

Andrew Ebekozien[1,2,3,4,*], Mohamed Ahmed Hafez Ahmed[1], Clinton Aigbavboa[2], Mohamad Shaharudin Samsurijan[3], Andrew Igiebor Awo-Osagie[5]

[1] Department of Engineering, INTI International University, Nilai 71800, Malaysia
[2] Department of Construction Management and Quantity Surveying, University of Johannesburg, Johannesburg 2006, South Africa
[3] Development Planning and Management, School of Social Sciences, Universiti Sains Malaysia, Gelugor 11800, Malaysia
[4] Department of Quantity Surveying, Auchi Polytechnic, Auchi 312101, Nigeria
[5] Department of Quantity Surveying, Delta State University of Science and Technology, Ozoro 334113, Nigeria
*** Corresponding author:** Andrew Ebekozien, ebekoandy45@yahoo.com

CITATION

Ebekozien A, Ahmed MAH, Aigbavboa C, et al. (2024). Appraising the impact of climate change on construction activities: Are the Nigerian practitioners prepared?. Journal of Infrastructure, Policy and Development. 8(6): 3861. https://doi.org/10.24294/jipd.v8i6.3861

ARTICLE INFO

Received: 27 December 2023
Accepted: 23 February 2024
Available online: 3 June 2024

Abstract: Rapid global warming and continuous climate change threaten the construction industry and human existence, especially in developing countries. Many developed countries are engaging their professional stakeholders on innovation and technology to mitigate climate change on humanity. Studies concerning inclusive efforts by developing countries' stakeholders, including Nigeria, are scarce. Thus, this study investigates the construction industry's practitioners' preparedness to mitigate climate change through pre- and post-planning. Also, the study appraises climate change's impact on construction activities and proffered measures to mitigate them. The research employed face-to-face data collection via a qualitative approach. The researchers engaged 33 knowledgeable participants. The study covered Abuja, Benin City, Owerri, and Lagos and achieved saturation at the 30th participant. The research employed a thematic approach to analyse the collected data. Findings reveal that Nigerian construction practitioners cannot cope with climate change impacts because of lax planning and inadequate technology to mitigate the issues. Also, the government's attitude towards climate change has not helped matters. Also, the study suggested measures to mitigate the impact of climate change on construction activities in Nigeria. Therefore, as part of the research contributions, all-inclusive and integrated regulatory policies and programmes should be tailored toward mitigating climate change. This includes integrated stakeholder sensitisation, investment in infrastructure that supports anti-climate change, prioritising practices in the industry to achieve sustainable project transformation, and integration of climate change interventions into pre- and post-contract administration.

Keywords: carbon emission; climate change; construction industry; Nigeria; technology; stakeholders

1. Introduction

Climate change is a real and top environmental issue facing the globe. Agboola et al. (2023) described climate change as an environmental alteration due to unregulated human activities. This includes agricultural methods, industrial procedures, forest clearing, and fossil fuel combustion that emits greenhouse gas (GHG) emissions. In the building sector, the GHG from operational energy use is the key contributor to climate change (Ahmed et al., 2021; Francart et al., 2019; Sharma et al., 2011). Eurostat (2018) reported that the sector contributes 16% of GHG emissions within the European Union and 5%–40% in other countries (Yokoo et al., 2015). It is a long-term change in temperature forms, precipitation levels, wind

forms, and other features of climate schemes (Federici et al., 2015; Morecroft et al., 2019). Construction activities expose the environment to unfriendly consequences if not regulated. This may be compounded with climate change issues. Agboola et al. (2023) affirmed that climate change aggravates current economic and social inequalities, unduly upsetting vulnerable inhabitants, including low-income groups and developing countries. Besides the economic instability, public health issues, water shortage, and food security risks impacting humanity, it compromises the planet's ecological balance and biodiversity and causes ecosystem loss. Scholars in the construction sector, especially in developed countries, are enhancing their endeavours to reduce and acclimatise to our environmental reality (climate change) (Luo et al., 2013). Thus, it is pertinent to adapt measures and embrace mechanisms to mitigate GHG emissions, and adapting approaches should be encouraged. This may include sustainable land management, energy efficiency improvements, and renewable energy sources for mitigation. Agboola et al. (2023) emphasised that proposed measures should minimise climate change impact by integrating climate considerations into urban planning, implementing disaster preparedness plans, and enhancing ecosystems and communities' resilience. Global collaboration and cooperation are key factors in addressing climate change. This is because it is a global issue.

Globally, many efforts have been made, such as the Paris Agreement and the United Nations Framework Convention on Climate Change. These frameworks were designed to mitigate GHG emissions via various measures. In developing continents, especially in Africa, climate change may decrease if actions are taken immediately (Agboola et al., 2023; Isingoma, 2009). The scientific community need to do more to bring this to the front burner, especially in the Nigerian context. Climate change has caused waterborne diseases, pest proliferation, deteriorating coastlines, and unpredictable weather patterns in the continent. Urbanisation drives increased construction activity, which in turn drives up GHG emissions. Major cities in African nations are not exempted (Yuen and Kumssa, 2010). Rajabifard et al. (2019) opined that these African countries face inadequate human and economic resources to reduce the consequences of climate change. The need for African countries, including Nigeria and their stakeholders in the construction industry, to proffer technologically driven sustainable measures cannot be over-emphasised.

Kahan et al. (2015), Agboola (2019), Tunji-Olayeni et al. (2020), Shittu (2020), and Agboola et al. (2023) emphasised concerns about the influence of climate change on the Nigerian construction sector. The sector comprises all human-made edifices. This includes urban space, infrastructure, and buildings. Agboola et al. (2023) found that Nigeria is susceptible to climate change and faces many risks and encumbrances, especially in the construction sector. The urbanisation and rapid development may have contributed to the increased extreme weather events. This includes heatwaves, storms, and floods. Many constructed and ongoing projects have been victims, leading to human displacement and disruption of other infrastructure like transportation and network systems. Studies show that changing precipitation patterns and rising temperatures can influence the building's longevity and functionality. World Health Organisation (2021) asserted that extreme temperatures can lead to higher energy requests for cooling. This would affect the building's

energy proficiency. Hence, many developed countries engage their professional stakeholders in technological-driven and sustainable innovation to reduce its consequences.

Studies concerning inclusive efforts by developing countries' stakeholders, including Nigeria, are scarce. This is a component of the research motivation to bring to the front burner of research and mitigate climate change damages to construction activities. Besides Camilleri et al. (2001), Ezeabasili and Okonkwo (2013), Hurlimann et al. (2019), and Agboola et al. (2023), others (Beyioku, 2016; Agboola, 2019; Shittu, 2020; Tunji-Olayeni et al., 2020; Nwankpa, 2022) focused on related areas. However, none covered Nigeria, and the majority either used a quantitative or a review approach, apart from Hurlimann et al. (2019), which covered the Australian construction industry. Tunji-Olayeni et al. (2020) addressed their studies from a quantitative perspective and covered only southwestern states, and Ezeabasili and Okonkwo (2013) conducted a review. Camilleri et al. (2001) focused on climate change impacts on New Zealand's building performance and adopted a review and case studies approach. Also, Hurlimann et al. (2019) focused on the Australian construction sector and how prepared to tackle climate change challenges. Thus, this study offers measures to mitigate climate change for Nigeria's construction activities via a qualitative approach as part of the areas suggested for future studies by Agboola et al. (2023). Beyioku (2016) reviewed the causes and impact of climate change in the Nigerian environment. Agboola (2019) affirmed that climate change threatens achieving Sustainable Development Goals (SDGs). Tunji-Olayeni et al. (2020) investigated the drivers and policies for implementing sustainable construction in developing countries and used Nigeria as a case study. They identified five main drivers and suggested public sensitisation and tax relief via government regulations. Nwankpa (2022) opined that the impact of climate change is compounding Nigeria's environmental fragility risks. Extreme floods resulting from climate change have compounded construction activities in flood zones. Thus, this study investigates the construction industry's practitioners' preparedness to mitigate climate change through pre- and post-planning. The researchers will achieve the study's aim through the following:

i. To examine the level of construction practitioners' preparedness to mitigate climate change.
ii. To investigate the impact of climate change on construction activities in Nigeria.
iii. To proffer measures to mitigate climate change impacts on construction activities.

2. Literature review

The subject of climate change is incomplete without a discussion of SDG 13. Goal 13 and its targets are taking steps to mitigate climate change impacts on humanity and the environment. The Paris Agreement acknowledged this and emphasis on implementing policies and programmes to reduce building vulnerability to climate change-related issues (Kelman, 2017; UNFCC, 2015). This shows that the building industry has a great role in mitigating climate change. A regenerative and

focused construction industry embracing resilient human habitats is key to mitigating factors influencing climate change. It is a mechanism that challenges the conventional approach and encourages regenerating ecosystems (preventive) (Agboola et al., 2023). Besides the approach contributing to ecosystem resilience, it acknowledges that people's well-being is interconnected with the natural environment (Svec et al., 2012). Agboola et al. (2023) identified major regenerative construction industry principles. This includes ecological restoration, sustainable resource use, climate resilience, social equity, circular design, and integrated systems thinking.

The construction industry's role is critical in forming and transforming urban identity (Anastasiou et al., 2021; Arefi and Aelbrecht, 2022). The sector is pertinent in promoting liveable communities with attributes like resilient, inclusive, and sustainable cities in line with SDG 11. The industry needs resilience. This includes social, cultural, economic, and rejuvenation (Agboola et al., 2023). Beyioku (2016) affirmed the need for climate protection because of the possible hazards if not checked. The environment is subjective and could be abused with follow-up consequences. Hence, sustainability is the way to go. The United Nations Brundtland Commission 1987 defined sustainability as, *"A growth that satisfies the current requirements without endangering the ability of future generations to satiate urgent needs."* In line with this description, environmental sustainability, one of the three pillars of sustainable development, is the focus of this study. Others are social and economic sustainability (Van der Waal and Thijssens, 2020).

Environmental sustainability is a procedure that stresses natural and social resource uses while considering long-term situations. It is a balanced condition that enables humanity and the community to meet their needs without weakening the biological ecosystem (Morelli, 2011). Sutton (2004) described it as maintaining the physical environment qualities. Pero et al. (2017) asserted that environmental sustainability emphasises mitigating tasks that affect the environment quality over a long-term period. Unregulated construction may cause encumbrances that affect man's well-being and the environment. Tunji-Olayeni et al. (2020) affirmed that the construction industry's over-dependence on fossil fuel, especially in many countries, including Nigeria, is one major cause of environmental pollution in urban locations. Ajayi et al. (2015), Akan et al. (2017), and Tunji-Olayeni et al. (2019) identified other encumbrances emerging from unregulated construction. This includes GHG emissions and deforestation, depletion of natural resources like sand, limestone, freshwater, timber, and toxic landfills. Ness, et al. (2007) and Ebekozien et al. (2023b) emphasised that sustainable tools through the life cycle of a building are the best way to accomplish sustainability (environmental). The level of achievement can be measured using the life cycle evaluation of carbon emission. Life cycle evaluation of carbon emissions can mitigate environmental impacts (Pajula et al., 2017). Also, evaluating the carbon life cycle of people tasks in the industry can greatly mitigate environmental impacts (Al-Nuaimi et al., 2019).

Tyokumbur (2014) identified urbanisation, population increase, deforestation, desertification, pollution, and poverty as major environmental issues. The influence or activities of humans regarding the environment cannot be understated. The open grazing and epileptic power supply are anti-environmental sustainability. Hence, the

construction industry is germane to ameliorate climate change impacts through a sustainable energy economy (House of Lords, 2016). Agboola et al. (2023) identified three major factors that can influence the environment regarding climate change. This includes people task responsible for deterioration and degradation and global environmental problems. Agboola (2019) identified extreme heat island effects, air pollution, frequently rising sea level temperatures, extreme flooding, and weather patterns as evidence of climate change's impact on Nigeria's environment. Also, Agboola et al. (2023) identified variables that predict climate change in the construction industry. In their order of severity, this includes land degradation (flood erosion), biodiversity loss, smog (land, air, and water), drought (water shortage), deforestation/desertification, urbanisation, stratospheric ozone weakening, health issues, population expansion, and transport disruption. These factors are critical within climate change management mechanisms and should be addressed. They emphasise the need to reduce climate change impacts via mitigation and adaptation approaches. Hurlimann et al. (2019) clustered climate change into temperature changes, extreme weather events, and sea level rise (projected rise of 0.17–0.38 m by 2065).

3. Research method

The research employed a qualitative research design. Besides filling the established methodological gap in Agboola et al. (2023), the unexplored climate change impacts and the strategy offer an opportunity to proffer measures to mitigate factors that could enhance climate change in the construction industry. The study data were collected from thirty-three selected knowledgeable participants (Abuja, Benin City, Owerri, and Lagos), as presented in **Table 1**. Abuja and Lagos are top Nigerian cities with the highest construction practitioners that offer services to the industry (Ebekozien et al., 2023a; Odediran et al., 2013). This study expanded the coverage to fill the coverage gap in Agboola et al. (2023). The collected data were analysed via a thematic approach in line with Hurlimann et al. (2019), Tunji-Olayeni et al. (2020), and Aigbavboa et al. (2023a, 2023b). Tunji-Olayeni et al. (2020), Jaafar et al. (2021), and Ebekozien et al. (2022) avowed that interviews make the researcher flexible in getting the participants' opinions. The study's semi-structured interview questions are presented in Appendix. The investigators adopted the snowball sampling technique. Saunders et al. (2019), Ebekozien and Samsurijan (2022), and Ibrahim et al. (2022) affirmed that snowball sampling comprises drawing available and organised samples to contribute to the study. The study sample included selected construction consultants, environmentalists, relevant government ministries/departments/agencies, meteorologists, Non Governmental Organisations (NGOs), and developers/construction contractors across the covered locations (Abuja, Benin City, Owerri, and Lagos), as presented in **Table 1**. As part of the study's assumptions, the adopted cities are in Nigeria (developing nation). The interviewees' detailed particulars were concealed, but they knew about climate change and the Nigerian construction industry. The participants align with Tunji-Olayeni et al. (2020) and Agboola et al. (2023), identifying them as the main stakeholders. The interviews via recording took 50 min on average per participant.

Table 1. Interviewees' description (Source: Authors work.).

ID	Type of organisation	Location	Years of experience	Rank/post
1	Construction contracting firm	Abuja	33 years	Site manager, medium firm
2			30 years	CEO, small firm
3	Construction consultant firm		14 years	Principal manager, Arch. firm
4			18 years	Director, structural Engr. firm
5	Government official		12 years	Senior staff
6	Government higher education institution		22 years	Senior lecturer
7	Television station		14 years	Broadcaster/meteorologist
8	NGO (environment matters)		29 years	Director/founder
9			22 years	Director
10	Construction contracting firm	Benin City	29 years	CEO, small firm
11			11 years	Site engineer, medium
12	Construction consultant firm		23 years	Principal partner, QS firm
13	Government official		13 years	Senior staff
14	Government higher education institution		22 years	Academic environmentalist
15			18 years	Senior lecturer
16	Television station		10 years	Broadcaster/meteorologist
17	NGO (environment matters)		16 years	Director
18	Construction contracting firm	Lagos	17 years	CEO, small firm
19			22 years	Manager, medium firm
20	Construction consultant firm		35 years	Chief director, QS Firm
21			29 years	CEO, architect firm
22	Government official		14 years	Senior staff
23	Government higher education institution		25 years	Academic environmentalist
24	Television station		12 years	Broadcaster/meteorologist
25	NGO (environment matters)		22 years	Director
26			10 years	Staff
27	Construction contracting firm	Owerri	25 years	Operation manager, medium firm
28	Construction consultant firm		22 years	CEO, architectural firm
29			20 years	Principal director, QS firm
30	Government official		12 years	State government ministry
31	Government higher education institution		29 years	Academic environmentalist
32	Television station		11 years	Meteorologist
33	NGO (environment matters)		15 years	Deputy director

The researchers conducted the interviews between late October 2023 and early December 2023 and adopted a thematic pattern to analyse the collated data. Morse (2015) and Saunders et al. (2017) affirmed that determining sample size in a qualitative study is based on saturation. Thus, 33 oral interviews were conducted, and saturation was achieved with the 30th interviewee. After the 30th interviewee,

subsequent information was like the preceding 30 participants. Hence, the researchers believe that saturation has been achieved. This aligns with Tunji-Olayeni et al. (2020) and achieved saturation at the 15th interviewee in a related study. The investigators employed a quality assessment approach to ensure the study's findings' reliability and credibility, as presented in **Table 2**. This aligns with Yin (2014, p. 34) and Aigbavboa et al. (2024). Plano-Clark and Creswell (2015) asserted that integrity in qualitative study depends on the investigator's effort as the instrument. The study adopted words like generalisability, reliability, validity, integrity, and transferability (Aigbavboa et al., 2024). The interviewees were informed of the objectives and agreed to partake at their will. This research aligns with the best practices concerning ethics, and the interviewees were reported in an unidentified pattern. The researchers adopted open coding to analyse the transcribed data. The study utilised themeing, invivo, emotion, and narrative coding techniques (Corbin and Strauss, 2015). The themeing enhances the thematic approach of results presentation. The invivo allows verbatim quotations. Lastly, the emotion and narrative allow in-depth capture of the participants feeling as reported. The researchers generated 90 codes and re-structured based on frequency, reference, and occurrence. From the 90 codes, 12 categories emerged. Three themes were generated from them.

Table 2. Quality assessment strategies (Sources: Modified from Yin (2014, p. 34) and Aigbavboa et al. (2024)).

Method	Assessment strategies	The phase of research
Reliability	Interviewers' well-guided (consistent).	Data collection
Validity	The adoption of a recognised method (face-to-face semi-structured interviews).	Data collection
Generalisability	Recognition of limitation due to sample size potential interviewer bias.	Data analysis
Transferability	Compare the study's implications against the extant reviewed literature.	Post data analysis
Credibility	Theme approach to establish a pattern from the data.	Data analysis
Dependability	Developing semi-structured face-to-face interview guidelines.	Research design

4. Results

As presented in this section, the study's findings are timely to reawaken key construction practitioners regarding GHG emissions threats to the industry. This can be better appreciated by understanding the construction practitioners' level of preparedness, impact, and the measures for mitigating climate change in construction activities. The findings are presented as follows:

Theme one: Level of construction practitioners' preparedness to mitigate climate change

Construction activities are a major source of GHG emissions, and the environmental protection from all degradation procedures can be underscored. However, the awareness and preparedness to protect the environment from construction activities are germane to environmental protection (major). Assessing key construction practitioners' level of preparedness to mitigate climate change

impacts that may emerge from construction activities during and after the project cannot be over-emphasised. *"… construction activities and environment are correlated because construction activities occur in the environment. Likewise, without the environment, construction activities can't take place…"* said Participant P8. Globally, stakeholders are paying attention to environmental issues because of the rapid climate change and ensuring the world is a better place for habitation now and in the future. The construction practitioners cannot be left behind. Hence, one of the study's motivations. Participant P6 says, *"... the construction practitioners need to study the Paris Climate Change agreement regarding cutting carbon emissions by 50% in less than a decade and understand the role expected from them…"* Findings reveal that a lot needs to be done regarding integrating sustainable materials into the building life cycle as the way forward to mitigate GHG emissions, including across the supply chain. Participants P1, P4, P20, P24, P29, & P33 opine that construction practitioners should use sustainable tools throughout the building life cycle. Findings show that Nigerian construction practitioners know the major causes of climate change. Still, many are determining the role construction practitioners could play in mitigating the impact of climate change (majority). Construction activities expose the environment to more damage (majority) via GHG emissions. The study's findings reveal that most engaged participants (construction practitioners) need more appropriate technologies and design adaption to mitigate climate change. It should show a stronger preparedness for construction practitioners to mitigate climate change (majority). Action that will improve the construction practitioners' knowledge needs to be taken. So, stakeholders should integrate the willingness and consciousness to mitigate climate change into the mission statement of the respective construction practitioner (majority).

Theme two: Impact of climate change on construction activities

This sub-section identifies the impact of climate change on construction activities in Nigeria. Worker's migration (forced migration), increased unemployment (increased poverty/food shortage), increased running costs, and time overrun emerged in this study. Thus, 12 indirect and direct impacts on construction activities emerged. This includes:

- Worker's migration (forced migration) (majority).
- Increased unemployment (increase poverty/food shortage) (P8, P14–18, P23–24, & P33).
- Increased overheating and air-conditioning load (majority).
- Greenhouse gas emissions of buildings (majority).
- Decreased water heating-energy (P2, P5, P8, P16, P20, P30, & P32).
- Increased costs because of GHG charges (P3, P4, P19, & P28).
- Extreme flooding (rising water tables, erosion, coastal, and inland flooding) (P14, P23, & P31).
- Land-degradation (polymers) (P3, P16, & P23).
- Wind changes (P1, P11, P17, P20, P23, P27, & P33).
- Increased running costs (e.g., insurance cost) (P5, P13, P18, & P30).
- Changes in timber properties (deforestation/desertification) (P22, P29, & P32).
- Increased running costs and time overrun (majority).

Among the 12 emerging impacts, increased costs, time overruns, GHG

emissions of buildings, increased overheating and air-conditioning load, and worker's migration were frequently identified as significant impacts of climate change on construction activities. This excludes rising insurance costs and other associated costs (P5, P13, P18, & P30). Deforestation, desertification, and air pollution (wind change) are possible threats to climate change because of unregulated construction activities. Participant P26 says, *"… the environmental impact assessment of citing a construction stone-base quarry near residential location should be well evaluated. Many quarry-sites are wrongly positioned and causing air pollution to the inhabitant and exposing the environment to extreme flooding…"* In northern Nigeria, many persons have migrated from their states (Borno and Yobe States) to other states for greener pastures (P8, P14–18, P23–24, & P33). Also, the impact of climate change can be seen in massive flooding in 2021 and 2022, respectively. Many houses were destroyed in a windstorm, which increased the poverty level (majority). It could lead to heat-related illnesses if not quickly addressed. For heat-related illnesses and waterborne diseases, Participant P31 says, *"… higher temperatures and heatwaves can increase the risk of heat-related infections. This is pronounced in low-cost houses in urban areas because it is densely populated and insufficient cooling facilities…. for the waterborne diseases, dengue fever and malaria are frequent because of the changed climatic conditions..." "... we still encourage fossil fuel in urban locations and new layouts. This is unacceptable in the 21st century. The construction practitioners, especially the design team and constructors, should discourage fossil fuel use in new designs... The need to integrate sustainable materials with less GHG emission cannot be overemphasized..."* said Participant P17.

Theme three: Measures to mitigate climate change impacts on construction activities

This sub-section proffers measures to mitigate climate change impacts on construction activities in Nigeria. This has become pertinent because the industry significantly mitigates climate change emissions by promoting low climate change impact materials and methods (majority). Thus, 14 variables emerged as measures to mitigate climate change impacts on construction activities. This includes:

- Stakeholder's sensitisation through education (majority).
- Embrace sustainable consumption, green practices, and waste recycling (majority).
- Promote mitigation strategies (for overheating-solar gain control, higher insulation levels, ventilation, double glazing, etc.) (majority).
- Promote adaptation strategies (for flooding-move services to above flood, upgrade flood defences, raise or move house, etc.) (majority).
- Promote digital clean technologies (solar energy) (P2, P5, P27, & P32).
- Long-term institutional framework (mainstreaming climate change in various professional institutions activities) (P5, P8, & P24).
- Appropriate technologies for adaption and mitigation (P11, P15, P23, P30, & P33).
- Strengthen the human capacity of construction practitioners (majority).
- Create urban forests (forest preservation and regenerative practices) (P11, P15, & P27).

- Sustainable land management (P10, P22, P27, & P30).
- Biodiversity conservation (P7, P9, P13, P26, & P32).
- Water resource management (P9, P12, P18, P28, & P32).
- Urban planning (population control) (P5, P7, P13, P18, & P28).
- Research and investment (P4, P14, P26, P29, & P33).

Among the 14 emerging measures, promoting mitigation strategies, adaptation strategies, long-term institutional framework, stakeholder sensitisation through education, embracing sustainable consumption, green practices, and waste recycling, and strengthening the human capacity of construction practitioners were frequently cited by participants as pertinent measures to mitigate climate change impact on construction activities. Participant P4 says, *"... key stakeholders, especially policymakers, should prioritise interventions and allocate scarce resources to address the identified environmental problem within the construction industry. Climate change issues are better managed through preventive approach and promoting a more sustainable construction…"* The design team should ensure materials specification captures more sustainable and recycled materials. The contracting firm should complement this by embracing sustainable materials (majority). Creating urban forests within a city is a strategy for reducing the city's carbon footprint by reducing carbon intake from the atmosphere and reducing the city's energy use for cooling. Participant P10 says, *"... construction practitioners, especially Architect, should encourage the design of trees with commercial value at a strategic position within the site layout to keep carbon out of atmosphere circulation over a sufficient time frame…"* It will mitigate the impact of climate change on the property and environment. Also, climate-resilient practices advocacy, clean digital technology, and sustainable construction should be encouraged with government support (majority). Findings reveal that integrated collaboration is critical to enhancing some of the existing measures in practice.

5. Discussion

Awareness of construction stakeholders regarding environmental protection is pertinent because of their contribution to GHG emissions. Thus, there is a correlated between construction activities and the environment. Results align with Chinowsky et al. (2011) and Beyioku (2016). They affirmed that without the environment, human activities, including construction, cannot exist. Integrating sustainable materials to mitigate GHG emissions cannot be over-emphasised. Results align with Ness et al. (2007), Tunji-Olayeni et al. (2020), Alsheyab (2021), and Ebekozien et al. (2023b). They asserted that sustainable tools are the best option to accomplish sustainability in the industry. Also, results align with Ahmed et al. (2021). They affirmed that the construction industry is the major GHG emissions contributor to materials production and electricity usage. The extensive impact on the socioeconomic systems is unmeasurable on the fragile economy, including posing a threat to food security and increased unemployment if not curtailed (Nwankpa, 2022). Also, the study's results align with Hurlimann et al. (2019). They discovered low innovation in the Australian construction stakeholders, including the construction practitioners.

The emerged impact of climate change on construction activities in Nigeria slightly differ from Camilleri et al. (2001) and Hurlimann et al. (2019). Camilleri et al. (2001) investigated climate change impacts on New Zealand's building performance. Worker's migration (forced migration), increased unemployment (increased poverty/food shortage), increased running costs, and time overrun emerged in this study. The frequently identified impacts of climate change on construction activities align with Hurlimann et al. (2019) regarding construction delays and higher costs. They discovered higher construction costs and increased time for construction because of temperature changes, extreme weather events, and rising sea levels. Also, findings agree with Beyioku (2016), who found air pollution, global warming, damage to infrastructure, GHG effects, rising sea temperatures, workers migration, etc., as fall-out from climate change issues. Many houses were destroyed in a windstorm, which increased the poverty level (majority). Findings agree with Agboola et al. (2023). They discovered land degradation (flood erosion), biodiversity loss, smog (land, air, and water), a dearth (water shortage), deforestation/desertification, urbanisation, stratospheric ozone weakening, health issues, population expansion, and transport disruption as the influential factors that impact climate change on the environment. Also, these issues, if not mitigated, could lead to related health effects and worsen the poverty level of economic activities (Agboola et al., 2023). Findings agree with Ajayi et al. (2015), Akan et al. (2017), Tunji-Olayeni et al. (2019), and Tunji-Olayeni et al. (2020). Ajayi et al. (2015), Akan et al. (2017), and Tunji-Olayeni et al. (2019) identified other encumbrances emerging from unregulated construction. This includes GHG emissions and deforestation, diminishing natural resources like sand, limestone, timber, and toxic landfills. Tunji-Olayeni et al. (2020) affirmed that the construction industry's over-dependence on fossil fuel, especially in many countries, including Nigeria, is one major cause of environmental pollution in urban locations.

Theme three: Measures to mitigate climate change impacts on construction activities

Mitigating climate change impacts on construction activities is the way out via promoting low climate change impact materials and methods. Results align with Francart et al. (2019) and Hurlimann et al. (2019). They discovered that stakeholders are more willing to promote sustainable construction materials if policies and strategies are implemented. The role of the key stakeholders, including contracting firms and the design team are pertinent to improve achieving this goal. The major findings slightly agree with Agboola et al. (2023). They suggested climate change awareness and adaptation strategies to regenerate Nigeria's built environment. Also, the results align with Ness et al. (2007) and Ebekozien et al. (2023b). They emphasised sustainable tools through the life cycle of a building, including the best way to accomplish sustainability. Evaluating the carbon life cycle of people's tasks in the industry can greatly mitigate impacts. Encouraging urban forests within a city is a strategy to mitigate GHG emissions. The findings agree with Ezeabasili and Okonkwo (2013). They suggested establishing urban forests to mitigate carbon in an urban environment. Also, the results align with Agboola et al. (2023). They emphasised that stakeholder sensitisation through education and advocacy to mitigate GHG emissions is critical in fostering sustainable lifestyles. Regarding

long-term institutional framework and comprehensive strategies, findings agree with Chou et al. (2016), Yilmaz (2021), and Agboola et al. (2023). They suggested a comprehensive technique and long-term commitment at all levels (international, regional, national, and local). Chou et al. (2016) and Yilmaz (2021) found that previous studies focused on climate change scenario analysis and damage consequences to humanity.

6. The study's implications

The research findings would contribute to the scarce knowledge of climate change in a developing country's construction industry from the theoretical perspective. The research engages inclusive stakeholders through a qualitative design regarding climate change impacts on construction activities and proffered measures to mitigate the impacts from the participants' perspective. The reviewed extant literature and participants provided knowledge regarding climate change impacts and proffered measures to mitigate them. Findings reveal that climate change impacts construction activities, but differs depending on the building type, location, and construction method. Actions to mitigate climate change impacts are better taken during the design and construction phases. The items/dimensions of new constructs that emerged like strengthening the human capacity of construction practitioners, promoting digital clean technologies, worker's migration (forced migration), increasing unemployment (increase poverty/food shortage), and increased running costs (e.g., insurance costs) can be further developed and validated in future research.

Concerning the research's practical implications, recommendations would reawaken construction practitioners, especially the professional institutions and regulatory bodies, to teach the causes as part of their core responsibility to improve achieving SDG 13 (climate action). What role the construction professional can play is germane to mitigating not just climate change, but improving many SDGs related to the construction industry. It should be supported by the government. The government should lead with policies and programmes that are pro-measures to mitigate the impacts of climate change on construction activities. Other developing countries with similar encumbrances can leverage these recommendations and modify them to align with their needs. Also, the emerging strategies to mitigate climate change impacts on construction activities have far-reaching paybacks for construction practitioners and policymakers. Besides the advantages of mitigating climate change impacts on construction activities like sustainable consumption, promoting mitigation and adaptation strategies, and long-term institutional framework, the research has reawakened stakeholders to do what is needed to improve achieving SDGs, especially Goal 13. This research has significant implications for mitigation and adaptive climate change approaches in Nigeria. It highlights the impact on construction activities and offers measures beyond the conventional approaches aiming to improve and mitigate the consequences of climate change in the industry.

7. Limitations and future research

The study covered major locations, including the two cities with evidence of top-ranked construction activities and offices of practitioners in Nigeria. However, the study's primary data were collected through semi-structured interview questions. Thirty-three participants were interested in the invite and were interviewed with saturation attest at the 30th interviewee. To validate the study's findings, the researchers suggest future studies. Also, besides expanding the research method to a mixed-method approach for the generalisability of findings, a proposed framework on how to implement strategies to mitigate climate change impacts on construction activities is pertinent and should be encouraged in future studies.

8. Conclusion and recommendations

The study reveals that climate change is a critical global issue, affecting major sectors that have a role in in achieving SDGs. This is a concern for stakeholders, including Nigerian construction practitioners. Hence, this study provided an in-depth, unexplored approach (qualitative insights) to Nigerian construction practitioners' preparedness level to mitigate climate change. The study emphasises mitigation and adaptive strategies to be supported with advanced technologies and construction sustainability to mitigate the consequences of climate change on construction activities. Achieving this is challenging if not implemented before construction or during construction at most. Findings show that construction practitioners are vast regarding climate change and its impacts, but implementing measures to mitigate these consequences has been low and not encouraging. This is not good news for SDGs, especially Goal 13. It may have contributed to the construction activities' low level of innovation in proffering sustainable and feasible measures to climate change. Action needs to be taken by the relevant stakeholders, especially policymakers, construction consultants, and developers/contractors.

The study identified the impacts, and measures were suggested to mitigate climate change impacts on construction activities through a proactive and resilient mechanism. The research proffered measures mitigating climate change consequences on construction activities, as follows:

i. The researchers recommend that the government intervene through a policy framework and feasible pro-construction regulations for practitioners to embrace. This is key because government is responsible for strategic policy decisions. An example is to develop policies or programmes to promote regenerative practices in urban locations, including establishing healthy watersheds, urban forests (forest preservation), and citywide tree canopies. The Architect or Urban Planner can incorporate this mechanism at the early stage of the design. It would mitigate climate change impacts on the environment and improve the adoption of sustainable materials on a broader scale.
ii. Knowledge is germane in mitigating the impact of climate change on construction materials and its environment. It is more complicated to know that practitioners who ought to use their role to mitigate this life-threatening issue may not be well knowledgeable regarding how to go about it, as revealed. Hence, awareness and education regarding how construction practitioners' roles

could mitigate climate change impacts on construction activities should be encouraged. Construction stakeholders, especially policymakers, construction contractors, consultants should emphasise the benefit of sustainable construction through a regenerative paradigm and how it can contribute to developing a regenerative construction industry. The role expected from the practitioners, including embracing and implementing construction sustainability, is pertinent.

iii. Collaboration between the government (policymakers), industry, regulatory agencies of higher education institutions in Nigeria, and the academic sector is important. The collaboration should encourage knowledge sharing among the research units of these organisation regarding sustainable development and the construction industry. This is missing, and the gap should be bridged to facilitate innovative concepts and best practices for mitigating climate change impacts on construction activities. Collaboration would translate existing measures into practice and enhance regulatory reforms, including increased awareness of climate change impacts on construction activities.

iv. Mitigating climate change in the 21st century requires to rethinking talent, taking strategic risks, continuous learning and improvement, visualisation and mindset shifts, adaptation and mitigation strategies, and identifying goals. Achieving these requires construction practitioners' capacity building. This includes upskilling and reskilling in implementing regenerative principles, understanding the long-term sustainability of the construction industry, mitigating construction and demolition waste, embracing construction recycling, and integrating climate change considerations for the benefit of the construction industry and humanity. The outcome would mitigate GHG emissions and hazardous risks.

Author contributions: Conceptualization, AE, MAHA, CA, MSS and AIAO; methodology, AE, MAHA, CA, MSS and AIAO; software, AE, CA and MSS; validation, AE, MAHA, CA and AIAO; formal analysis, AE, MAHA, CA, MSS and AIAO; investigation, AE, CA and MSS; resources, AE, MAHA, CA, MSS and AIAO; data curation, AE, MAHA and CA; writing—original draft preparation, AE, MAHA, CA, MSS and AIAO; writing—review and editing, AE, MAHA, CA, MSS and AIAO; visualization, AE and CA; supervision, AE, MAHA, CA and MSS; project administration, AE, MAHA, and CA; funding acquisition, MAHA and CA. All authors have read and agreed to the published version of the manuscript.

Acknowledgments: Special thanks to the participants for providing scholarly contributions to enhance the findings of this study. The authors appreciate the comments, suggestions, and recommendations provided by the anonymous reviewers, which honed and strengthened the quality of this manuscript during the blind peer-review process.

Funding: This research was funded by School of Social Sciences, Universiti Sains Malaysia, George Town, Malaysia and Faculty of Engineering and the Built Environment and CIDB Centre of Excellence, University of Johannesburg,

Johannesburg, South Africa, grant number 05-35-061890. The APC was funded by INTI International University, Nilai, Malaysia.

Conflict of interest: The authors declare no conflict of interest.

References

Agboola PO (2019). Exploring the impact of climate change on public space. Environmental Epidemiology, 3, 4–5. https://doi.org/10.1097/01.ee9.0000605640.12341.b0

Agboola, O. P., Alotaibi, B. S., Dodo, Y. A., et al. (2023). Built environment transformation in Nigeria: the effects of a regenerative framework. Journal of Asian Architecture and Building Engineering, 23(2), 789–812. https://doi.org/10.1080/13467581.2023.2238045

Ahmed, N., Abdel-Hamid, M., Abd El-Razik, M. M., et al. (2021). Impact of sustainable design in the construction sector on climate change. Ain Shams Engineering Journal, 12(2), 1375–1383. https://doi.org/10.1016/j.asej.2020.11.002

Aigbavboa, C., Ebekozien, A., Afetorgbor, E. K., et al. (2024). Investigating the barriers facing corporate social responsibility in the built environment: Ghana's perspective from a qualitative approach. Property Management. https://doi.org/10.1108/pm-07-2023-0060

Aigbavboa, C., Ebekozien, A., & Mkhize, N. (2023a). A qualitative approach to investigate governance challenges facing South African airlines in the fourth industrial revolution technologies era. Social Responsibility Journal, 19(8), 1507–1520. https://doi.org/10.1108/srj-07-2022-0278

Aigbavboa, C. O., Ebekozien, A., & Mkhize, N. (2023b). An assessment of South African airlines' growth in the era of Fourth Industrial Revolution technologies: the unexplored dimension. Journal of Facilities Management. https://doi.org/10.1108/jfm-07-2022-0076

Ajayi, S. O., Oyedele, L. O., Bilal, M., et al. (2015). Waste effectiveness of the construction industry: Understanding the impediments and requisites for improvements. Resources, Conservation and Recycling, 102, 101–112. https://doi.org/10.1016/j.resconrec.2015.06.001

Akan, M. O., Dileep, G., Dhavale, D. G., Sarkis, J. (2017). Greenhouse gas emissions in the construction industry: An analysis and evaluation of a concrete supply chain. Journal of Cleaner Production, 167, 1195–1207. https://doi.org/10.1016/j.jclepro.2017.07.225

Al-Nuaimi, S., Banawi, A., Al-Ghamdi, S. (2019). Environmental and Economic Life Cycle Analysis of Primary Construction Materials Sourcing Under Geopolitical Uncertainties: A Case Study of Qatar. Sustainability, 11(21), 6000. https://doi.org/10.3390/su11216000

Alsheyab, M. A. T. (2021). Recycling of construction and demolition waste and its impact on climate change and sustainable development. International Journal of Environmental Science and Technology, 19(3), 2129–2138. https://doi.org/10.1007/s13762-021-03217-1

Anastasiou, D., Tasopoulou, A., Gemenetzi, G., et al. (2021). Public's perceptions of urban identity of Thessaloniki, Greece. URBAN DESIGN International, 27(1), 18–42. https://doi.org/10.1057/s41289-021-00172-8

Arefi, M., & Aelbrecht, P. (2022). Urban identity, perception, and urban design. URBAN DESIGN International, 27(1), 1–2. https://doi.org/10.1057/s41289-022-00179-9

Beyioku, J. (2016). Climate change in Nigeria: a brief review of causes, effects, and solutions. Available online: https://fmic.gov.ng/climate-change-nigeria-brief-review-causes-effects-solution/ (accessed on 7 March 2023).

Camilleri, M., Jaques, R., & Isaacs, N. (2001). Impacts of climate change on building performance in New Zealand. Building Research & Information, 29(6), 440–450. https://doi.org/10.1080/09613210110083636

Chinowsky, P., Hayles, C., Schweikert, A., et al. (2011). Climate change: comparative impact on developing and developed countries. Engineering Project Organization Journal, 1(1), 67–80. https://doi.org/10.1080/21573727.2010.549608

Chou, J., Dong, W., Yan, X. (2016). The impact of climate change on the socioeconomic system: a mechanistic analysis. Chinese Journal of Atmospheric Sciences, 40(1), 191–200. https://doi.org/10.3878/j.issn.1006-9895.1507.15131.

Corbin, J., Strauss, A. (2015). Basics of qualitative research: Techniques and procedures for developing grounded theory, 4th ed. Thousand Oaks, California, USA: Sage.

Ebekozien, A., Aigbavboa, C., Emuchay, F. E., et al. (2022). Urban solid waste challenges and opportunities to promote sustainable developing cities through the fourth industrial revolution technologies. International Journal of Building

Pathology and Adaptation. https://doi.org/10.1108/ijbpa-09-2021-0119

Ebekozien, A., Aigbavboa, C., Nwaole, A. N. C., et al. (2023a). Quantity surveyor's ethical responsiveness on construction projects: issues and solutions. International Journal of Building Pathology and Adaptation, 41(5), 1049–1066. https://doi.org/10.1108/ijbpa-04-2021-0061

Ebekozien, A., Aigbavboa, C. O., & Samsurijan, M. S. (2023b). Appraising alternative building technologies adoption in low-cost housing provision to achieving Sustainable Development Goal 11. Engineering, Construction and Architectural Management, 31(13), 41–58. https://doi.org/10.1108/ecam-06-2023-0538

Ebekozien, A., & Samsurijan, M. S. (2022). Incentivisation of digital technology takers in the construction industry. Engineering, Construction and Architectural Management. https://doi.org/10.1108/ecam-02-2022-0101

Eurostat. (2018) Eurostat—Data Explorer. Available online: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_ac_ainah_r2&lang=en (accessed on 31 May 2023).

Ezeabasili, A., & Okonkwo, A. (2013). Climate Change Impacts on the Built Environment in Nigeria. African Research Review, 7(4), 288. https://doi.org/10.4314/afrrev.v7i4.18

Federici, S., Tubiello, F. N., Salvatore, M., et al. (2015). New estimates of CO2 forest emissions and removals: 1990–2015. Forest Ecology and Management, 352, 89–98. https://doi.org/10.1016/j.foreco.2015.04.022

Francart, N., Larsson, M., Malmqvist, T., et al. (2019). Requirements set by Swedish municipalities to promote construction with low climate change impact. Journal of Cleaner Production, 208, 117–131. https://doi.org/10.1016/j.jclepro.2018.10.053

House of Lords. (2016). Select committee on national policy for the built environment: building better places; report of session 2015-16. Available online: http://www.publications.parliament.uk/pa/ld201516/ldselect/ldbuilt/100/10002.htm (accessed on 7 March 2023).

Hurlimann, A. C., Warren-Myers, G., & Browne, G. R. (2019). Is the Australian construction industry prepared for climate change? Building and Environment, 153, 128–137. https://doi.org/10.1016/j.buildenv.2019.02.008

Ibrahim, F. S. B., Ebekozien, A., Khan, P. A. M., et al. (2022). Appraising fourth industrial revolution technologies role in the construction sector: how prepared is the construction consultants? Facilities, 40(7/8), 515–532. https://doi.org/10.1108/f-09-2021-0086

Isingoma, J. B. (2009). Climate change and energy in Africa. Climate Change Africa, 36.

Jaafar, M., Ebekozien, A., Mohamad, D. (2021). Community participation in environmental sustainability: A case study of proposed Penang Hill Biosphere Reserve, Malaysia. Journal of Facilities Management. https://doi.org/10.1108/JEM-03-2021-0033

Kahan, D. M., Jenkins-Smith, H., Tarantola, T., et al. (2015). Geoengineering and Climate Change Polarization. The ANNALS of the American Academy of Political and Social Science, 658(1), 192–222. https://doi.org/10.1177/0002716214559002

Kelman, I. (2017). Linking disaster risk reduction, climate change, and the sustainable development goals. Disaster Prevention and Management: An International Journal, 26(3), 254–258. https://doi.org/10.1108/dpm-02-2017-0043

Luo, L., Tang, Q., & Lan, Y. (2013). Comparison of propensity for carbon disclosure between developing and developed countries. Accounting Research Journal, 26(1), 6–34. https://doi.org/10.1108/arj-04-2012-0024

Morecroft, M. D., Duffield, S., Harley, M., et al. (2019). Measuring the success of climate change adaptation and mitigation in terrestrial ecosystems. Science, 366(6471). https://doi.org/10.1126/science.aaw9256

Morelli, J. (2011). Environmental Sustainability: A Definition for Environmental Professionals. Journal of Environmental Sustainability, 1(1), 1–10. https://doi.org/10.14448/jes.01.0002

Morse, J. M. (2015). Analytic Strategies and Sample Size. Qualitative Health Research, 25(10), 1317–1318. https://doi.org/10.1177/1049732315602867

Ness, B., Urbel-Piirsalu, E., Anderberg, S., et al. (2007). Categorising tools for sustainability assessment. Ecological Economics, 60(3), 498–508. https://doi.org/10.1016/j.ecolecon.2006.07.023

Nwankpa, A. (2022). Managing existential risk and climate resilience: the case of Nigeria. Available online: https://www.brookings.edu/blog/africa-in-focus/2022/03/14/managing-existential-risk-and-climate-resilience-the-case-of-nigeria/ (accessed on 7 March 2023).

Odediran, S. J. (2013). Assessment of Business Development Strategies in the Nigerian Construction Industry. Journal of Business & Management, 2(1), 34–45. https://doi.org/10.12735/jbm.v2i1p34

Pajula T, Behm K, Vatanen S, Saarivuori E (2017). Managing the life cycle to reduce environmental impacts. In: Gr€osser SN, Arcadio Reyes-Lecuona A, Granholm G (editors). Dynamics of Lifelong Assets, Springer Nature, Switzerland.

Pero, M., Moretto, A., Bottani, E., et al. (2017). Environmental Collaboration for Sustainability in the Construction Industry: An Exploratory Study in Italy. Sustainability, 9(1), 125. https://doi.org/10.3390/su9010125

Plano-Clark, V. L., Creswell, J. W. (2015). Understanding research: A consumer guide, 2nd ed. Boston, USA: Pearson.

Rajabifard, A., Bueti, C., Zeng, L., et al. (2019). Urban drought challenge to 2030 sustainable development goals. Science of the Total Environment, 693, 133536. https://doi.org/10.1016/j.scitotenv.2019.07.342

Saunders, B., Sim, J., Kingstone, T., et al. (2017). Saturation in qualitative research: exploring its conceptualization and operationalization. Quality & Quantity, 52(4), 1893–1907. https://doi.org/10.1007/s11135-017-0574-8

Saunders, M., Thornhill, A., Lewis, P. (2019). Research methods for business students. Harlow: Pearson Education.

Sharma, A., Saxena, A., Sethi, M., et al. (2011). Life cycle assessment of buildings: A review. Renewable and Sustainable Energy Reviews, 15(1), 871–875. https://doi.org/10.1016/j.rser.2010.09.008

Shittu, O. (2020). Emerging sustainability concerns and policy implications of urban household consumption: A systematic literature review. Journal of Cleaner Production, 246, 119034. https://doi.org/10.1016/j.jclepro.2019.119034

Sutton, P. (2004). A Perspective on Environmental Sustainability? Available online: http://www.green-innovations.asn.au/A-Perspective-on-Environmental-Sustainability (accessed on 3 July 2023).

Svec, P., Berkebile, R., & Todd, J. A. (2012). REGEN: toward a tool for regenerative thinking. Building Research & Information, 40(1), 81–94. https://doi.org/10.1080/09613218.2012.629112

Tunji-Olayeni, P., Kajimo-Shakantu, K., & Osunrayi, E. (2020). Practitioners' experiences with the drivers and practices for implementing sustainable construction in Nigeria: a qualitative assessment. Smart and Sustainable Built Environment, 9(4), 443–465. https://doi.org/10.1108/sasbe-11-2019-0146

Tunji-Olayeni, P., Omuh, I., Afolabi, A., et al. (2019). Effects of construction activities on the planetary boundaries. Journal of Physics: Conference Series, 1299(1), 012005. https://doi.org/10.1088/1742-6596/1299/1/012005

Tyokumbur, E. T. (2014). Review of ecological perspectives on climate change in Nigeria. Am J. Environmental Eng Sci., 1(1), 36–49.

UNFCCC. (2015). The Paris agreement. United Nations Framework Convention on Climate Change (UNFCCC), Bonn.

Van der Waal, J. W. H., Thijssens, T. (2020). Corporate involvement in sustainable development goals: exploring the territory. Journal of Cleaner Production, 252(119625). https://doi.org/10.1016/j.jclepro.2019.119625.

Yilmaz, D. G. (2021). Model Cities for Resilience: Climate-led Initiatives. Journal of Contemporary Urban Affairs, 5(1), 47–58. https://doi.org/10.25034/ijcua.2021.v5n1-4

Yin, R. K. (2014). Case study research: Design and methods 5th ed. Thousand Oaks, USA: Sage.

Yokoo, N., Oka, T., Yokoyama, K., Sawachi, T., Yamamoto, M. (2015). Comparison of embodied energy/co 2 of office buildings in China and Japan. Journal of Civil Engineering and Architecture, 9, 300–307. http://doi.org/10.17265/1934-7359/2015.03.008

Yuen, B., Kumssa, A. (2010). Africa and Asia: Two of the World's Fastest Growing Regions. In: Climate Change and Sustainable Urban Development in Africa and Asia, 3–18. Dordrecht, Netherlands: Springer. https://doi.org/10.1007/978-90-481-9867-2_1

World Health Organisation. (2021). Climate Change and Health. Available online: https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health (accessed on 7 March 2023).

Appendix

Semi-structured interview questions:

Dear Participant,

Request for an Interview

Rapid global warming and continuous climate change threaten the construction industry and human existence, especially in developing countries. Many developed countries are engaging their professional stakeholders on innovation and technology to mitigate climate change on humanity. Studies concerning inclusive efforts by developing countries' stakeholders, including Nigeria, are scarce. Therefore, this research is titled: "Appraising the Impact of Climate Change on Construction Activities: Are the Nigerian Practitioners Prepared?" Specifically, the researchers will achieve this research through the following objectives:

i. To examine the level of construction practitioners' preparedness to mitigate climate change.
ii. To investigate the impact of climate change on construction activities in Nigeria.
iii. To proffer measures to mitigate climate change impacts on construction activities.

Please note that the interview questions will be within the stated objectives. Also, your responses will be collated and analysed with other participants. This will make up the valued and helpful contribution to achieving the success of this work, and all information provided will be handled with the greatest confidentiality.

Hence, the researcher will highly cherish your valuable time and input in answering the questions. Note that the researcher will share findings with the participants who indicate interest after the interviews via email address to be supplied by them.

Many thanks.

Yours faithfully,

(Research Coordinator)

Basic questions for the participants:

1) Please, for record purposes, what is your organisation's name and position?
2) How long have you been working in the organisation?
3) What do you understand about the term "climate change" related to the construction industry?
4) Are the construction practitioners prepared to mitigate climate change?
5) If yes to question 4, how?
6) If the answer to question 4 is no, why do you think so?
7) What is the impact of climate change on construction activities?
8) What can the stakeholders (policymakers, contractors, consultants, NGOs, environmentalists, and clients) do to mitigate climate change impacts on construction activities in Nigeria?
9) What are the possible measures to mitigate climate change's impact on construction activities in Nigeria?