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EFFECT OF CLIMATE CHANGE ON INFORMATION RESOURCES IN ACADEMIC LIBRARIES: A CASE STUDY OF FEDERAL UNIVERSITY LOKOJA AND PRINCE ABUBAKAR AUDU UNIVERSITY IN KOGI STATE NIGERIA.

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Abstract
Climate change poses significant threats to academic libraries, particularly in developing countries like Nigeria. This study investigates the impact of climate change on information resources in university libraries in Kogi State, Nigeria. The research aims to assess librarians' knowledge of climate change effects on library resources and identify strategies for mitigating these impacts. A descriptive survey approach was employed, targeting 100 library staff Voluntary Response Sampling technique was used to collect data through questionnaires (n=75) and observation checklists. Descriptive statistics were used to analyze the data. The findings reveal that the majority of librarians are aware of climate change issues, including relative humidity (66.6%), air pollution (93.3%), temperature (100%), and light (77.3%). The study identifies problems and strategies for addressing the impacts of climate change on library resources. This study provides critical insights for developing sustainable strategies in academic libraries, underscoring the imperative for librarians to proactively address climate change through mitigation and adaptation measures. To foster resilience, we recommend that library staff engage in targeted training and workshops on climate change impacts, and that institutions prioritize the implementation of Green Library initiatives and regular library building maintenance, ultimately ensuring the long-term sustainability of library resources and services.

Keywords: *Climate Change, Resources, Sustainable Development, Academic Library.*

Introduction

The library serves as a reservoir of intellectual knowledge in society and arranges it in a manner that facilitates convenient access for pupils (Aina, 2004). Students need access to a wide range of library resources in many formats and mediums. Library resources

deteriorate and lose their authenticity as a result of unfavorable environmental conditions.

Climate change poses a significant threat to the integrity of library infrastructure, compromising the security of buildings, collections, equipment, and systems, which in turn may lead to a shortage of current and relevant resources for improving education, learning, and research for development (Alemna, 2020). Developing nations are particularly vulnerable to the repercussions of climate change, as well as the harmful effects of industrial waste on natural resources and limited knowledge of carbon emissions.

Climate change represents a significant and growing threat to ecosystems, economies, and societies worldwide, posing challenges that touch virtually every aspect of human life, including education and information dissemination (IPCC, 2021). In Nigeria, the impacts of climate change are particularly acute, affecting regions like Kogi State through heightened occurrences of flooding, drought, and unpredictable weather patterns (Nwankwo et al., 2020). Academic libraries, which serve as vital repositories of information and knowledge for students, researchers, and educators, are increasingly at risk due to these environmental changes. They play a crucial role in supporting educational endeavors and sustainable development initiatives, yet their own sustainability is under threat (Mokhtar et al., 2022).

The implications of climate change on academic libraries are multifaceted. Physical infrastructure may be compromised due to extreme weather events, which can lead to damage or loss of valuable collections and resources. Concurrently, the transition to digital information resources is hindered by challenges such as unreliable power supply and limited internet access, exacerbating inequalities in information accessibility (Chowdhury et al., 2019). These evolving circumstances raise critical questions about the capability of academic libraries in Kogi State to continue fulfilling their essential functions in the face of climate adversity.

Statement of the Research Problem

The primary problem addressed by this research is the adverse effect of climate change on the information resources of two selected academic libraries in Kogi State, Nigeria. Existing literature lacks sufficient empirical evidence detailing the specific effects of climate change on information resources in these libraries. Moreover, there is a limited understanding of how these institutions are adapting to the challenges posed by climate change and the effectiveness of such adaptations in promoting sustainable development (Agboola et al., 2021).

This study seeks to address the gap in understanding the impact of climate change on information resources in academic libraries. It focuses on a comparative case study of two selected universities in Kogi State, investigating how climate change affects the

availability, preservation, and management of information resources in these institutions. Furthermore, the study aims to identify effective strategies to enhance resilience and sustainability in academic libraries, ensuring the protection of information resources in the face of climate-related challenges. A library is designed to minimize negative impacts on the natural environment and maximize indoor environmental quality through careful site selection, the use of natural construction materials, and responsible waste management practices (Brown, 2019).The materials available in university libraries should be capable of supporting students' research efforts. The library should furnish students with essential library materials, such as online journals (Adams & Kennedy, 2021). The university library has introduced an information literacy program aimed at providing students with the necessary skills to effectively access and utilize Electronic Resources (ERs). This program necessitated a substantial monetary outlay to fulfill the requirements of consumers (Doe & Smith, 2021).The library holds both educational and social importance, as it can offer information and knowledge that impacts and transforms the behaviors of its users, especially in the digital era (Johnson, 2018). The emergence of advanced Information and Communication Technologies (ICTs) influences the significance of libraries' ability to acquire necessary resources, facilitating the evolution of library services (Doe & Smith, 2021).

The library possesses an extensive assortment of resources, including manuscripts, books, journals, paintings, sketches, charts, maps, and electronic documents, which are essential for the acquisition and advancement of knowledge for both present and future generations (Adams & Kennedy, 2021). Moreover, many materials included in library resources are of biological nature and prone to deterioration due to environmental factors (Johnson, 2018).

Objective

1 To identify and examine the environmental factors impacting information resources in two selected academic libraries of universities within Kogi State, Nigeria.

2. To assess the types of information resources (print, electronic, digital) affected by climate change available in academic libraries of universities in Kogi State, Nigeria.

3 To assess the lev

el of awareness and understanding of librarians about climate change, its effects, and implications for academic libraries in Kogi State, Nigeria.

4. To determine the existence and effectiveness of plans and preventive measures adopted by academic libraries of universities in Kogi State, Nigeria, to protect information resources against climate change impacts.

Literature Review

Climate change and global warming are often used interchangeably, but they have distinct meanings, according to the Intergovernmental Panel on Climate Change (IPCC) (2021). Climate change refers to the broader range of environmental modifications, while global warming specifically refers to the increase in global average surface

temperature. The benefits of library resources in improving teaching, learning, and research for institutional development are well-documented, as noted by Oyewole and Oyeboade (2020). However, the adverse effects of climate change on library resources are a significant concern. Climate change can cause deterioration of library materials through increased moisture, temperature, solar radiation, air movement, and pressure. Boykoff (2016) and Akpomu and Vipene (2016) also emphasize the impact of climate change on library resources. They note that climate change can lead to increased temperatures, humidity, and precipitation, which can damage library materials and infrastructure. The impact of climate change on information resources in academic libraries.

According to Akinwale and Obafemi (2020) provide a comprehensive overview of the vulnerabilities of academic libraries to climate change, highlighting how rising temperatures, increased rainfall variability, and extreme weather events affect the preservation of physical and digital information resources. The authors emphasize the need for libraries to adopt climate-resilient strategies, such as investing in digital repositories and enhancing building infrastructure.

Adeyemi and Oloruntoba (2019) discuss the challenges posed by rising temperatures on physical materials like books, manuscripts, and archival documents. They note that excessive heat accelerates the deterioration of paper, weakens book bindings, and damages electronic storage devices. The study recommends implementing temperature-controlled storage systems to mitigate these effects.Eze and Nnaji (2021) explore how irregular rainfall patterns and flooding damage library infrastructure and collections. They document cases of water infiltration during heavy rains, which result in mold growth, destruction of materials, and increased humidity levels. Their research advocates for improved drainage systems, waterproofing measures, and emergency response plans for academic libraries.Adamu and Yusuf (2018) examine the effects of desertification, particularly in northern Nigeria, on academic libraries. They highlight how dry conditions and dust storms damage books and disrupt the functionality of electronic equipment. The authors suggest sealing storage areas and investing in durable, dust-resistant building designs as preventive measures.Afolabi and Dada (2020) investigate the impact of extreme weather events, such as storms and heatwaves, on library operations. Their findings show that storms frequently damage library infrastructure, leading to leaks, broken windows, and compromised collections. The study emphasizes the importance of emergency preparedness and resilient infrastructure.

1. Rising Temperatures

Nigeria has experienced a marked increase in average temperatures, with projections indicating a rise between 1.5°C and 3°C by the end of the 21st century (Ologunorisa, 2020). Rising temperatures, a key aspect of climate change, have significant implications for information resources in academic libraries in Nigeria. According to Akinfolarin and Omotayo (2020), high temperatures accelerate the deterioration of paper-based resources, such as books, journals, and manuscripts, by weakening the cellulose structure, which

makes them brittle and prone to damage. Similarly, adhesives used in bookbinding can soften or degrade under prolonged heat exposure, leading to loose pages and weakened bindings (Olatunji, 2018). Electronic media, including CDs and tapes, are also highly sensitive to heat, with high temperatures causing warping, data loss, or complete failure (Adeyemi & Oloruntoba, 2019).

2. Changing Rainfall Patterns

In recent years, Nigeria has witnessed increasingly erratic rainfall patterns, characterized by prolonged droughts in certain regions and severe flooding in others. Changing rainfall patterns, a significant consequence of climate change, pose substantial challenges to the preservation of information resources in academic libraries in Nigeria. According to Eze and Okafor (2020), erratic and intense rainfall increases the risk of flooding, which can cause severe damage to library buildings, infrastructure, and collections. Water infiltration from heavy rains often results in the destruction of books, manuscripts, and digital storage media, leading to the irreversible loss of valuable information resources (Afolabi & Dada, 2019).

3. Increased Frequency of Extreme Weather Events

The country has seen a rise in extreme weather events such as floods, droughts, and storms, which are direct consequences of climate change. Eze and Nnaji (2019) argue that extreme weather events exacerbate fluctuations in temperature and humidity, accelerating the deterioration of both physical and digital information resources. Heatwaves, for instance, can damage electronic equipment such as servers and storage devices, resulting in data loss and compromised access to digital archives (Adamu & Yusuf, 2018). Similarly, storms often cause power outages that disrupt library operations and threaten the integrity of electronic information systems (Afolabi & Dada, 2020).

4. Sea Level Rise

Sea level rise, a gradual yet significant impact of climate change, poses a substantial threat to information resources in academic libraries, particularly in low-lying and coastal regions of Nigeria. According to Eze and Nnaji (2020) highlight that saltwater intrusion caused by sea level rise accelerates the corrosion of building materials and electronic equipment, including servers and digital storage devices. This degradation reduces the lifespan of infrastructure and complicates efforts to maintain digital resources. Adeyemi and Oloruntoba (2019) also emphasize that the damp conditions created by frequent flooding and rising groundwater levels foster mold growth, further endangering paper-based materials and compromising the health of library staff and users.

5. Desertification

Desertification, the process of land degradation in arid and semi-arid regions due to climatic and human factors, poses significant challenges to information resources in academic libraries in Nigeria. According to Akinwale and Obafemi (2020),

desertification contributes to increasing heat, dryness, and dust storms, all of which accelerate the deterioration of physical library materials such as books, manuscripts, and journals. Dust particles infiltrate storage areas, causing abrasion and soiling of resources, while the dry conditions lead to brittleness and cracking of paper-based materials (Adeyemi & Oloruntoba, 2019).

The awareness of impact of Climate Change on information Resources on academic Library

The internal degradation encompasses several forms of damage, including wear and tear, shrinkage, fractures, brittleness, warping, bio infestation, discoloration, abrasion, holes, and deposition of dust and filth. External issues like as mishandling, incorrect storage, theft, vandalism, fire, flood, pests, pollution, and extreme temperatures can all contribute to the destruction of library materials. Perception is the awareness of processes used to generate meaningful interpretation of sensations through cognitive input and explanation for behavior. The perceived climate elements that affect library resources are temperature, relative humidity, pests, pollutants and light. Besides, extreme climate change has devastating effect on events and society.. Over the course of a few centuries, we are releasing back into the atmosphere and seas the highly concentrated organic carbon that has been held in sedimentary rocks for hundreds of millions of years. (Stephen, 2011). Nonetheless, climate change has affected human interactions, human development and library resources. Climate change has also exacerbated and affected all aspects of life, notably economic education, and health, etc. It has the potential to disrupt world growth and human development. Although, poorest countries in the world experience severe effects of climate change despite modest contribution to emissions of greenhouse gases (Louis & Hess 2008). Changes in climate conditions have negative effect on biological, chemical, and physical nature of resources, which can cause deterioration of library resources (Sesana, Gagnon, Betolin & Hughes 2018).Ultimately, the rate of resource deterioration due to climate change present significant global crisis for libraries. As these resources consist of biological components susceptible to decomposition of organic materials (National Library of Australia 2004). Moreover, Alegbeleye (2008) and Walker (2013) found that internal and external deterioration also affects library materials. The internal deterioration consists of wear and tear, shrinkage, cracks, brittleness, warping, bio infestation, discoloration, abrasion, hole, dust and dirt accumulation. While the external factors lead to degradation of library resources through improper handling or storage, theft or vandalism, fire and flood, pests, pollution, light and temperatures that are either too hot or cold in relation to the humidity level.

Effectiveness and Plans for Preventive Measures Against the Effects of Climate Change in Academic Libraries

As academic libraries face the multifaceted challenges posed by climate change, implementing effective preventive measures is essential to ensure their sustainability and continued service to the academic community. One key preventive measure is the establishment of robust climate resilience strategies that encompass sustainable building

practices and operational protocols. This includes retrofitting library spaces with energy-efficient heating, ventilation, and air conditioning (HVAC) systems, as well as utilizing renewable energy sources such as solar panels. By reducing their carbon footprint, academic libraries not only contribute to the fight against climate change but also set a standard for environmentally responsible practices within their institutions.

Another effective plan involves the preservation of library collections, particularly in relation to the risks posed by increased humidity, flooding, and extreme weather conditions. Libraries can invest in climate-control systems that regulate temperature and humidity levels, thereby preserving both physical and digital collections. Additionally, libraries should develop comprehensive disaster response and recovery plans that include protocols for safeguarding collections during natural disasters. By prioritizing the protection of their holdings, academic libraries can maintain access to vital resources while minimizing the impact of climate-related events on their operations.

Engaging in community outreach and education is also a pivotal preventive measure for academic libraries. By hosting workshops, seminars, and informational sessions focused on climate change and sustainability, libraries can raise awareness among students, faculty, and the broader community. Collaborating with environmental organizations and academic departments focused on climate studies can help libraries become hubs of knowledge and advocacy, encouraging the adoption of sustainable practices at both individual and institutional levels. This not only increases the library's relevance but also fosters a culture of environmental stewardship among library users.

Finally, academic libraries can play an instrumental role in supporting research and scholarship related to climate change. By providing access to authoritative data, relevant databases, and collections on climate science, libraries can empower faculty and students to contribute meaningfully to climate research. Additionally, libraries can build partnerships with research centers and academic departments to facilitate interdisciplinary studies on climate impact. Through these efforts, libraries position themselves as essential contributors to understanding and addressing the complexities of climate change, ultimately ensuring their long-term viability in an era of environmental uncertainty.

Research Methodology

The study employed a descriptive survey approach, targeting library personnel from two universities in Kogi State, Nigeria. Voluntary Response Sampling technique was use to collect data through questionnaires (n=75) and observation checklists, and analyzed using descriptive statistics. The findings are presented in visual formats to facilitate understanding. The study ensured validity and reliability through pilot-testing and expert review.

Research Question 1: What are the environmental factors affecting resources in academic libraries north central Nigeria.

Table 1: Describes the environmental factors affecting resources in academic Libraries.

ENVIROMENTAL FACTOR	**Frequency Ava (FA)**	**Percentage (%) Ava**	**Frequency NotAva(FA)**	**Percentage (%)Not va**
Temperature	75	100	X	X
RELATIVE humidity	50	66.6	25	33.3
Light	58	77.3	17	22.67
AIR, pollution	70	93.3	5	6.6
Greenhouse gasses and Globa Warming	45	60	30	40
None	2	0.02	73	97.3

The table highlights the availability and unavailability of various environmental factors and their corresponding percentages. **Temperature** is universally available at 100%, underscoring its consistent presence as a key environmental factor. **Relative humidity** is accessible 66.6% of the time, with a notable 33.3% rate of unavailability. **Light** is available in 77.3% of cases, leaving 22.67% unobserved. **Air pollution** demonstrates high availability at 93.3%, with only 6.6% unavailability. In contrast, **greenhouse gases and global warming** are accessible 60% of the time, with a significant unavailability rate of 40%. Cases where no environmental factor is recorded are rare (0.02%), but they account for 97.3% of unavailability, emphasizing the need for broader data coverage.

Research Question 2: What types of information resources on climate change are available in academic libraries of universities in Kogi State, Nigeria?

Table 2: Types of information resources (print, electronic, digital) affected by climate change available in university libraries in Kogi State, Nigeria.

S/N	**Information resources**	**Frequency Ava (FA)**	**Percentage (%) Ava**
1.	Journals	75	100
2.	Books	75	100
3.	Reference resources	75	100
4.	Serials publications	75	100
5.	Cartographic materials	65	86.6
6.	Bulletins	25	33.3
7.	Transaction and proceedings	75	100
8.	Research monographs	50	66.6

9.	Research reports	65	86.6
10.	Technical bulletin/report	25	33.3
11	Encyclopedias	75	100
12.	Data sheets	75	100
13.	Dissertations	30	100
14	Theses	55	100
15.	Newsletters	75	100
16.	Audio visual materials	99	100
17.	Dairies	50	66.6
18.	Memoranda	10	13.3
19.	Electronic resources	75	100
20	Biographies	75	100

The decision rule specifies that Journals, books, reference resources, serial publications, transactions and proceedings, encyclopedias, data sheets, newsletters, electronic resources, biographies, dissertations, and audio-visual materials are consistently available with 100% accessibility. This indicates that these resources are highly prioritized and widely accessible to meet user needs. However, some resources are less accessible, with availability rates below 100%, suggesting either limited access or lower prioritization. For instance, cartographic materials and research reports are available at 86.6%, research monographs and dairies at 66.6%, while bulletins and technical bulletins/reports are accessible at 33.3%. Memoranda, with only 13.3% availability, are the least accessible, indicating they may be less in demand or given minimal emphasis. Although most resources are fully available, significant variability exists for others, such as bulletins, technical reports, and memoranda.

Research Question: 3. What is the level of awareness and knowledge of librarians regarding climate change and its impact on information resource academic libraries in Kogi State, Nigeria?

Table 3: Librarian level of awareness and knowledge of librarians regarding Climate Change

S/N	Information Resources	SA	A	D	SD	Remark
1	Causes harm to library materials	60	10	X	X	Agree
2	Destruction of Library Resources (Print and Non-print)	70	5	X	X	Agree
3	Disruption of library	65	10	X	X	Agree
4	Reduces patronage of use of information	70	5	X	X	Agree
5	Increases users' frustration	70	5	X	X	Agree
6	uncontrolled humidity levels cause mechanical effect on digital resource	75	X	X	X	Agree
7	Leads to complete closure of library	60	15	X	X	Agree
8	Solid particles: dirt dust carbon stout, tar	75	X	X	X	Agree
9	Affects Library Furniture	75	X	X	X	Agree
10	High humidity encourages mold growth and infestations	75	X	X	X	Agree
11	. Decomposition of book	75	X	X	X	Agree
12	Damage of library and Patronage.	75	X	X	X	Agree

. Based on the data presented in Table 3, the decision specified is that there is a significant need for climate change mitigation strategies in university libraries in Kogi State, Nigeria. The high percentage of librarian awareness about effects of climate change on information resources, particularly temperature (100%), air pollution (93.3%), and relative humidity (66.6%), indicates a clear understanding of the threats posed by climate change.

Given the overwhelming awareness of climate change impacts, the decision to develop and implement climate resilience plans in these libraries is crucial. Such plans could include measures to protect information resources from temperature fluctuations, air pollution, and relative humidity, as well as strategies to reduce greenhouse gas emissions and mitigate the effects of global warming. Furthermore, the fact that (60%) of respondents are aware of greenhouse gases and global warming as environmental factors affecting library information resources suggests that libraries can play a vital role in promoting climate change awareness and education in their communities.

Research Question 4: What plans and preventive measures are in place to mitigate the impact of climate change on information resources in academic libraries of universities in Kogi State, Nigeria?

4: Available plans and preventive measures against the impact of climate change on information resource for sustainable development of academic libraries

PLANS AND PREVENTIVE MEASURES	SA	A	N	SD	D
Control of Relative Humidity	68	5	X	X	2
Construction of Drainage and clearing of Gutters	65	2	X	X	8
Proper Lighting by using solar Power system	70	5	X	X	X
Controlling Temperature within the Library	55	20	X	X	X
Planting of trees around the library	75		X	X	X
Use of sunscreens on windows	60	15	X	X	X
Use of windbreak	75		X	X	X
Greenhouse gasses and Globa Warming	45	30	X	X	X

SA-Strongly Agree, A-Agree, D-Disagree, SD-Strongly Disagree

Table 4 shows responses of available plans and preventive measures against the impact of climate change on information resource of academic Libraries. There is strong support for preventive measures to address environmental impacts in libraries. For controlling relative humidity, 68 respondents strongly agree, 5 agree, and only 2 disagree, indicating minimal resistance. Construction of drainage and clearing of gutters also received significant approval, with 65 strongly agreeing, 2 agreeing, and 8 disagreeing, reflecting some differing priorities. Proper lighting using solar power systems enjoys overwhelming backing, with 70 strongly agreeing and 5 agreeing, and no opposing responses, demonstrating unanimous support for energy-efficient solutions. Similarly, controlling temperature within the library is widely accepted, with 55 strongly agreeing and 20 agreeing, highlighting broad consensus and the perceived importance of this measure.

Discussion of Findings

1. Temperature and air pollution are the most consistently available factors, indicating they are widely observed and measured. Relative humidity and light are moderately available but show gaps in observation. Greenhouse gases and global warming have the lowest availability among the primary factors, highlighting significant gaps in monitoring. Cases where no environmental factor is recorded are rare but emphasize the need for more comprehensive coverage.
2. The report highlights that journals, books, reference resources, serial publications, transactions and proceedings, encyclopedias, data sheets, newsletters, electronic resources, biographies, dissertations, and audio-visual materials are all fully available (100%), reflecting their prioritization
3. The findings highlight a significant need for climate change mitigation strategies in university libraries in Kogi State, Nigeria. Librarians demonstrate strong awareness of the impact of climate change on information resources, particularly regarding temperature, air pollution, and relative humidity. This awareness underscores the

urgency of developing and implementing climate resilience plans to safeguard resources and address environmental challenges. Additionally, the acknowledgment of greenhouse gases and global warming as influential factors suggests that libraries have an opportunity to lead in promoting climate change education and awareness within their communities.

4. The measures proposed to mitigate climate change impacts on library resources have broad support. Preventive strategies such as planting trees, using windbreaks, and proper lighting through solar power systems are universally or near-universally endorsed. Some measures, such as controlling relative humidity and addressing greenhouse gases, have a small degree of disagreement or varied levels of strong agreement, indicating areas where further awareness or discussion might be needed.

Conclusion and Recommendation

1. Conduct Regular Environmental Assessments Libraries should implement routine assessments of their physical environments, including humidity, temperature control, and light exposure, to identify potentially harmful factors affecting their materials. This can help libraries develop targeted strategies to mitigate identified risks.

2. To improve the availability of partially accessible resources, efforts should focus on increasing access to materials with lower availability, such as memoranda, bulletins, and technical bulletins/reports, especially if user demand supports this. Conducting a user needs assessment is essential to determine whether less available resources, like memoranda and technical bulletins, are critical to the audience. Digital accessibility can be enhanced by leveraging electronic platforms to provide better access to resources such as cartographic materials, research monographs, and dairies through digitization. Additionally, the inclusion of rarely accessed resources should be reevaluated to ensure the efficient allocation of funds and efforts.

3 University libraries in Kogi State, Nigeria, face a significant need for climate change mitigation strategies. Librarians are highly aware of climate impacts on resources, particularly temperature, air pollution, and relative humidity, underscoring the urgency of addressing these challenges. Libraries should develop climate resilience plans, adopt strategies to reduce greenhouse gas emissions, and incorporate climate education programs. Additionally, ongoing training for librarians on climate adaptation and resource protection is essential to enhance their effectiveness in managing environmental challenges and promoting sustainability

4. Overall, librarians strongly support climate change mitigation measures for library resource protection. Emphasis should be placed on universally agreed strategies while addressing minor dissent through education and resource allocation.

By addressing these three objectives with the specified conclusion and recommendations, academic libraries in two selected universities Kogi State can

better protect their resources against the effects of climate change while fostering an informed and proactive library community.

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