

## **THE EMERGENCE OF TECH COMPANIES AND SUSTAINABLE LEGAL FRAMEWORK IN NIGERIA.**

**Enakireru Eric Omo (PhD)**

Department of Jurisprudence and International Law,  
College of Law,  
Western Delta University, Oghara,  
Delta State, Nigeria.

**Abotu Goodnews**

Associate Lawyer,  
Eric Omo & Associates.

### **Abstract**

The Nigerian business space over the past decade has experienced explosion of Tech companies especially in Financial Technology and Educational Technology. In the financial technology services alone, there are more than 200 registered startups. With the drastic shift from industrial and information ages to digital age, the future is now tied to providing knowledge based solutions to practical problems in finance, education, medicine, commerce and other critical areas of human endeavour. Nigerian entrepreneurs are now seeking for various ways through the use of technology to solve human problems. The rise of Nigerian Tech Startups has led to several spontaneous adjustments in the corporate and business regulation sector in Nigeria, for instance on the 18th of May 2022, the federal government approved tax reliefs for tech startups in the country. This article examines corporate regulations binding on these Tech companies, regulatory compliance for tech startups, it also considers extant and proposed laws intending to regulate the activities of these companies in Nigeria. The article recommends the amendment of certain laws and enactment of more laws to regulate the activities of tech companies as this will enhance sustainable development of the sector to meet up with best competitive practices in developed economy and concludes that in a developing country like Nigeria there is the need for innovation, growth, development and the legislature must make laws to promote these concepts because as more Tech companies emerge it is imperative to create a legal environment where they can thrive in a sustainable global economy.

**Keywords:** Tech, Companies, Startups, Legislations.

### **Introduction**

Due to the rise in the activities of startup Tech companies, it becomes imperative to look at the impact of their emergence on the laws governing such companies and how the companies have complied to these rules and regulations. There are several corporate legislation binding on Tech companies however the primary law governing companies in Nigeria is the Company and Allied

Matters Act (CAMA) 2020, which deals with the various types of company structures, eligibility, process of regulation and rules for operation.

There are however others such as: Companies Income Tax Act, Investment and Securities Act, these companies also need to be registered under agencies like National Office for Technology Acquisition and Promotion (NOTAP) and the National Information Technology Development Agency(NITDA).

More than ever, innovation remains one of the key features of the 21st century, with technology startups developing solutions which companies are leveraging on to change their industries and consequently, improve service delivery and solve other socioeconomic challenges. Nigeria is not left behind with the steady rise of technology startups from Fin-Techs disrupting the financial services space to Agri-Tech. Despite the massive impact, these startups need the necessary Legal/Financial expertise to navigate the risk associated with their ventures.<sup>1</sup>

As more and more of these startups emerge, more rules and regulations must be developed to guide the innovative activities of these companies. For Instance, currently there are no statutes specifically created to regulate electronic contracts and digital services, apart from the general laws regulating businesses and contracts in Nigeria. Although several of these startups and Fin-Tech companies predate most existing sector laws and regulations. Regardless of the year of incorporation or commencement of business, there are several legal requirements and obligations that must be complied with alongside mandatory legislation and guidelines that regulate the activities of these companies.<sup>2</sup>

The emergence of Tech companies has also given rise to new legislation like the Nigeria Startup Bill 2021 and the National Information Technology Development Agency Bill 2021.

### **Regulatory Compliance for Tech Startups**

A Tech Startup has been defined as a company whose purpose is to bring technology product or services to the market. These companies deliver new technology products or services or deliver existing technology products or services in new ways. Interestingly, even traditional non-tech based companies are beginning to leverage on technology for things like ecommerce, digital marketing etc.

There are various regulations new Tech companies must comply with ranging from Company Registration Laws, Intellectual Property Laws, Taxation Laws, Data Protection Laws and Acquisition and Transfer Laws.

For Fin-Tech Startups, the legal and regulatory frame work is that which is generally applicable to Financial Institutions, such as The Central Bank of Nigeria (CBN) Act 2007, The Banks and Other Financial Institution Act (BOFIA) 2020 and all subsidiary instruments stemming from same are all relevant to non-bank led startups providing digital equivalents of offline financial services. This

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<sup>1</sup> Commencing Business in the Technology Space in Nigeria: Legal Guide, Advocacy Law Practice Pg. 1

<sup>2</sup> Overview of the Nigerian Legal Framework for Technology Startups and Fintech Companies, DCSL Corporate Services Limited Pg. 1

frame work brings with it mandatory obligations such as Know Your Customer (KYC) and Anti-Money Laundering (AML) requirements that must be strictly adhered to.<sup>3</sup>

Compliance refers to the practice of obeying rules or request made by people in authority. Every company has specific compliance obligations that it must comply with to keep its licenses.<sup>4</sup>

Under the Company and Allied Matters Act (CAMA) 2020 startups must take note of the different companies under the CAMA and their minimum capital share, companies are also required to file annual returns once a year at the Corporate Affairs Commission. This is important because it informs the commission and the general public that the company is still active. Failure to do this leaves the company liable to a penalty as may be prescribed by the commission. New companies are not required to file annual returns in the year of their incorporation or in the following year, as long as it holds her First Annual General Meeting (AGM) within 18 months of incorporation.

Regulation is important but it is imperative that regulatory environment promotes growth, funding, staffing and eventually viability of startups i.e. enable startups achieve scalability within the shortest time, and for that to happen, regulations need to stimulate growth and boost investors' confidence, while protecting customers and society.<sup>5</sup>

In shaping the future of the tech industry legislative bodies and policy makers must make laws and policies that advances innovation and growth, these companies should in turn be proactive and anticipate these regulatory laws.

### **Extant Laws and Regulatory Bodies for Fin-Tech Companies**

The main regulators of the Fin-Tech sector in Nigeria are the following:

- A. The Central Bank of Nigeria (CBN)
- B. The Nigerian Deposit Insurance Commission (NDIC)
- C. The Nigerian Communication Commission (NCC)
- D. The Securities and Exchange Commission (SEC)
- E. The National Information Technology Development Agency (NITDA)
- F. The National Insurance Commission (NAICOM)
- G. The Federal Competition and Consumer Protection Commission (FCCPC)
- H. The Corporate Affairs Commission (CAC)
- I. The Federal Inland Revenue Service (FIRS)
- J. The National Office for Technology Acquisition and Promotion (NOTAP)

#### *A. Central Bank of Nigeria (CBN)*

The CBN has primary responsibility for regulating lending and payment financial services in Nigeria. The CBN is the principal regulator mandated to issue Licenses to banks and

<sup>3</sup> The legal Consideration of Running a Fin-Tech Startup in Nigeria; Tech-point Africa, [www.techpoint.africa/2017/03/28/fintech-startup-legal-considerations](http://www.techpoint.africa/2017/03/28/fintech-startup-legal-considerations). Last assessed 22nd August 2022

<sup>4</sup> Muiyiwa Atoyebi & Nnamdi Okoronkwo, Setting Up a Compliance Framework as a Startup, [Newstimes.com.ng/setting-up-a-compliance-framework-as-a-start-up-by-oyetola-muyiwa-atoyebi-nnamdi-okoronkwo/amp/](http://Newstimes.com.ng/setting-up-a-compliance-framework-as-a-start-up-by-oyetola-muyiwa-atoyebi-nnamdi-okoronkwo/amp/) Last assessed 24th August 2022

<sup>5</sup> Regulating Startups to Death: The Curious Case of Nigerian Regulators Pg. 3

other financial institutions by virtue of the Banks and Other Financial Institutions Act, 2020 (BOFIA). Fintech companies offering financial services to Nigerian customers must obtain the appropriate licenses and comply with CBN's applicable Guidelines.<sup>6</sup>

*B. Nigerian Deposit Insurance Commission (NDIC)*

The NDIC is responsible for insuring all deposit liabilities of licensed banks and other deposit receiving financial institutions in Nigeria. Fintech companies that are in business of obtaining and saving money deposited by Nigerian customers, such as Payment Service Banks, must be registered with the NDIC, pursuant to Section 15 of the NDIC Act, 2006.<sup>7</sup>

*C. Securities and Exchange Commission (SEC)*

The SEC is the securities and capital markets regulator in Nigeria pursuant to the Investments and Securities Act 2004 (ISA). Fintech companies desirous of raising capital from the capital market must register their securities with the SEC and comply with the ISA and the rules made thereunder.<sup>8</sup>

*D. Corporate Affairs Commission (CAC)*

The CAC carries out the incorporation of and official record-keeping for all Companies and Allied Matters Act, 2020. Fintech companies (including banks) must be incorporated at the CAC to carry on business in (as distinct from doing business) Nigeria except otherwise exempted from this requirement by the Minister of Trade, Industry and Investment ( see Sections 78 & 80 of CAMA 2020)<sup>9</sup>

*E. The Nigerian Communication Commission (NCC)*

The NCC is empowered by the Nigerian Communication Act, 2003 to regulate the telecommunications industry in Nigeria, thus Fintech companies offering services that involve the use of mobile networks or mobile phones are subject to NCC's regulatory purview and must obtain operating licenses from the NCC. For Instance, companies that operate mobile payments must be licensed by the NCC pursuant to the License Framework for Value added Service (VAS). The NCC VAS regulation defines a VAS provider as a person or organization engaged in the provision of Value-added mobile/fixed services.<sup>10</sup>

*F. The National Insurance Commission (NAICOM)*

The NAICOM was established by the NAICOM Act, 1997 with the responsibility for ensuring the administration, regulation and control of insurance business in Nigeria. Thus, where an insurance tech company carries on insurance business, it will require a license from NAICOM.<sup>11</sup>

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<sup>6</sup> Favour Ogini, Samuel Dunmade, Titilola Hassan, Fintech Laws and Regulations 2022|Nigeria, Global Legal Insights, [www.globallegalinsights.com/practice-areas/fintech-laws-and-regulations/nigeria/amp](http://www.globallegalinsights.com/practice-areas/fintech-laws-and-regulations/nigeria/amp)

<sup>7</sup> Ibid Pg. 6

<sup>8</sup> Ibid Pg. 6

<sup>9</sup> Ibid Pg. 6

<sup>10</sup> Ibid Pg. 6

<sup>11</sup> Ibid Pg. 6

G. *The Federal Competition and Consumer Protection Commission (FCCPC)*

The FCCPC was established by the Federal Competition and Consumer Protection Act, 2018 (“FCCPA”). The FCCPA provisions extend to Fintech companies that do not qualify as banks or other Financial institutions as defined by BOFIA and to this extent prohibits anti-competitive practices in the Fintech space. The practices covered include price-fixing market division and exclusive dealing agreements that have anti-competitive effect. The regime here is as yet relatively undeveloped. Much about the regime is unclear.<sup>12</sup>

H. *The National Office for Technology Acquisition and Promotion (NOTAP)*

The NOTAP is the primary legislation in Nigeria which regulates the transfer of technology agreements. The NOTAP provisions extends to Nigerian Fintech companies entering into any technology transfer agreements in their business with foreign entities.<sup>13</sup>

I. *The Federal Inland Revenue Service (FIRS)*

The FIRS is the federal tax regulator in Nigeria; Fintech companies are required to remit income, withholding, value added and stamp taxes to the government through the FIRS. Pay-as-you-earn taxes are remitted to the state (not federal) internal revenue services for the location where the employee in question works.

There is no single primary statute specifically targeted towards Fintech companies in Nigeria, there are however several statutes and regulation guiding the Fintech Space.

They include the Companies and Allied Matters Act 2020, The Investments and Securities Act 2007, The NAICOM Act, the BOFIA, the EFCC Act 2004, the Finance Act 2021, CBN Regulations etc. There is yet neither a policy document nor regulations focused on addressing the issues likely to be posed for Fintech Companies by the advent of the Metaverse.<sup>14</sup>

The technology industry is growing at such a rapid pace and the laws in Nigeria have not been able to keep up with this growth, there is hence no adequate Legal or institutional framework to govern and regulate the activities and operation of this companies. Currently, the main laws governing Tech companies in Nigeria are:

- A. Company registration laws which are embedded in the Companies and Allied Matters Act CAMA 2020
- B. Intellectual Property Laws such as the Nigerian Copyright Act, Patent and Design Act, Trademark Acts
- C. Taxation laws
- D. Data Protection Laws such as the Nigeria Data Protection Regulation 2019, The Cybercrimes (Prohibition and Prevention) Act etc.
- E. Acquisition and Transfer Laws such as the NOTAP Act.

A. *Company Registration Laws*

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<sup>12</sup> Ibid Pg. 6

<sup>13</sup> Ibid Pg. 6

<sup>14</sup> Ibid Pg. 6

The very first provisions to be aware of is the Companies and Allied Matters Act 2020.

- **The Companies and Allied Matters Act 2020**

To provide commercial and business services including e-commerce, the Corporate Affairs Commission requires that all such businesses or persons be registered as an entity under a category in the Companies and Allied Matters Act, the category of business is dependent on the structure of the business, size and goal. Section 18(2) of the CAMA 2020 now makes it possible for or only one Member or Shareholder to establish a private company.<sup>15</sup>

The Companies and Allied Matters Act 2020 is one of the most power legislation aiding the advancement of tech companies in Nigeria, for instance Section 175(1) of the CAMA<sup>16</sup> provides that instruments of transfer of shares shall include electronic instruments of transfer. Companies are able to record equity such as preferred shares, ordinary shares, convertible notes as digital shares, and issue them accordingly. A number of developed countries have since advanced towards digitization and Nigeria is following in this pattern with the advantage and convenience of electronic shares. Electronic shares have quite a number of advantage over paper issued shares, one of which is that they cannot be easily lost or stolen as compared to the paper certificates. It is also easier to track and manage electronic shares by companies.

Also Section 101 of the CAMA provides that an electronic signature is deemed to satisfy the requirement for signing. In Section 240(2) of the CAMA private companies may conduct its meetings virtually so long as it is conducted in accordance with the Articles of Association of the company. By Section 731(2) of the CAMA company records can be maintained in electronic format.

*B. Intellectual Property Laws.*

Tech companies should also register their trademarks, trademarks are images, logos, pictures, symbols, names, signs, designs, colors, sounds and jingles etc. which distinguish a product or service from others. By registering trademarks under the Trade Marks Act, the owner retains exclusive right of use and can institute legal action against anybody who infringes on this right. The Nigerian Copyright Act(NCA) classifies computer programmes also refer to as software's as literary works which are eligible for copyright protection.<sup>17</sup>

*C. Taxation Laws*

Tech companies are also governed by taxation laws, the Federal Government through establishment of the Nigerian Investment Promotion Commission (NIPC) released guidelines for pioneer status incentives, which include, among other things:

- a) A three-year tax holiday from the initial stage

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<sup>15</sup> Olajumoke Ogunfowora 5 Legal Provisions Tech Startups Should Know About February 2022 [aocsolicitors.com.ng/5-legal-provisions-tech-startups-should-know-about/](https://aocsolicitors.com.ng/5-legal-provisions-tech-startups-should-know-about/)

<sup>16</sup> Companies and Allied Matters Act 2020 herein called CAMA

<sup>17</sup> Ibid Pg. 9

- b) Ten Percent withholding tax would not be deducted from dividends paid to company shareholders.

Another tax law which is levied on ICT Companies is called the Information Technology Tax, this tax is payable by specified companies (GSM service providers and all telecommunications companies, cyber companies and internet providers, pension managers and pension related companies, banks and other financial institutions and insurance companies) who have an annual turnover of One Hundred Million Naira (N100,000,000). The companies are to pay a levy of one percent (1%) of their annual profit before tax to the National Information Technology Development Fund (NITD Fund). This tax when paid is tax deductible for company income tax purpose.<sup>18</sup>

*D. Data Protection Laws*

The NITDA Act empowers the National Information and Technology Agency (NITDA) to issue guidelines to cater for electronic governance and monitoring the use of electronic data exchange. Deriving from this provision, NITDA then developed and issued the Nigeria Data Protection Regulation 2019.

The Cybercrimes (Prohibition and Prevention) Act criminalizes data privacy breaches. It prescribes that anyone or service provider in possession of any person's personal data shall take appropriate measures to safeguard such data.

The fundamental purpose of the CPPA is to establish a framework for the prohibition, prevention, detection, prosecution and punishment of cybercrimes in Nigeria. It imposes an obligation on mobile networks; computers and communications service providers to store and retain subscriber information for a period of two years.<sup>19</sup>

*E. Acquisition and Transfer Laws*

The NOTAP Act LFN 2007 as well as the revised guidelines made thereunder provide the regulatory frame work for the regulation of transfer of technology and/or expertise between offshore service providers and Nigerian Companies. NOTAP registers technology transfer agreement in sectors like manufacturing, Information communication technology (ICT), finance and insurance, oil and gas, power and energy etc.

This Act establishes the National Office of Technology Acquisition and Promotion (NOTAP), which facilitates the flow of foreign technology into Nigeria. NOTAP also registers all contracts for the transfer of technology to Nigerian partners and seeks to promote locally generated technologies.

The NOTAP Act specifies the types of agreements that must be registered with NOTAP. These includes the use of trademarks, the right to use patented inventions, and the supply of technical expertise, engineering and machinery.

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<sup>18</sup> Ibid Pg. 9

<sup>19</sup> Ibid Pg. 9

It is important that all Tech startups before commencing operations go through all relevant legal provisions such as the ones mentioned above in to her to comply with the law as well as avoid civil liability or in some cases criminal charges for breach of any given regulation.<sup>20</sup>

### **Proposed Laws and Regulations for Tech Startup Companies**

There are two major bills seeking to regulate the activities of startups in Nigeria they are the Nigeria Startup Bill 2021 and the National Information Technology Development Agency (NITDA)Bill 2021.

#### **The Nigeria Startup Bill (NSB) 2021**

The Nigeria Startup Bill project is managed by the ventures platform foundation and supervised by the presidential strategic Advisory Group(PSAG) comprising of stakeholder representatives from the public sector and Tech startup ecosystem in Nigeria.

Government authorities and Tech ecosystem organizations are also partnering with PSAG to ensure that the NSB reflects global best practices and perspectives from countries like Senegal and Tunisia that have enacted their startup laws. Apart from being the first joint initiative between the government and the tech ecosystem, the NSB will provide startups with regulatory clarity, improved access to capital, and an enabling environment to drive sustainable growth and scalability. Since the commencement of the drafting process of the NSB in July 2021, the Bill has received a collection of inputs from several members of the Tech ecosystem and government through a series of town hall meetings, webinars, and rallies. Although the draft law may not provide answers to all the problems confronting the typical tech startup, it promises realistic provisions to issue relation to incorporation, fundraising, licensing, growth and operations and exits.

The bill is suited for startups as it seeks to solve the regulatory, financial and structural constraints that have plagued the Nigerian ecosystems over the years. The bill is set to create an enabling environment for startups, as well as facilitate the rebuilding of the Nigerian economy on a step by step basis. In all, the view is expressed that the bill is indeed a welcomed innovation<sup>21</sup>

The bill seeks to harmonize all pieces of legislation towards incentivizing and protecting investments in innovation, increasing industry, government engagement, building Nigeria through talent development and encouraging investments in infrastructure as a tool for economic stability. Notable provisions of the draft legislation include the creation of National Council consisting of individuals from both the private and public sectors, to advise regulators.<sup>22</sup>

The Nigeria startup Bill (NSB) 2021 is a joint initiative by President Muhammadu Buhari and a group of technology practitioners and policymakers which aims to provide an enabling

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<sup>20</sup> Ibid Pg. 9

<sup>21</sup> O.M Atoyebi S.A.N, Nigerian Startup bill 2021: Comparative Analysis Pg. 5

<sup>22</sup> Inyene Ibanga, The Nigerian Startup Bill and the Regulatory Framework, Premium Times, [www.premiumtimesng.com/opinion/495348-nigerian-startups-bill-and-the-regulatory-framework-by-inyene-ibanga.html](http://www.premiumtimesng.com/opinion/495348-nigerian-startups-bill-and-the-regulatory-framework-by-inyene-ibanga.html), Last assessed 24th August 2022



environment for startups in Nigeria. The ultimate goal is to position Nigeria as Africa's leading digital technology centre, The NBS aim to tackle issues may Tech startups are currently facing in Nigeria and to ensure that Nigeria is a startup friendly environment for both founders and investors to carry out business since its launch in May 2021 by the presidency the bill has gathered support from all participating ministries, departments and organization as well as from both chambers of the National assembly.<sup>23</sup>

### **NITDA Bill 2021**

The NITDA Act 2007 which establishes the National Information Technology Development Agency (NITDA) as the agency to oversee Nigeria's Technological Transformation is quite outdated, and to keep with the pace of innovation that has swept the country, NITDA task itself to review these laws and make them more beneficial for Startups.

This new bill NITDA Bill 2021 wants tech companies operating in Nigeria to get a license, pay pre-tax profits levies and sanction whoever operates contrary to the new Act. Section 6 of the Bill details the powers accrued to NITDA. Some of them include the power to fix Licensing and authorization charges, collect fees and penalties and issue contravention notices and non-compliance with the Act.

The agency says it also reserves the right to “enter premises, inspect, seize, seal, detain and impose administrative sanctions on erring persons and companies who contravene any provision of the Act”, subject to a court order.

In Section 13, NITDA proposes establishing a fund (The National Information Technology Development Fund) to carry out the country’s digital economy objectives.<sup>24</sup>

The bill declares that tech companies making an annual turnover of 100 Million Naira (\$200,000) will have to pay a levy of 10% of their profit before tax. The proposed bill carries a lot of regulation for individuals and corporate carrying out Tech related activities.

Meanwhile some Legal Experts in the country are critical of the proposed NITDA (Repeal and Re-enactment) Bill because they believe that the bill has provisions overlapping on the regulatory functions of other agencies, they also observed that a number of the provisions in the Bill are ambiguous, unclear, nebulous, fluid and capable of exerting substantial regulatory conflict in the system.

The planned NITDA Bill 2021 is seriously generating heat in the industry over its possible overlapping and over bearing effects on some functions, which industry analysts claim would cause serious friction in the sector if not expunged or simplified.<sup>25</sup> The proposed drafted bill is however set to consolidate the agency's regulatory powers to include emerging technologies and digital

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<sup>23</sup> A Bill for startups, [www.republic.com.ng/june-july-2022/the-nigeria-startup-bill/](http://www.republic.com.ng/june-july-2022/the-nigeria-startup-bill/), Last assessed August 26th 2022

<sup>24</sup> Tage Kene-Okafor, A Leaked Bill for Nigerian Startups, [www.techcrunch.com/2021/08/17/a-leaked-bill-for-nigerian-startups-reveals-a-theme-of-licenses-fees-fines-and-sentences/amp/](http://www.techcrunch.com/2021/08/17/a-leaked-bill-for-nigerian-startups-reveals-a-theme-of-licenses-fees-fines-and-sentences/amp/), Last assessed august 26th 2022

<sup>25</sup> Adeyemi Adepetun, How Proposed NITDA Bill 2021 is Unsettling the ICT Sector; [www.guardian.ng/technology/how-proposed-nitda-bill-2021-is-unsettling-ict-sector/](http://www.guardian.ng/technology/how-proposed-nitda-bill-2021-is-unsettling-ict-sector/), Last Assessed August 26th 2022

economy development, providing the agency with administrative enforcement, powers and defining the objectives of the agencies among others. Going by the focus of the proposed law, it is surprising to notice the sudden wave of anxiety and trepidation within the Nigerian Tech community over a purportedly drafted proposal in circulation, which they say is harmful and would pose a serious threat to Startups. Going by the proposed NITDA Bill, stakeholders believe the agency's focus is about Nigerian Tech companies obtaining licenses, paying pre-tax profit levies and imposing sanctions on individuals and companies that operate contrary to the provisions of the new Act. They Cited Sections 6, 13,20,21 and 22 of the NITDA Bill 2021 which cover NITDA's powers, classes of licenses and authorizations including offences and penalties amongst others, are the contentious provisions causing apprehension.<sup>26</sup> As part of the commitment of the National Information Technology Development Agency (NITDA), Nigeria for the first time, has joined the Tech world in show casing its Tech ability at the 2021 Consumer Electronics Show (CES) Exhibition a platform where the world's biggest brands meet for business, new partners, and the best innovators.<sup>27</sup>

### **Challenges of Implementation of Extant Laws and Regulations for Tech Companies.**

There are certain areas in which regulators face challenges while implementing laws and regulations, issues may arise from Internet Governance, Internet Banking, Digital Signature, Computer and Cyber Crimes, Electronic Commerce, Data Protection and Privacy, Electronically Generated Evidence, Tele-medicine and Intellectual property etc. because laws have not been made to capture these activities, Apart from the Cyber Crimes(Prohibition and Prevention) Act 2015 , the provisions of Section 84 the Evidence Act 2011 on electronically generated evidence, the Nigeria Data Protection Regulation 2019, there exist few legislation regulating other digital and technological activities in Nigeria.

To this end it is pertinent to state that more laws should be made to solve legal needs in the technology space.

The Data Protection Bill,2020 is a proposed law which intent to guide data protection and privacy in Nigeria and replace the Nigeria Data Protection Regulation, the objectives of the bill are to create a regulatory framework for the protection and processing of personal data and to safeguard the rights and freedoms of data subjects which are guaranteed under the Nigerian Constitution.

The Tech space will continue facing challenges if the right framework is not in place, in many ways, the Nigerian Tech space regulators are also on the learning curve and they are striving to keep up with the pace of change, there have been certain positive attempts. For example, the Central Bank announced that it had begun implementation of its digital currency called eNaira with a partner called Bitt Inc. Despite this progress however, regulation has remain largely erratic

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<sup>26</sup>Inyene Ibanga, The Facts on NITDA Amendment Bill and Tech stakeholders, [pmnigeria.com/2021/08/20/nitda-amendment-tech-stakeholders-/,](https://pmnigeria.com/2021/08/20/nitda-amendment-tech-stakeholders-/) August 20 2021, Last Assessed August 26th 2022.

<sup>27</sup> NITDA Sponsors Nigeria to Join CES 2021 Tech Startups, Marketing Edge 2020, [Marketingedge.com.ng/nitda-sponsors-nigeria-to-join-ces-2021-tech-startups,](https://Marketingedge.com.ng/nitda-sponsors-nigeria-to-join-ces-2021-tech-startups/) Last Assessed August 26th 2022.

and inconsistent, and skewed towards protecting existing institutions and the administration.<sup>28</sup> For example the Ban on crypto currencies to protect traditional banks, regulatory bodies have also focused more on taxes and fines rather than innovative approach to the growth and development of these companies.

The following recommendations have been proposed to help regulators achieve better result:

- A. Government authorities should aim for synergy across regulatory bodies, if regulatory bodies and their functions can't be merged.
- B. Collaboration and communication with key stakeholders should be prioritized, a cohesive, multi-stakeholder approach to policy and regulation will go a long way. However, this communication has to be two-way startups and investors (individually or as groups and association) should also be deliberate in engaging and educating regulators on how best they think they should be regulated
- C. To carry out their jobs, regulators need to understand and appreciate the role of technology in building their economies. One example that they can lean on is Singapore's MAS, which staffs some of its workers in private companies for some time to help them understand new technologies
- D. Regulation should be multi-staged to match the company's growth. At the early stage, when the impact of the company's activities is minimal, there should be relaxed regulation. Growth indicators include revenue, number of employees, years in operation. etc.
- E. Startups and investors need to be pragmatic and realize that they are not operating in an ideal environment, particularly those expanding to new markets; they should be highly cautious and engage the regulators at every step of the way. They can also acquire a new company to get around complicated regulatory environments.<sup>29</sup>

### **Challenges of Tech Companies in Nigeria**

Nigeria may be able to boast of having the most number of tech startups in Africa, but lags in a number of other significant areas:

- A. **The Challenging Environment:** The tech space in Nigeria contends with the frustrating process of conducting business, a number of promising tech startups in Nigeria with the potential to immensely drive profit to the Nation's economy stopped operation because of the government's inconsistent approach to policies that relate to tech support. An example is the clamp down on crypto firms by the Central Bank of Nigeria.
- B. **Poor Electricity:** Inadequate electricity is another major problem facing the tech companies in Nigeria. Often times, these firms incur additional costs when they resort to an alternative means of generating electricity for their firms outside the country's supply, this would mean a shortage in funds that could be invested in the growth of their firms.

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<sup>28</sup> Regulatory Risk in Tech to Continue Rising with Growth of Sector, Control Risks, [www.controlrisks.com/our-thinking/insights/regulatory-risks-in-tech-to-continue-rising-with-growth-of-sector](http://www.controlrisks.com/our-thinking/insights/regulatory-risks-in-tech-to-continue-rising-with-growth-of-sector)

<sup>29</sup> Future Africa, African Tech: How Regulation Can Shape the Future. Page 2

- C. Access to Funding: Tech firms in Nigeria complain of the difficult process they undergo to obtain loans from banks. It's not news that the banks in Nigeria are always reluctant about loaning to small enterprises for fear of bad loans, this makes it tougher for startup tech firms to convince the banks that they are trustworthy.
- D. Poor Internet Quality: Despite the fact that Nigeria has the largest number of online users in Africa, the quality of internet services in the country is still poor. The reason for the penetration of internet service across the country is that there is an increase in the number of those who use mobile data over broadband user. While mobile data can work effectively for an individual, it cannot serve large organizations or businesses that require a lot of people being online at the same time.
- E. Identity Management: By January 2021, Nigeria's population was estimated to be about 209 million people, and in the same year, only about 46 million people have been successfully documented digitally in the country's database as citizen. The statement to employ the use of the National Identification Number linked with a user's sim as a means of identification for delivery of service within the country was first issued in 2018. After three years the approach to utilizing the digital identity strategy for identity management is still a challenge.
- F. Government Policies: The government needs to be consistent with regulating policies that would encourage tech firms for a change, and not appear like a killjoy working hard to frustrate the talents that should sprout from the country's tech space. The operating environment can be friendlier to innovations and creativity with the kind of policies created by the government.

The challenges faced by the tech space in the country all lie within the environment and so, their possible solutions are not far-fetched from the environment.

### **Recommendation**

To foster growth and development in the Tech space we recommend that the Nigeria Startup Bill be passed into law only after careful deliberations and scrutiny, we also recommend the amendment and simplification of Section 6 ,13, 20 and 22 of the NITDA Bill 2021 which has been declared ambiguous and conflicting with other laws in force. Since laws may be detrimental or beneficial to the growth of the Tech companies it is important to posit that these laws and regulations should not only focus on penalties and sanctions but should also promote and support growth, development, digital economy, innovation and solve problems. Also other legislation can be made in respect of this.

### **Conclusion**

In a developing country like Nigeria there is the need for innovation, growth and development and the legislators must make laws to promote these concepts. As more Tech companies emerge it is imperative to create a legal environment where they can thrive.

Though Nigeria has one of the fastest developing technological economies in the Middle East and Africa (MEA) markets, the tech development in the country is still not mature enough, the reason according to the Tech entrepreneurs is that the supporting strictures to a strong tech economy are still lacking in Nigeria.<sup>30</sup>

In view of this, it is therefore the duty of the Legislature and executive to work hand in hand to create a better Tech environment for Tech companies. Since Laws and regulations can both be detrimental and beneficial the growth of the economy.

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<sup>30</sup> Zakariyya Adaramola, Daily Trust, [www.dailytrust.com/nigerias-economy-and-tech-ecosystem](http://www.dailytrust.com/nigerias-economy-and-tech-ecosystem), Last assessed August 26th 2022

**CLIMATE VARIABILITY EFFECT OF ON POULTRY PRODUCTION IN BOSSO  
LOCAL GOVERNMENT AREA OF NIGER STATE NIGERIA**

**Ahmad, F.,**

Department of Geography,  
Federal University of Technolog, Minna,  
Niger State, Nigeria

**Sulaiman, Y. M.**

Department of Geography,  
Federal University of Technolog, Minna,  
Niger State, Nigeria

**Ojoye, M. Y.**

Department of Geography,  
Federal University of Technolog, Minna,  
Niger State, Nigeria

**Abstract**

Poultry plays an important role in human diet and economy of Nigeria. It is the primary supplier of eggs and meat and as a source of income and employment for people compared to other domestic animals. Climate variability poses a great threat to the growth and productivity of chickens. Hence, this study investigates the effect of climate variability on poultry production in the Bosso Local Government Area of Niger State. Specifically, the study examined the trend in climate variables (Temperature, Relative Humidity and Rainfall); as well as the trend poultry production (growth); analyse the effect of climate variability on poultry production and identify adaptation and mitigation strategies of poultry farmers to the effect of climate change on poultry production. The study utilized both primary (reconnaissance survey, questionnaire administration, interview) and secondary (climate data of temperature, relative humidity, and rainfall for a record of 20 years (2000-2020) and poultry production data) sources from selected poultry farms. The data obtained were subjected to statistical analysis and are presented in form of tables, charts, and content analysis. The result indicates that there is a significant change in the climatic variables (temperature, relative humidity, and rainfall) on a monthly and annual basis in the Bosso Local Government Area of Niger State. The study also identified a variety of poultry birds stocked by farmers, which included layers, broilers, cockerels, and noilers across the study locations. The bird

stock ranges between 300 – 1000, with an average feed consumption of 3–4 bags per day for every 500 birds, resulting in an increase of 1.34 kg–1.62 kg per body weight per bird. Poultry farmers are also well-aware of climate variability and its effects on poultry production, with over 80% agreeing that climate variability affects egg and meat production and that high temperatures cause birds to eat less and drink more. Similarly, the result also revealed that high temperatures and low rainfall lead to the production of low-quality eggs. The researcher thereby concluded that there is a significant change in the climatic variables (temperature, relative humidity and rainfall) on monthly and annual basis in Bosso Local Government Area of Niger State and its effects on poultry production. It is thereby recommended that: Enlightenment programs should be organized for poultry farmers agencies on the climate change mitigation, adaptation, and resilience strategies in order to improve livelihood of the people in a sustainable manner and continuous monitoring of climate variables and poultry management to ensure profitable business.

**Keyword:** Climate, Variability, Effect, Poultry, Production, Diet

### **Introduction**

In Nigeria, the most common attempt at improving agriculture has been the increase in the area of land for agricultural purposes as a response to improving food production and raising its contribution to GDP in the nation. In 2015, agriculture's contribution to GDP in Nigeria rose to 47%, which has been increasing till date (National Bureau of Statistics, NBS, 2020). The significance agricultural product that contributed to the GDP is poultry production which come after of crop production.

Poultry are birds such as the domestic fowl, Turkey, Duck, Goose, Ostrich etc which render economic service to man. Their production is one of the livestock production with significant contribution to human food (Oniah et al., 2018). Poultry plays an important role in the diet and economy of Nigerian. It is the primary supplier of eggs and meat and as a source of income and employment to people compared to other domestic animals (Thieme et al., 2014; Lenis et al., 2019). They are raised with relatively low capital investment and readily available household labour. Scavenging village chickens have cultural, social, nutritional, economic and sanitary functions in human life.

Climate is the average weather condition of a place taken over a prolonged period of time (NASA, 2015). It is the statistics of temperature, humidity, pressure, wind, rainfall, sunshine intensity, particle count and other meteorological elemental measurements in a given area over a long period of time, usually 30years and above (Intergovernmental Panel on Climate Change, IPCC, 2017). While weather is the present atmospheric condition such as the intensity of sunshine and amount of rainfall for the day, climate is the average of these meteorological elements collected over a range of time.

Livestock products most especially poultry are an important agricultural commodity for global food security because they provide 17% of global kilocalorie consumption and 33% of global protein consumption (Rosegrant *et al.*, 2019). The poultry sector contributes to the livelihoods of one billion of the poorest population in the world and employs close to 1.1 billion people (Hurst *et al.*, 2015). There is a growing demand for poultry products, and its rapid growth in developing countries has been deemed the “livestock revolution” (Wright *et al.*, 2017). Worldwide poultry production is expected to increase from 664 million tonnes (in 2006) to 1077 million tonnes (by 2050), and meat production will double from 258 to 455 million tonnes (Alexandratos and Bruinsma, 2016). Poultry production is likely to be adversely affected by climate change, competition for land and water, and food security at a time when it is most needed (Thornton, 2018).

Global climate change is primarily caused by greenhouse gas (GHG) emissions that result in warming of the atmosphere (IPCC, 2017). The livestock sector contributes 14.5% of global GHG emissions (Gerber *et al.*, 2013), and thus may increase land degradation, air and water pollution, and declines in biodiversity (Thornton and Gerber, 2019). At the same time, climate change will affect poultry production through competition for natural resources, quantity and quality of feeds, diseases, heat stress and biodiversity loss while the demand for livestock products is expected to increase by 100% by mid of the 21st century (Garnett, 2019). Therefore, the challenge is to maintain a balance between productivity, household food security, and environmental preservation (Wright *et al.*, 2017).

There is growing interest in understanding the interaction of climate change and agricultural production and it is motivating a significant amount of research (Oniah *et al.*, 2018). There is still limited research regarding the impacts of climate change on livestock production (IPCC, 2017). This study therefore analyse the potential effect of climate variability on Poultry Production, in Bosso Local Government Area of Niger State Nigeria.

### **Study Area**

Bosso local government area in Niger State, Nigeria covers a total area of 1,592 square kilometres and experience two major seasons which are the dry and the rainy seasons. The average temperature of the area is 31 degrees centigrade while the relative humidity level averages 31 °C percent.

Rainfall in the area begins around April and last till October, it has a mean yearly rainfall of 1334mm with September recording the most elevated downpour of 300mm. The mean month to month temperature is high in March at 30.5° C and lowered 22.3° C in August. Bosso LGA falls inside of the Guinea Savannah vegetation zone of Nigeria.





Figure 1a: Map of Nigeria Showing Niger State Figure 1b: Map of Niger State

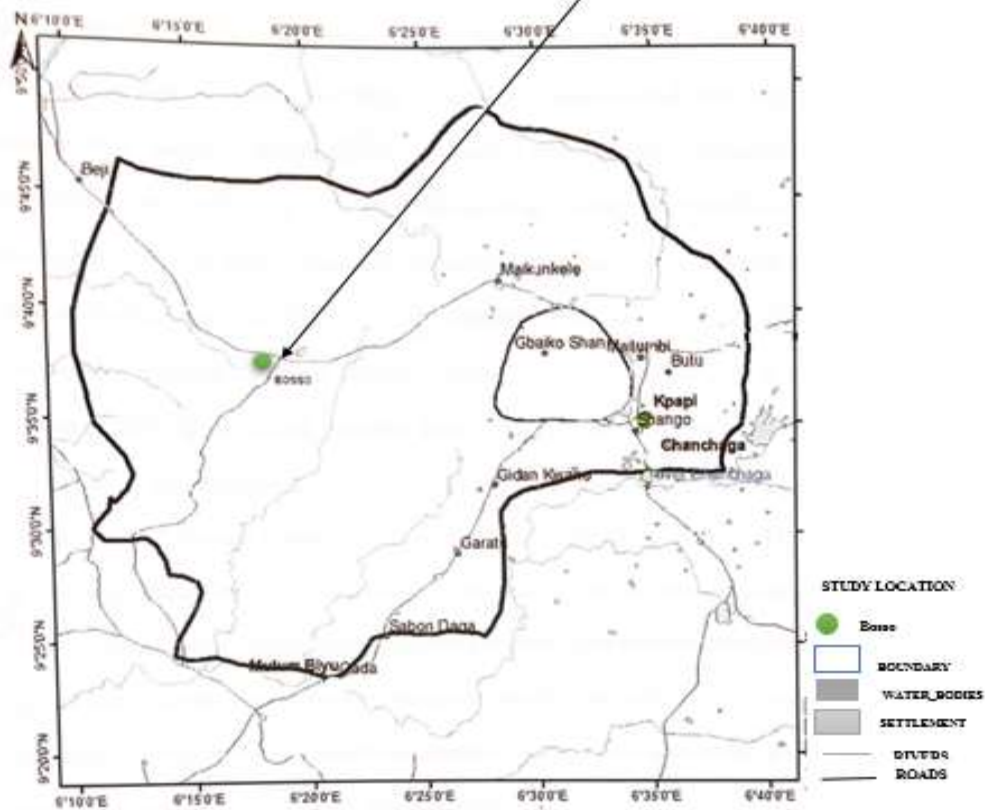


Figure 1: The study area (Bosso Local Government Area, Niger State Nigeria Source: Department of Geography

**Materials and Methods**

The study utilised both primary and secondary data.

The primary data include; reconnaissance survey of selected poultry farms; questionnaire administration to critical stakeholders in poultry production and interview schedule to be

administered to poultry farmers and operations. The reconnaissance survey was carried out to ascertain the status of the poultry farms in terms of birds availability, feeding pattern, environment of habitation and micro climate of the study location. The questionnaire administration was carried out to illicit responses on the impact of climate variability on poultry production.

#### **The secondary data include**

Climate data of temperature, relative humidity and rainfall for a record of 20 years (2000 - 2020) and Poultry production data. The target population of the study comprises of both managers and staff of public and private poultry farm in Bosso Local Government Area of Niger State.

#### **Sampling and sample size**

The type of data required for this research is rainfall, relative humidity and temperature data that spanned 20 years from (2000 - 2020) will be collected for the study and these will be sourced from the archival records of the Nigerian Meteorological Agency (NIMET), Minna, Nigeria.

Five (5) poultry farms which consists of on public poultry (Federal Ministry of Livestock and Animal Production), Bosso, Niger State and four (4) private farms.

#### **Method of Data Collection**

##### **Questionnaire**

A self-develop and constructed questionnaire is a tool designed for the collection of quantitative data and is widely used in construction research. In this study, a self-structured questionnaire was used, as these simplify the statistic process. The questionnaires were well structured to address information about the individual respondent, background information about the variation in climate, factors contributing to the variation in climate, potential effects on poultry production with view of suggesting the adaptation and mitigation strategies in Bosso Local Government Area of Niger State by poultry farmers.

##### **Interview**

Interviews are a tool mainly for the collection of qualitative data and are popular as a data collection tool because of their flexibility. The researcher will also conducts structured interviews with a sample of the interview guide to each 1 manager of each poultry. The researcher will ensure she interviewed the manager of each poultry. considered for the study, which make up a total of 5 interviewees. The interview will be conducted with each participant in their respective offices. Each of the interviews will take approximately 40 minutes. In order to obtain pertinent information of the study the researcher ensures the interviewee gave response to all the structured questions. All the responses of interviewees will be recorded and transcribed. After transcription, the resultant information will be qualitatively analysed.

##### **Method of data analysis**

Method of data analysis essentially refers to the statistical tools employed in data analysis and presentation of results. The data obtained were subjected to statistical analysis and are presented in form of tables, charts, and content analysis.

##### **Results**

##### **Trend in climatic variables (Temperature, Relative Humidity, Rainfall) in Bosso Local Government Area of Niger State**

In this section, data obtained on climatic variables (temperature, relative humidity, and rainfall) for Bosso Local Government Area of Niger State from the NIMET Archive within the period of

(2000 -2020). Figure 2 – 5 shows a chart presentation of the trends in temperature, relative humidity, and rainfall.

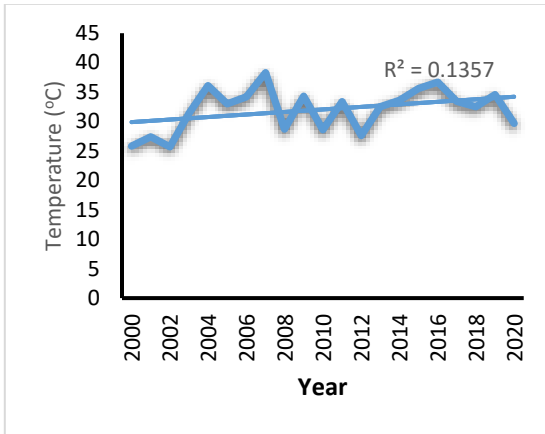


Figure 2: Trend in Temperature distribution (2000 - 2020)

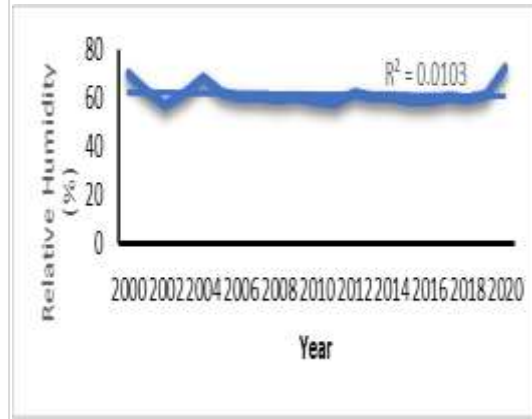


Figure 3: Trend in mean relative humidity distribution (2000 - 2020)



Figure 4: Relative Humidity Distribution in %

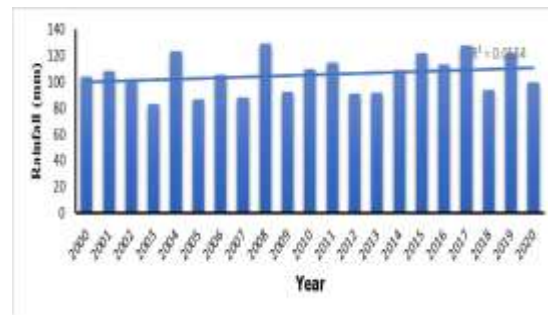


Figure 5: Trend in mean rainfall distribution (2000 - 2020)

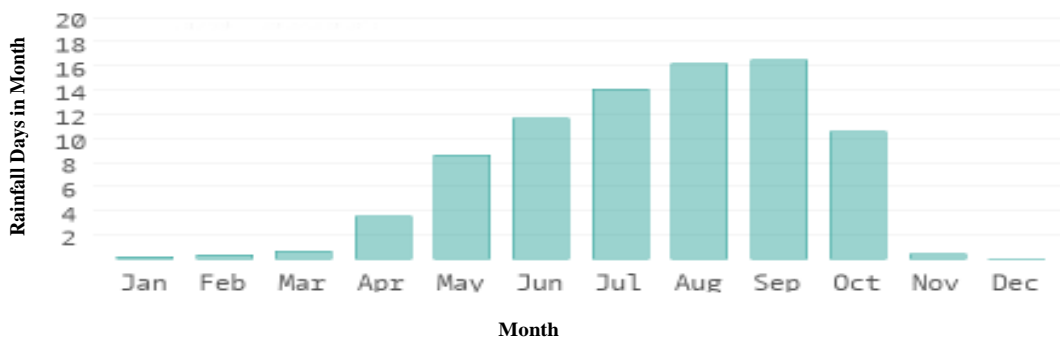


Figure 6 Rainfall Distribution days per month

Figure 2 shows the trend in mean temperature from the year 2000 – 2020. It was revealed that a highest recorded temperature of 38.3 °C was observed in the year 2007 while a lowest recorded temperature of 25.7 °C in the year 2002. In between these extremes, the temperature is steady, hovering between 25 °C and 38 °C. This indicates that the study area temperature is high relatively throughout the year.

Figure 3 shows the trend in mean relative humidity from 2000 – 2020. It revealed that a highest recorded relative humidity of 72.5 % was obtained in the year 2020 while a lowest recorded relative humidity of 57.6 % in the year 2002. In between these extremes, the relative humidity hovers between 57.6 % - 72.5 % and this indicates that the study area's relative humidity is high throughout the year. The Figure 4.1.3 shows the average monthly relative humidity in %.

Figure 4 reveals the distribution of relative humidity in the study area which indicates how much moisture is contained in the air. At high humidity, the birds feel uncomfortable and perceive this as oppressive. In general, relative humidity of 40-60% is considered to be pleasant while relative humidity averaging at 87% as experienced in the month August is considered to be uncomfortable. Although in the month of February on the other hand, it is easier to endure.

Figure 5 shows the trend in mean rainfall within the year 2000 – 2020, it revealed that a highest recorded rainfall of 128.9 mm was obtained in the year 2008 while a lowest recorded rainfall of 82.7 mm in the year 2003. In between these extremes, the rainfall was steady, hovering between 52 mm - 128 mm. This indicates that the study area rainfall is relatively high throughout the year. The rainfall days in Months are presented in Figure 6

Figure 6 reveals a rainy day is a day in which at least an amount of 0.1 mm precipitation (=0.1 liters) per square meter falls. This can be rain, snow, hail, or dew. So, it does not have to rain the whole day. With 17 rainy days, September offers the most number of rainy days, and in December the least.

### **Examining the Trend in Poultry Production (Growth) in Bosso Local Government Area of Niger State.**

#### **Analysis of the attribute's poultry farms and their personnel**

In the section information on respondents is revealed. The target participants comprised of managers and staff of five (5) poultry farms in Bosso Local Government Area. Table 4.1 shows the distribution of poultry farms' location as well as their staff strength.

**Table 1 Poultry Farms and their Location**

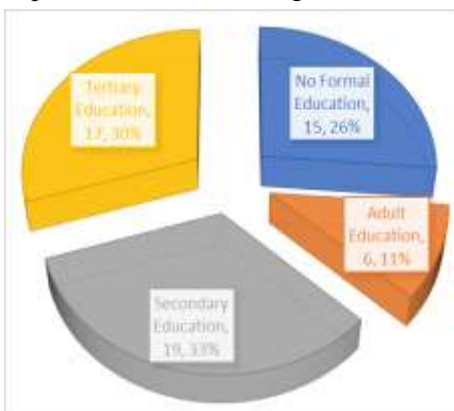
S/N	Poultry Farm	Location	System of Poultry	Years of Existence	Staff strength
1	Niger State Poultry and Animal Production	9°37'25.9"N 6°32'44.2"E	intensive	15	22
2	Shamuda Group	9°39'20.9"N 6°31'29.8"E	Semi intensive	4	8
3	Nnadama Farm Ltd	9°39'04.7"N 6°32'04.2"E	Semi intensive	3	11

4	NAS Poultry Farm	9°39'58.6"N 6°30'48.0"E	Extensive	4	7
5	BAB-SALAM	9°39'24.5"N 6°31'49.9"E	Extensive	3	9
<b>Total</b>					<b>57</b>

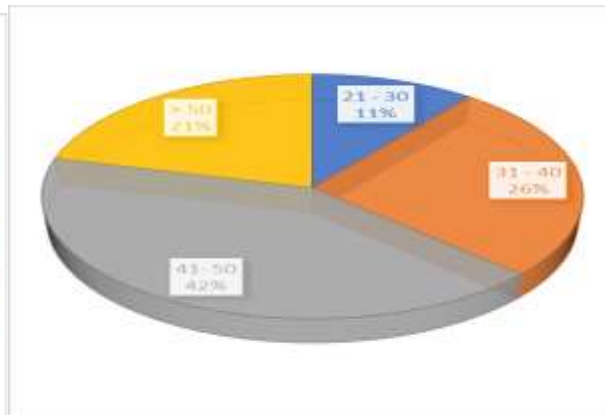
Table 1 shows the target poultry farm, as well as their locations. The poultry farms are all located in Bosso Local Government Area of Niger State. The result revealed that the six poultry farms had a total of 57 staff that manned the poultry facilities. Intensive, Semi-intensive, and Extensive poultry farming are identified as the practice by poultry farmers in the study area. Shamuda Group and Nnadama Farm Ltd practice semi- intensive poultry farming while NAS Poultry Farm and BAB-SALAM practice extensive poultry farming. Only Niger State Poultry and Animal Production practice intensive poultry farming.

**Demographic characteristics of studied population**

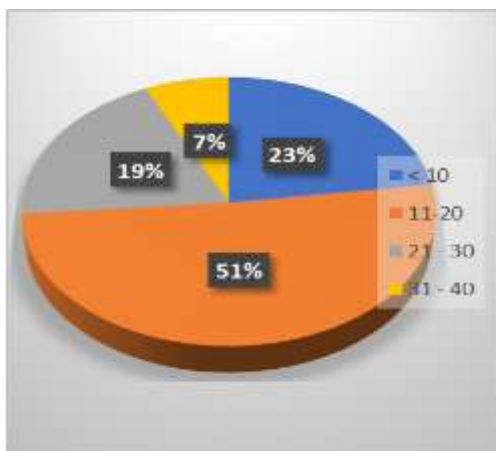
The analysis respondent profile which is based on age, education level, and years of poultry experience is shown in Figure 7 - 9.



**Figure 7 Age Distribution**



**Figure 8 Education level of respondent**



**Figure 9 Years of Poultry Experience**

The result on Figure 7 reveals that 6 (10.5%) are within the age range of 21 -30, while 15 (26.3%) are within the age range of 31 – 40, similarly, 24 (42.1%) are within the age range of 41 - 50 and 12 (21.1%) are > 50. Figure 8 shows the education level of respondent. Analysis on the education level of the respondent are reveal that 15 (26.3%) of the respondents had no formal education, 6 (10.5%) had adult education, while 19 (33.3%) had secondary education and finally, 17 (29.8%) had

tertiary education. Hence most of the respondents are educated. Furthermore, in Figure 9, 13 (22.8%) had < 10 years of experience in poultry farming, 29 (50.9%) had 11 – 20 years' experience, 11 (19.3%) had 21 – 30 and 4 (7.0) had 3 – 40 years of experience. The implication of this is that majority of the respondent are highly experienced. To achieve the objective on Poultry Production (Growth) in Bosso Local Government Area of Niger State, the record of production on types of bird, feeding, and weight of birds, death (stock birds/available) as shown in Table 2.

### Trend in Poultry Production (Growth) in Bosso Local Government Area of Niger State

**Table 2 Trend in Poultry Production (Growth) in Bosso Local Government Area of Niger State**

Poultry Farm	Birds	Stock birds/ available	Grain/Day (bags)(50kg)	Weight increase in month(kg)
Niger State Poultry and Animal Production	Layers	800	4 -5	1.62
	Broiler	500	3 -4	1.34
	Noiler	600	4 – 6	1.54
	Cockerel	500	3 – 4	1.44
Shamuda Group	Layers	500	3 – 4	1.48
	Broiler	400	3 – 4	1.54
Nnadama Farm Ltd	Layers	450	3 – 4	1.61
	Broiler	300	2 – 3	1.58
NAS Poultry Farm	Layers	900	6 - 8	1.56
BAB-SALAM	Layers	1000	7 – 8	1.43

Table 2 reveals the trend in poultry which shows varieties of birds stocked by farmers among these are layer, broilers, cockerel, and Noiler across the study area. The result also bird stock ranging from 300 – 1000. The distribution of birds indicate that all the five sampled poultry farms kept layers with their number hovering between 500 and 1000. In terms of feed consumption in relation to their body weight in monthly basis, Niger State poultry and Animal production Farm (NSPAP) with 800 birds utilized between 4 – 5 bags of layer mesh to feed the birds per day and this has result in weight increase of 1.62kg.

At Shamda Farms, they have 500 layer birds. It is shown that the birds consume 3 – 4 bags of 50kg layer mesh per bag and this results to an increase of 1.48kg in their weight per month. Considering the Nnadama Farm Ltd, the have stock of 450 layer, with consuming rate of 3 -4 bags of 50kg layer mesh per bag. The rate of increase in weight per month of the bird is at 1.61kg.

At NAS poultry Farm also have a total of 900 layer in their farm. It is disclose that the bird consume 6 - 8 bags of 50kg layer mesh per bag at expected increase in weight per month to be 1.56kg. Likewise at BAB-SALAM layer have 1000 stock of layer bird in their possession. The consuming rate of the birds falls between 7 and 8 bags of 50kg layer mesh per bag and this has result in weight increase of 1.43kg monthly.

Similarly, the distribution on Broiler birds reveals that three farms stocked the birds, hovering between 300 – 500. In terms of feed consumption in relation to their body weight on monthly basis, Niger State poultry and Animal production Farm (NSPAP) with 500 birds utilized between 3 – 4 bags of Broiler mesh to feed the birds per day and this has resulted in weight increase of 1.34kg. In Shamda Farms, they have 400 Broiler birds. It is shown that the birds consume 3 – 4 bags of 50kg Broiler mesh per bag and this results to an increase of 1.54kg in their weight per month. Considering the Nnadama Farm Ltd, they have stock of 300 Broiler, with consuming rate of 2 - 3 bags of 50kg broiler mesh per bag. The rate of increase in weight per month of the bird is at 1.58kg. Similarly, the distribution of Cockerel birds reveals that one farm stocked 500 birds. In terms of feed consumption in relation to their body weight on monthly basis, Niger State poultry and Animal production Farm (NSPAP) with 500 birds utilized between 3 – 4 bags of Broiler mesh to feed the birds per day and this has resulted in weight increase of 1.44kg.

#### **Determining the effect of climate variability on poultry production in Bosso Local Government Area of Niger State.**

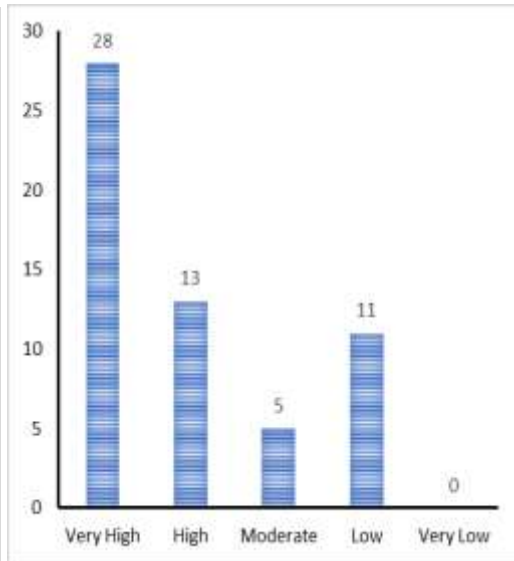
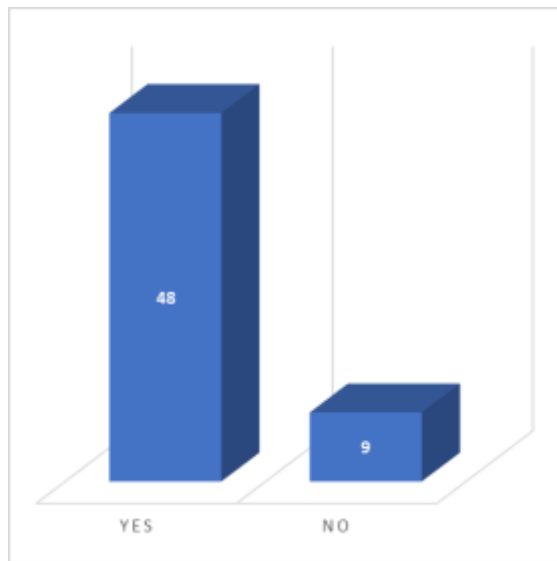
How climate variability affects poultry production is disclosed through the farmers and their staff responses. Various effects on climate variability are shown in Table 4.3.

**Table 3 Effect of Climate Variability on Poultry Production in Bosso Local Government Area of Niger State**

<b>Effect</b>	<b>SA (%)</b>	<b>A(%)</b>	<b>D(%)</b>	<b>SD(%)</b>
Are you aware of climate variability	57(100.0)	0(0.0)	0(0.0)	0(0.0)
Climate variability affects egg and meat production	42(73.7)	15(26.3)	0(0.0)	0(0.0)
High temperature make birds eat less and drink more	42(73.7)	13(22.8)	2(3.5)	0(0.0)
High temperature and low rainfall leads to production of low quality egg	50(87.7)	7(12.3)	0(0.0)	0(0.0)
High sunshine affect the eggs production	35(61.4)	12(21.1)	4(7.0)	6(10.5)
High temperature and low rainfall have resulted in high feed availability	14(24.6)	11(29.3)	30(52.6)	2(3.5)
Prices of feed-grain are usually high during the hot and dry season	31(54.4)	20(35.1)	6(10.5)	0(0.0)
High temperature and low rainfall conditions reduce the quality of grains	25(43.9)	17(29.8)	7(12.3)	8(14.0)
Climate variability has effect on food grain availability	45(78.9)	10(17.5)	2(3.5)	0(0.0)

Table 3 shows that 57 (100.0%) of the respondent strongly agree that they are aware of climate variability, 42 (73.7%) strongly agrees that climate change affects egg and meat production and high temperature make birds eat less and drink more while 0(0.0%) strongly disagree. Also,

50(87.7) strongly agrees that high temperature and low rainfall leads to the production of low-quality egg. 35(61.4) strongly agree that high sunshine affects eggs production while 6(10.5%) strongly disagree. 14(24.6) strongly agree that High temperature and low rainfall have resulted in high feed availability while 30(52.6) disagrees. 31(54.4%) strongly agree that Prices of feed-grain are usually high during the hot and dry season while 6(10.0%) disagree, 25(43.9) strongly agree that high temperature and low rainfall conditions reduce the quality of grains while 8(14.0) strongly disagree. And finally 45(78.9) Climate change affects food grain availability while 2(3.5) disagree. Figure 10 and 11 shows the responses of the respondent on the climatic change effect of poultry disease distribution.



**Figure 10 Effect on poultry diseases distribution**

**Figure 11 Rating of Respondent on the Effect of Climate on Poultry Production**

Figure 10 reveals that 48(84.2%) say yes to climate change's effect on poultry diseases distribution, 9(15.8%). Among the cited disease are *Escherichia coli* infection, salmonellosis, paratyphoid infections, fowl cholera, mycoplasma, and so on. Similarly, some farmers lamented that: "... there are new variant of poultry disease in their farm", other respondents also disclosed that most of the poultry diseases they experience now are not well known in the past. Most of the birds affected by this new breed of diseases range from 14 – 70 across the visited poultry farm. Figure 10 shows the rating of the respondents on the effect of climate on poultry production. Figure 4.11 show that 28 (49.1%) stated that there is a very high effect of climate on poultry production, 13 (22.8%) agrees that climate change effect on poultry production is high, 5 (8.8%) lamented that there is a moderate effect, 11 (19.3%) responded that there is a low effect.

**Discussion**

The study is targeted at the potential effect of climate variability on poultry production in Bosso Local Government Area of Niger State Nigeria. From the outcome of the analysis, it is found out



that, there is a significant change in the climate variable trend in Bosso Local Government Area of Niger State, with a min-max temperature of 25.7 °C - 38.3 °C, min-max humidity 57.6 % - 72.5 %, and the min-max rainfall 82.7 mm - 128.9 mm.

The findings of the study also revealed an adequate trend in poultry which shows varieties of birds stocked by farmers among this are layers, broilers, cockerel, and Noiler across the study area. The result also shows that bird stock ranging from 300 – 1000. It can also be deduced that on average 3 – 4 bags per day goes for 500 bird, with an increase of 1.34 - 1.62. this is in line with the finding of Adesiji *et al.* (2017) who investigated the effects of climate change on poultry production in Ondo State, Nigeria.

The findings of the study further disclosed strong awareness of poultry farmers on climate variability and its consequences on poultry production. The majority of the respondents of this study strongly agrees that climate change affects egg and meat production and high temperature make birds eat and drink less. Also, high temperature and low rainfall led to the production of low-quality eggs. Most respondents lamented that high temperature and low rainfall have resulted in low feed availability. This study is similar to that of Adedeji *et al.* (2013) and Ibrahim *et al.* (2020) as their study lamented the adverse effect of climate change poultry farm production.

The findings of the study further disclosed poultry farmers opinion on climatic change effect on poultry disease distribution. Over 80% agree that climate change effect poultry diseases distribution. Among the cited disease are *Escherichia coli* infection, salmonellosis, paratyphoid infections, fowl cholera, mycoplasma, and so on, with 20% of the birds being affected, this corroborates with the findings of Ibrahim *et al.* (2020).

### **Conclusion and Recommendations**

Based on the findings of the study on the potential effect of climate variability on poultry production in Bosso Local Government Area of Niger State, Nigeria, it is concluded that there is a significant change in the climatic variables (temperature, relative humidity and rainfall) on monthly and annual basis in Bosso Local Government Area of Niger State. The study identified variety of poultry birds stocked by farmers which includes are layers, broilers, cockerel, and Noiler across the study locations. The bird stock range between 300 – 1000, with average feed consumption of 3 – 4 bags per day for every 500 birds, resulting in an increase in 1.34 kg - 1.62 kg per body weight per bird. There is also a strong awareness of poultry farmers on climate variability and its effects on poultry production with most farmers strongly agree that climate change affects egg and meat production and that high temperature make birds eat less and drink more. Also, high temperature and low rainfall also leads to the production of low-quality egg and so on.

Therefore the knowledge of climate change is very important to poultry farmers in view of its significant effect in the birds life, feed consumption, egg & meat production and general wellbeing.

Based on the findings, the study recommends the following:

1. Enlightenment programs should be organized for poultry farmers extension agencies on the climate change mitigation, adaptation, and resilience strategies in order to improve production of birds and livelihood of the people in a sustainable manner.

2. There should be continuous monitoring of climate variables and poultry management to ensure profitable business by the farmers and bodies concern.
3. There should be durable availability of drugs for the prevention and control of disease caused by climate variability in the location closed to the poultry famers.
4. Finally, the study recommends that poultry farmers should use proper medication for birds for adaptation to climate change.

## References

- Adedeji, O. S., Amao, S. R., Alabi, T. J., & Opebiyi, O. B. (2015). Assessment of poultry production system in Ilesha Western Local Government Area of Osun State, Nigeria. *Scholar Journal of Agriculture and Veterinary Science*, 1(1), 20-27.
- Adesiji, G. B., Tyabo. I. S., Bolarin, O. Ibrahim, M., & Baba, S. T. (2017). Effects of Climate Change On Poultry Production in Ondo State, Nigeria. *Ethiopian Journal of Environmental Studies and Management*, 6(3), 45 -79.
- Alexandratos, N., & Bruinsma, J., (2016). World agriculture towards 2030/2050: the 2012 revision. ESA Working paper No. 12–03. FAO, Rome.
- Garnett, T. (2019). Livestock-related greenhouse gas emissions: impacts and options for policymakers. *Environ. Sci. Policy*, 12, 491–503.
- Gerber, P.J., Carsjens, G.J., Pak-uthai, T., & Robinson, T.P., (2013). Decision support for spatially targeted livestock policies: diverse examples from Uganda and Thailand. *Agric. Syst.* 96, 37–51.
- Ibrahim, K. K., Mohammed, Z., & Popoola, E. O. (2020). Climate Change: An Implication on Poultry Production in Kontagora Local Government Area of Niger State. *International Journal of Agricultural Science and Technology*, 8(4), 45 -76.
- Lenis S. O., Liverpool-Tasie, A. S., & Justice A. T. (2019) Climate change adaptation among poultry farmers: evidence from Nigeria. *Climatic Change*, 157, 527–544.
- National Aeronautics and Space Administration (NASA) (2015). Aircraft Weather Assessment Report. American USA.
- National Bureau of Statistics, (NBS) (2020). Assessment of Need for Improving Food Production. NBS Abuja.
- Oniah, M. O., Meremeku, V. N., & Agiopu, F. B. (2018). Influence of climate variation on household poultry production in South-South, Nigeria. *International Journal of Agricultural Economics and Management*, 8 (1), 9-19.
- Rosegrant, M.W., Fernandez, M., Sinha, A., (2019). Looking into the future for agriculture and AKST. In: McIntyre, B.D., Herren, H.R., Wakhungu, J., Watson, R.T. (Eds.), *International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD). Agriculture at a crossroads*, Island Press, Washington, DC, pp. 307–376
- Spore (2018). Feeding Africa’s livestock, fodder and forage solutions No.174, pp 13 and 14 February to March, 2018.
- The Intergovernmental Panel on Climate Change (IPCC) (2017). Climate Issues. Retrieved August 28, 2020, from [www.ipcc.com](http://www.ipcc.com)
- Thieme O, Sonaiya F, Rota A, Gueye EF, Dolberg F. & Alders, R. (2014). Defining family poultry production systems and their contribution to livelihoods. Ibadan, University. Press. 12-16.
- Thornton, P.K., & Gerber, P.J., (2010). Climate change and the growth of the livestock sector in developing countries. *Mitig. Adapt. Strategies Global Change*, 15, 169–184
- Thornton, P.K., & Gerber, P.J., (2010). Climate change and the growth of the livestock sector in developing countries. *Mitig. Adapt. Strategies Global Change*, 15, 169–184
- Wright, I.A., Tarawali, S., Blummel, M., Gerard, B., Teufel, N., & Herrero, M., (2017). Integrating crops and livestock in subtropical agricultural systems. *J. Sci. Food Agric.*, 92, 1010–1015.

## AN EXPOSITION OF THE LEGAL IMPACT OF BREXIT ON NIGERIA-BRITAIN INVESTMENT RELATIONS.

**Lateefat Adeola Bello**

Department of Commercial Law,  
ABU, Zaria.

### **Abstract**

This United Kingdom's withdrawal from the European Union popularly referred to as Brexit has had significant impact on the legal landscape governing the investment relations between Nigeria and Britain. New trade and investment agreements have been put in place to maintain the current level of trade and investment between the two countries, but businesses may face challenges as they adapt to the new legal framework. In addition to the legal implications of Brexit on trade and investment, there have also been concerns about the impact on migration, the financial services sector, and data protection. Overall, Brexit has had a significant impact on the relationship between Nigeria and Britain, and businesses operating in both countries will need to be mindful of the legal changes that have occurred. The approach of this paper is to analyze the British- Nigerian relationship in the context of what it was? What it is? And; what should be the fulcrum for investment post-Brexit? This paper adopts a doctrinal approach in its elucidation of primary and secondary materials and recommends that the relationship between the two countries should be treated as a golden opportunity for Nigeria to secure better access, greater protection, and more aid from Britain and for Britain, to use its independence from the EU as a vista of opportunity for Nigeria and other Africa countries to leverage especially in the area of technology. This is in view of the impact of technological advancement on the general landscape of investment bringing about twists in the way of doing business which will invariably affect the interplay of Brexit - Nigeria's investment relations.

### **Introduction**

The United Kingdom's withdrawal from the European Union, commonly known as Brexit, has had a significant impact on the legal landscape governing the investment relations between Nigeria and Britain. One key area where Brexit has had an impact is trade. Prior to Brexit, the UK was a member of the EU's single market, which allowed for the free movement of goods, services, capital, and people between member states. With the UK's withdrawal from the EU, it is no longer party to the single market and has had to negotiate new trade agreements with countries, including Nigeria<sup>31</sup>.

Unlike most of the Western countries that came together to form the European Union, Britain was unsympathetic to the European ideal but only joined then because it seems to have no other option

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<sup>31</sup> UK-Nigeria Trade Continuity Agreement: <https://www.gov.uk/government/publications/uk-nigeria-trade-continuity-agreement>

than to join other prosperous Western European Democracies<sup>32</sup> in 1973. The EU is a politico-economic union comprising of 28 countries that promote ease of trade and free movement of citizens between member states. The EU was set up as a leading agent of peace, an antidote to the extreme Mercantilism, nationalism, or Realism which had pervaded Europe, causing bloody wars between neighbors, and culminating in the Second World War (WW 2).<sup>33</sup>

Part of the aim of the EU was the development of an internal single market through a standardized system of laws and bring about economic and political integration, cooperation, and interdependence among States for the promotion of peace, the liberalization of trade: opposing tariff barriers, domestic subsidies, sanctions, and other economic tools that distort the free flow of trade and investment capital. The philosophical root of the EU is Liberalism, a doctrine of International Political Economics, incubated by David Hume and later developed by Adam Smith in his “Wealth of the Nations”. For Liberals, the goal of economic policy is to create a maximum total wealth by achieving optimal efficiency.

Britain’s membership of the EU can be traced back to her membership of the European Communities (EC), comprising the European Coal and Steel Community (ECSC), the European Atomic Energy Community (EAEC), and the European Economic Community (EEC). The Treaty of Rome in 1957 by twenty-eight (28) European nations established the EC. In 1961, Britain or United Kingdom (UK) applied to be a member of the EC; and by 1973 she was granted membership in the EU Community. The United Kingdom (UK) however exited the European Union (EU) on 31 January 2020, despite this move, it’s still subject to EU law, customs, union, and single market. When the EU-UK transition period elapses, the UK will officially cease to be part of the EU political bodies/ institutions. The implication is that despite the UK’s official declaration of its exit from the EU, it remains part of EU political bodies until the transition period elapses<sup>34</sup>. However, UK’s action to exit from the EU has made it imperative for both the EU, the UK, and the Least Developed Countries (LDCs) especially Africa and particularly Nigeria to prepare for the likely and indispensable realignment that will accompany it<sup>35</sup>

Since Nigeria gained its independence in 1960, it has maintained strong diplomatic relations as one of the closest allies to Great Britain, its former colonial master. Although Nigeria is considered a regional power in the West African Sub-region and the African continent in general, the government still receives aid in the form of grants from the United Kingdom and Western allies like the United States America (USA), and France. As a result of this relationship, Nigeria’s internal affairs including security issues have been London’s major concern. This was evident in

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<sup>32</sup> Igbinyi, O.J., & Okereke, O.E. (2020). Political realism in International relations: Brexit and its implications for Nigeria. *Open Journal of Social Science*, 8 306-320. Available at <https://www.scirp.org>

<sup>33</sup> Ibid

<sup>34</sup> Edgington, T. (2020 January 31). *Brexit: what is the transition period?* BBC News. <https://en.m.wikipedia.org/wiki/Brexit>

<sup>35</sup> Igbini, M. Daniel, Oluka, N. Lucas and Oharisi, A. Jeremiah; Nigeria and the United Kingdom Diplomatic Relations: The Emerging Issues in the Post-Brexit Era; *International Journal of Research and Scientific Innovation (IJRSI) | Volume VII, Issue VII, July 2020 | ISSN 2321–2705; www.rsisinternational.org*

the frequent official visits of the monarchy and high-ranking officials of the UK to Nigeria. One of the such visits was that of August 2018 by former British Prime Minister, Theresa May to both Abuja, the Federal capital city of Nigeria, and Lagos, the commercial capital to further improve the existing diplomatic intercourse between the two nations of the Commonwealth.<sup>36</sup> Both nations have also maintained trade intercourse under the umbrella of the Commonwealth nations founded on 11 December 1931 with a current structure consisting of more than fifty -four (54) nations. The objective of this paper is to examine the legal and long-term effects and consequences of Brexit on the diplomatic and trade relations between Nigeria-UK

### The concept of Brexit

According to Akinfenwa<sup>37</sup>, Brexit is a coinage that signifies Britain's exit from the European Union (EU) a decision believed to have a long historical dimension initially traceable to the first referendum of 1975 held to determine whether or not Britain should continue to sustain its membership of the then *European Economic Community* (EEU), ( now the *European Union* (EU)), or withdraws completely. Another explanation for the word Brexit, is the coinage by Peter Wilding in May 2012, of the word "Grexit" (Greece's withdrawer from the Eurozone) to mean Britain's withdrawal from the EU, which raised a remarkable dimension to its meaning. Thirdly, is the 23rd June 2016 majority vote of Britons which favor Britain's withdrawal from the EU, and most specifically, Brexit was intensified by the UK in March 2017 at the final revocation of *Article 50 of the Lisbon Treaty* which gave member states of the EU legal rights to leave the EU provides that, "any member nations of the Union may withdraw from the EU by her constitutional provisions"<sup>38</sup>.

For Gaud,<sup>39</sup> the coinage *Brexit* is a short-term wording for Britain's quest to leave the European Union to which it has been a member since 1973 during the Conservative government of Prime Minister Edward Heath. He opined that since Britain entered into the EU, its relations with the EU have been highly acrimonious due to differences which ranged from agriculture, immigration, financial and monetary to governance policies. As a permanent member of the UN Security Council (UNSC) and a prime mover of the Commonwealth of English-speaking countries, Britain has always found itself being caged by EU's policies. Outlining its grievances upon Brexit, Britain stated immigration and economic controls as the major reasons for exit. On immigration, it argued that Britain has often experienced alarming growth or increased surge of immigrants from Eastern European countries who were taking advantage of EU protocols on the free movement of people within the EU to live and work in Britain a step which the British government argued has mounted

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<sup>36</sup> Ibid

<sup>37</sup> Akinfenwa, B. A. (2020 February 2). *Nigeria: Dynamics of Nigerian-British Relations in the Post-Brexit Era-the Challenges of New Anglo-French Rivalry*. This Day, Lagos, Nigeria. <https://allafrica.com/stories/202002020004.html>

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<sup>39</sup>Gadu, I. (2019 August 24). Brexit opportunities for Nigeria. Daily Trust Nigeria News. <https://www.dailytrust.com.ng/brexitopportunities-for-nigeria.html>.

pressure on the provisions of social amenities in Britain, as well as creating unnecessary competition between its citizens and these foreigners. On the economic front, the government felt constrained by the strict economic policies of the EU which limited Britain's ability to take advantage of emerging economic opportunities in a changing world. However, with Brexit, Britain hopes to bring these issues under maximum control<sup>40</sup> Although, the UK withdrawal was hindered by its inability to meet up with the constitutional requirements despite the EU's extended dates for the UK to either decline or sustain its withdrawal from the EU. EU extended the initial date of 28 October 2019 for another three months effective 31 October 2019 with an extension of a termination date initially scheduled for 31 January 2020 rescheduled for the end of 2020 as the official date for the withdrawal of the K from the EU.<sup>41</sup>

The UK's action has undoubtedly created discomfort for its close allies in the EU, Africa, Caribbean and Pacific (ACP) region, and Commonwealth countries. If the UK's foreign policy post-Brexit agenda towards Nigeria and other African counterparts is friendly and favorable, Africa will make significant changes from its previous engagement with the UK and EU. However, to achieve this it means Africa must be proactive in its dealings with the EU on one hand; and other familiar partners such as the USA, France, and Russia, as well as the newer entrants like India and China on the other hand.<sup>42</sup>

The major concern of Nigerian scholars, analysts, and observers currently is not the UK's withdrawal from the EU, but the aftermath of *Brexit* on the existing diplomatic ties between the EU and UK, as well as between the UK, Commonwealth countries, and Nigeria which is a close ally and mutually dependent nation to the UK and the other Commonwealth Countries. There is no doubt that the sustenance of post-Brexit Britain will be dependent on policies and actions which may differ significantly from the pre-Brexit era and could create impediments in the existing diplomatic relationship between the UK, African Commonwealth countries, and Nigeria<sup>43</sup>. This may also extend to other member nation-states of the EU, the USA, and other Nigeria's trade partners. To this effect, it is argued that "Nigerians relations with her traditional partners from the West, including the USA and China have always been exploitative, and now that there is the possibility of a paradigm shift from familiar global politics, there is also the possibility of a reshuffling and realignment in global *realpolitik* and *real economic* with Africa, especially Nigeria

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<sup>40</sup> Daily Trust, Nigeria, 2020.

<sup>41</sup> Igbini , M. Daniel, Oluka, N. Lucas and Oharisi, A. Jeremiah; Nigeria and the United Kingdom Diplomatic Relations: The Emerging Issues in the Post-Brexit Era; International Journal of Research and Scientific Innovation (IJRSI) | Volume VII, Issue VII, July 2020 | ISSN 2321-2705; [www.rsisinternational.org](http://www.rsisinternational.org)

<sup>43</sup> Ibid

which is likely to be at the receiving end<sup>44</sup>. On the contrary, Dirk<sup>45</sup>, argued that the Brexit trade regime may result in increased ambiguity, but it may also increase resilience and generate new opportunities and investment for the UK and its allies in Africa Commonwealth countries, including Nigeria. Since the UK provides the biggest market for exports for African Commonwealth countries, there is the possibility that the UK will enhance its trade relations with Nigeria, and by extension to the ACP countries<sup>46</sup>.

### **The legal implication of Brexit on Nigeria.**

. Nigeria one of the major allies and member of some of these regional and global arrangements have been predicted to suffer the most from UK's exit from the EU. To this effect, there are several contradictory predictions surrounding the phenomenon of Brexit diplomacy. This phenomenon is what scholars and analysts regarded today as an emerging issue in the post-Brexit era.<sup>47</sup>

What happens next? The effect of *post-Brexit diplomacy* is uncertain hence the need for the Nigerian government to redefine its diplomatic trade relations with the UK and other members of the European Union. Trade and investment will be affected, no doubt, but most of the UK's trade relations with Nigeria and other partners from Africa Commonwealth countries are likely to be renegotiated because some of these negotiations were done through the EU<sup>48</sup>. This may also be a likely setback in African diplomatic trade intercourse with UK and EU respectively<sup>49</sup>.

In a nutshell, a *new trade regime* that will tilt all existing tariff and nontariff arrangements negotiated under the EU and other sundry existing arrangements now and in the future. In his analysis the possible post-Brexit relationships between the EU, UK, and African countries including Nigeria, as it stands, identify some salient challenges or problems that are likely to be confronted in post-Brexit trade and diplomatic relations. These challenges include a change or shift in market access, foreign direct investment (FDI), aids, security, and the nature of the new partnership that is likely to emerge. In other words, the pursuits of ultranationalist agenda and goals would be envisaged following the post-Brexit diplomacy. Compromising human rights concerning increased inequality and crusading against immigrants are also possible challenges in the post-Brexit era. Unarguably, these emerging issues are likely to impact negatively on the existing diplomatic relations between Nigeria and UK and other EU member countries. Scholars and

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<sup>44</sup> Akinfenwa, B. A. (2020 February 2). *Nigeria: Dynamics of Nigerian-British Relations in the Post-Brexit Era- the Challenges of New Anglo-French Rivalry*. This Day, Lagos, Nigeria. <https://allafrica.com/stories/202002020004.html>

<sup>45</sup> Kohnart, D. (2018). More Equitable Britain-Africa Relations Post- Brexit: Doomed to Fail? In: *Africa Spectrum*, 53 (2), 119-130.

<sup>46</sup> Dirk (2018) Op.Cit

<sup>47</sup> Igbini, M. et.al. Op.cit

<sup>48</sup> Ibid

<sup>49</sup> Tan, A. (2016 August-November). After Brexit: African economies may be severely affected by Britain's exit. *United Nations African Renewal (UNAR)*. <http://www.un.org/africarenewal/magazine/august-2016/africaafter-Brexit>

analysts have had to argue that the emerging *post-Brexit trade diplomacy* will complicate Nigerians' internal challenges occasioned by violent clashes between Fulani cattle herders and sedentary farmers, banditry, kidnappings, armed robbery, as well as the security challenges occasioned by Islamic Jihadist movements in the form of Boko Haram and the Islamic State West African Province (ISWAP). Nigeria, due to its diplomatic relationship, may likely face more critical challenges in its foreign policy formulation and implementation in the post-Brexit era because of close diplomatic ties with UK and EU member states that have bilateral diplomatic ties with Nigeria. Some analysts argued that Nigeria's bilateral and multilateral arrangements will be altered and will require renegotiations in the post-Brexit era, hence, the fear of the unknown.

Razzaque and Vickers<sup>50</sup> argued that the prospect of the UK formulating new trade policies in the post-Brexit era may have damaging implications on the existing *Economic Partnership Agreements* (EPAs) between the EU and the ACP countries. Most importantly, Britain's (UK) future trade and diplomatic arrangement with the ACP countries may be renegotiated and if this is done, its impacts may not be comfortable to all the parties. Originally, there are certain privileged concessions enjoyed by these nations in their trade diplomatic intercourse, such as *duty-free and quota-free (DFQF)* market access.

The question of whether there would be any tangible benefit or equivalent market access to the UK's post-Brexit trade and other diplomatic relationships with African countries, with Nigeria as a focus may arise. This may be detrimental to both UK and its African allies if not properly negotiated in post-Brexit diplomacies. The problem here is that one cannot rule out emerging issues now and in post-Brexit diplomacies such as changes in tariffs and competitive pressure in the UK market. Since the UK has been the biggest market for Nigeria, Nigeria may face much higher tariffs on its exports to the UK and other EU member states following Brexit. This means that Nigeria may also experience double impacts in its trade relations with UK and EU respectively. Since Nigeria's economic stability to some extent is tied to the provisions of the ECOWAS within the West African sub-region, and further externally to the umbrellas of the Commonwealth, WTO, ACP-EU, and UK relations, Nigeria's economy may be threatened by post-Brexit diplomacy.

The question is, to what extent could these impact Nigeria's economic development? Will Nigeria and UK trade diplomacy improve following the predicted Brexit tariff regime which is likely to occur? What are the likely scenarios of Nigeria, a close ally of the UK with other EU member nations? These are pertinent questions that are likely to manifest in the future and that would require urgent responses if the Brexit trade tariff regime changes eventually occur. Nigeria which is one of the major beneficiaries of the old-world economic order may face a double impact and may be exposed to greater competition in the UK market. This will no doubt affect the foreign policy posture of Nigeria and the UK towards each other.

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<sup>50</sup> Razzaque, M., & Vickers, B. (2016). Post-Brexit UK-ACP Trading Arrangements: Some Reflections. *The Commonwealth Trade Hot Topics, Issue 137, ISSN: 2071-8527 (print) ISSN: 2071- 9914 (online), pp. 2-8*



### Nigeria and the Post-Brexit Diplomacy

With the exit of the United Kingdom from the European Union, a new *global realpolitik* has begun. As a consequence, the UK is facing one of its greatest challenges likewise the EU and UK's foreign partners from the Least Developed Countries (LDCs) of Africa, Asia, Latin America, and the Caribbean. Undoubtedly, UK's withdrawal has raised a lot of debates from scholars, policy analysts and commentators all over the world some of which are in support of the Brexit and some of who faulted it on the ground that it wasn't necessary since UK is a leader not only to the LDCs trade partners but also in the EU hierarchy. However, supporters of Brexit have argued that UK's exit is likely to offer the UK and its closest allies from Africa a lot of favorable opportunities in their trade relations with the rest of the EU member states.<sup>51</sup>

In the affirmative, Mendez-Parra<sup>52</sup>, argued that Brexit is likely to offer the UK the opportunity to pursue new strategic interests and renewed policy objectives in its relations with the LDCs, Commonwealth countries, and the nations of the EU. Most significant is its agenda in the LDCs which it has already established its hegemony and leadership status over the years. Perhaps, the most critical challenge of *post-Brexit* on the UK-LDCs relations, of Nigeria in particular, is a sustained dominance of the political and economic relations of the partnership. It can be argued that the UK is going to pursue a *new tariff regime* and champion its national policy objectives on plain ground. This means that the UK's foreign policy objectives in the post-Brexit era may or may not favor the LDCs because some of the LDCs have colonial links with Britain, especially Anglophone West African countries, including Nigeria.

In the same vein, Willem<sup>53</sup> argued that from the time the UK decided to leave the EU and voted against its stay in the EU, the effects of its exit on the developing economies, particularly Nigeria which is the UK's closest ally, was already predicted. This has manifested with the devaluation of *Pounds* through the reduction of the *Dollar* value of trade, aid, investment, and remittance. This has no doubt lent credence to the heightened uncertainty in the LDC's economic development already affected by the recent global economic recession in which LDCs especially Nigeria is the most affected because of over-reliance on the economies of the developed countries of the EU, and SA.

In another development, Willem the Velde<sup>54</sup> predicted possible scenarios in the UK's post-Brexit trade policy towards the LDCs, especially the ACP countries and some of the emerging middle-

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<sup>51</sup> Igbini, M. Daniel, Oluka, N. Lucas and Oharisi, A. Jeremiah; Nigeria and the United Kingdom Diplomatic Relations: The Emerging Issues in the Post-Brexit Era; International Journal of Research and Scientific Innovation (IJRSI) | Volume VII, Issue VII, July 2020 | ISSN 2321-2705; www.rsisinternational.org

<sup>52</sup> Mario Menez , The Impact of Brexit on the treaty- making power in the UK- School of Law, available at <https://www-qmul.ac.uk/alumni> Retrieved 22 Dec 2022.

<sup>53</sup> Willem te Velde, Dirk W. et. al (2016). *Scenarios for UK trade policy towards developing countries after the vote to leave the EU*. In M. Mendez-Parra., D. Willem te Velde & W. Allen (ed) *The Impact of the UK's post-Brexit trade policy development: An essay series*. The UK Trade Policy Observatory (UKTPO), University of Sussex UK

<sup>54</sup> Ibid

income countries from the Middle East, Europe, and Latin America. By implication, the outcome of UK-EU negotiations will have a lot of negative effects on the UK's relations with the LDCs in the post-Brexit era because LDCs, particularly Nigeria depend on exports to the UK which is also likely to be affected by a new tariff regime. Understudying the challenges envisaged for the LDC's relations with the UK and EU due to the exit of the UK advised the LDCs to focus their attention on the remaining EU member countries and probably on the World Trade Organization (WTO). Though the exit may have some disadvantages to Nigeria because Nigeria would have to sign separate pacts with the EU and with the UK unlike before when it only sign one agreement with the EU to cover all its pacts with the EU countries but to be realistic, it would offer the government of Nigeria the opportunity to go back to the drawing table and critically analyze her initial lapses with the EU pact and immediately readjust and renegotiate them to better the country's economic development in future<sup>55</sup>.

As a complement to scholars' and analysts' predictions of the prospects of post-Brexit trade diplomacy between the UK and EU on the one hand, and the EU, UK, and LDCs on the other hand, some scholars opined that, geography and history will have a lot of roles to play after UK transition period from its exit from the EU elapses and laws to guide them. Thus With the UK's withdrawal from the EU, it has had to negotiate new trade agreements with countries, including Nigeria.

Putting into consideration the historical ties between Britain and the majority of the Commonwealth member countries, the UK is likely to shift its attention to the Commonwealth which has a dominant position. It should be noted that the majority of the member countries of the Commonwealth of Nations are former British colonies, an advantage London may prioritize during and after its transition period and in the post-Brexit era. Remarkably, the majority of these countries are dependent economies from the South, another advantage UK is likely to explore in post-Brexit trade diplomacy. Although, the UK may experience some policy barriers its advantage over its former colonies cannot be neglected in the post-Brexit trade regime which is already envisaged by scholars and analysts alike.<sup>56</sup>

In absolute terms, UK and Nigeria may sustain and solidify their trade diplomatic intercourse in the post-Brexit era in several dimensions. Nigeria already has one of the largest economies in Africa with crude oil and a few exports from agriculture as its major export commodities. Though, a major importer of finished goods and services abroad, one may predict a smooth trade flow from the UK to Nigeria in the post-Brexit era. To ensure this is achieved,

The UK and Nigeria in March 2021 signed a Trade Continuity Agreement, which aims to maintain the current level of trade between the two countries while negotiations for a long-term trade deal were ongoing. This agreement includes provisions on trade in goods, services, and

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<sup>55</sup> Igbini, M. et-al Op.cit.

<sup>56</sup> Hearne, D., De Ruyter, A., & Davies, H. (2019). The Commonwealth: A Panacea for the UK's Post-Brexit Trade Ills? *Contemporary Social Science*, 14 (2), 341-360

investment, and aims to provide a stable and predictable environment for businesses operating in both countries.<sup>57</sup>

Another area where Brexit has had an impact is in investment. Before Brexit, the UK was party to the EU's Investment Protection Agreement with Nigeria, which provided certain protections for investors from both countries. With the UK's withdrawal from the EU, this agreement no longer applies to the UK and new arrangements have had to be put in place<sup>58</sup>.

In February 2021, the UK and Nigeria signed a Bilateral Investment Treaty, which aims to provide a framework for the promotion and protection of investment between the two countries. The treaty includes provisions on the treatment of investors, the settlement of disputes, and the transfer of funds. In addition to the Trade Continuity Agreement and the Bilateral Investment Treaty, the UK and Nigeria have also signed several other agreements in areas such as aviation, customs cooperation, and development cooperation. These agreements aim to facilitate trade and investment between the two countries and ensure that businesses can continue to operate smoothly following Brexit. In this respect, Hearne et al<sup>59</sup>. opined that, since Nigeria is a major UK commodities exporter and importer, it is a potential market soon to be reconsidered and explored by the UK to grow its post-Brexit trade. In addition to the advantages already at the UK's disposal, especially its Commonwealth link with African countries holds a lot of other advantages, first, the fact that the UK is home to a substantial Nigerian diaspora and ongoing educational link notably at the higher level where Nigerians are the third largest groups studying in UK universities and colleges. Secondly, Britain luxury goods are already well-known and highly patronized in Nigeria and by Nigerians. Thirdly, British firms control reasonable shares in the Nigerian oil and gas industry, and lastly, the UK runs several investments in other sectors of Nigeria's economy. According to the 2017 IMF report<sup>60</sup>, UK's exports account for a greater share of Nigerian imports of merchandise goods. By implication, this position is likely to resurface in the post-Brexit trade diplomacy between UK and Nigeria. In short, all of these factors put together may account for another successful penetration of the Nigerian market by the UK on the one hand and the EU on the other hand using post-Brexit trade diplomacy as an excuse. UK's import market volume in Nigeria may also increase beyond imagination in the post-Brexit era.

### **Conclusion and Recommendations**

In conclusion, the legal impact of Brexit on the investment relations between Nigeria and Britain has been significant, with new agreements and arrangements put in place in a range of areas including trade, investment, migration, financial services, and data protection. While these agreements and arrangements aim to maintain the current level of trade and investment between

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<sup>57</sup> UK-Nigeria Trade Continuity Agreement: <https://www.gov.uk/government/publications/uk-nigeria-trade-continuity-agreement>

<sup>58</sup> UK-Nigeria Bilateral Investment Treaty: <https://www.gov.uk/government/publications/uk-nigeria-bilateral-investment-treaty>

<sup>59</sup> Hearne, D., De Ruyter, A., & Davies, H. (2019). The Commonwealth: A Panacea for the UK's Post-Brexit Trade Ills? *Contemporary Social Science*, 14 (2), 341-360

<sup>60</sup> IMF Annual Report 2017, available at <https://www...imf.org> accessed 23 December 2022.

the two countries, businesses operating in both countries may face challenges as they adapt to the new legal framework. . Despite these challenges there are also opportunities for businesses operating in both Nigeria and Britain, It is therefore important for businesses to be aware of the changes that have occurred as a result of Brexit and to take steps to ensure compliance with the new legal requirements. Considering the legal impact of Brexit on Nigeria -British investment relations, the following are recommended :

1. The careful review of any existing contracts or agreements that may be affected by Brexit, including those related to trade, investments and other business activities. This can help in the identification of any potential issues or risks that may arise as a result of UK'S withdrawal from EU.
2. That businesses and investors should alternatively dispute resolution mechanism like arbitration or mediation as option in the event of a dispute arising as a result of Brexit.
3. Investors and businesses should engage the services of a lawyer to provide guidance on the specific legal implication of Brexit for businesses or investment and assist to identify potential risks.
4. Stakeholders on investment should stay up to date on information on the UK-Nigeria trade relationship, such as changes to tariffs, regulations or other legal requirement that may affect businesses or investment .This will assist to plan for potential challenges or opportunities that may arise as a result of Brexit.

**COMPARATIVE STUDY OF CASHEW TREE GUM EXUDATES AND STANDARD  
(IMPORTED) INDUSTRIAL NATURAL GUM (XANTHAN GUM) FOR  
PHARMACEUTICAL APPLICATIONS.**

**M. C. Okonkwo<sup>1</sup>,**

Department of Chemical Engineering,  
Federal University of Technology Minna,  
Niger State, Nigeria.

**Habibu Uthman<sup>2</sup>,**

Department of Chemical Engineering,  
Federal University of Technology Minna,  
Niger State, Nigeria.

**O. S. Azeez<sup>3</sup>**

Department of Chemical Engineering,  
Federal University of Technology Minna,  
Niger State, Nigeria.

**Abstract**

Gums are carbohydrate bio-molecules that have the potential to bind water and form gels. They are regularly linked with proteins and minerals in their construction and they have several forms. In many pharmaceutical formulations, plant-based gums are the key ingredients due to their widespread accessibility, non-toxicity, and reasonable prices. These compete with many polymeric materials for use in pharmaceuticals and have created a significant achievement from being an excipients to innovative drug carriers. Scientists and pharmaceutical industries have been drawn to uncover the secret potentials of plant-based gums through a deeper understanding of their physicochemical characteristics and the development of safety profile information. The innovative unique class of drug products, useful in drug delivery applications, gene therapy and biosynthesis, has been developed by modification of plant-based gums. In this comparative study, (FTIR), (XRD) and (XRF) were carried out to investigate the functional groups as well as the molecular structures, the changes in their chemical structures and observed characteristic IR wave number, characterizing crystalline materials and the active oxides present. It was observed that the raw gum possesses most of the features of the imported industrial gum and therefore can be adopted in the pharmaceutical industries.

**Keyword:** Cashew tree gum, FTIR, Natural gum, polymeric materials, XRD, XRF.

**Introduction**

According to Glicksman and Sand (1973), the term "gum" denotes a wide range of compounds which includes polysaccharides, trepans, proteins and synthetic polymer. Nowadays, the term now covers a group of industrial polysaccharides or their derivatives that hydrates in hot or cold water to produce viscous solutions (Glicksman and Sand, 1973).

Generally, gum refers to a variety of substances that are gummy in nature and therefore cannot be precisely define. Thus, some types of rubbers can be considered to be gums, so also some synthetic

polymers, high molecular weight hydrocarbons and even some petroleum products(Lima et al., 2014).

This aforementioned led to the classification of gum into natural and modified (synthetic) gums, natural gums such as seaweed extract, plant exudates, gum from seed or root and gums obtained by microbial fermentation, modified (semi synthetic) gums included cellulose and starch derivatives and certain synthetic gum such as methoxyl pectin propylene, glycol, alginate and other petroleum products(Lankalapalli and Sandhala, 2019).

Natural gums are majorly produced in Asia and Africa, even though it's being gotten in some other parts of the world but importantly, its commercial interest has found a lot of uses industrially both for food and non-food processing industries(Glicksman, 1969).

The latter references to the gum mean soluble cellulose derivatives and modifications of other polysaccharides that in their original state would be insoluble. Thus, definition of gum can include mucilaginous polysaccharides(Glicksman and sand, 1973).

Natural gums possess physicochemical properties such as color, odour, taste, shape, texture, touch, solubility, pH, swelling index, loss on drying, hygroscopic nature, angle of repose, bulk, true densities, porosity, surface tension etc Gums and mucilages are highly viscous(Lankalapalli and Sandhala, 2019)

Cashew tree gum represents non-conventional alternatives, this movement started in china so many years ago, reaching its climax of development during the period of 1368-1644AD. Cashew gum is similar to gum Arabic and can be used as a substitute of liquid glue for paper, in the pharmaceutical and cosmetic industries as agglutinant for capsules and pills and in food industry as a stabilizer of juice. It can also be utilized in the making of cashew wines(Glicksman, 1969).

The sticky exudates from this tree darkens and thickens rapidly on exposure to air. When applied as a vanish, provides remarkable protection, as it's unchanged by acids, alkalis, alcohols or heat up to 70°C(Douglas and Michael, 1977).

Gum is a compound polysaccharide comprising 61% galactose, 14% arabinose, 7% rhamnose, 8% glucose, 5% glucuronic acid and 2% other sugar residues(Glicksman and Sand, 1973).

Elementary analysis performed on gum revealed water content 7.4%, total protein measured about 0.5%, total lipids 0.6%, fibres 0.95% and ash 0.95%, the total carbohydrate was 98%.Hydrolysis of cashew gum yields L-arabinose, L-rhamnose, D-galactose and glucuronic acid(Glicksman and sand, 1973).

Among the natural gums are the hydrophobic resinous sap that often exudes from plants or trees which are commercially taped or otherwise are collected as dried exudates produced with or without artificial stimulation by injury, such trees include Balsam(gum balsam) and other evergreen trees (gum resin) such as gum Arabic, gum tragacanth, acacia gum, cashew gum, karaya gum and Ghatti gum(Douglas and Michael, 1977).

Gum can be used for various purposes in industries such as wood, pharmaceutical,, paper, paint, cosmetics and textile industries to mention a few. It can as well be used for domestic application. In pharmaceutical industries, during drug production and delivery, Acacia gum serves as binder in tablet formulations like paracetamol, metronidazole etc(Tekade, 2011).

Broad use of diverse excipients, such as binders, thickening agents, sweeteners, and glidants, which can vary the physicochemical properties of the final formulation of the drug and regulate the pharmaco-dynamic and pharmaco-kinetic properties, has made major progress in the field of drug delivery systems. Polymers are used as excipients for the progress of polymer-based drug delivery systems with the function of targeted drug delivery. Synthetic polymers have high physical,

chemical, and mechanical stability but can cause cytotoxicity and are bio-incompatible (Amiri, Mohammad et al., 2021).

Gums possess a compound, split polymeric structure which shows high cohesive and adhesive properties. Gums have a variety of applications in pharmaceutical industries. They are used in drug production as demulcent for cough suppression, dental, and also as adhesive in bulk laxatives. They are useful as tablets binder, disintegrating agent, stabilizing agent, protective colloids in suspension, and sustainable agent in tablets (Lankalapalli and Sandhala, 2019).

In pharmaceutical industries today, gums are largely used as thickeners, suspending agents and emulsifying agents etc. Natural gums are hydrophilic colloids that form diffusion with water and boost the viscosity of the constant phase so that solid particle suspended is adequate for long time to measure the uniform dose (Lankalapalli and Sandhala, 2019).

### **Reason for research**

The reason for this research is to investigate the suitability of the local cashew tree gum for pharmaceutical applications. This will be done in this research by analyzing and characterising the local cashew exudate and compare with the properties of standard (imported) gum. This research therefore seeks to compare a locally sourced gum in Nigeria with an already existing industrial gum (xanthan gum) to see the similarities and possible differences in the characteristics so that the cashew tree gum can then be recommended for adoption in our pharmaceutical industries. Gum can be incorporated as binding, suspending, emulsifying, demulcent, jellying agent etc. in the manufacture of cough syrup, paracetamol, some vitamins and multivitamins among other uses in pharmaceutical industries (Amiri, Mohammad et al., 2021).

### **Importance of this research**

This research is capable of assisting the pharmaceutical industries in Nigeria to save the cost of acquiring the imported industrial gums, which can eventually reduce reliance on dollar outsourcing for importation of these industrial gums, it can also create jobs in terms of fetching these cashew tree gums in cashew plantations and processing across Nigeria.

### **Experimental Methodology**

The method adopted in this research is to analyse and characterise the locally sourced gum and the imported gum to see the similarities and the differences between the two. The method also highlighted the differences that exist between the two and therefore suggest the needs and the method for the beneficiation of the locally sourced gum. The analytical method adopted include the FTIR, XRD, XRF etc

### **Fourier transform infrared spectroscopy (FT-IR)**

Fourier transform infrared spectroscopy (FT-IR) analysis was performed on all samples isolated to obtain results of the bio-mineral. A few crystals were varied with KBr (Merck for spectroscopy) and pulverized in an agate mortar to produce a homogenous powder, under a pressure of 7 tons, the suitable pellet was prepared. All spectra were recorded from  $4000$  to  $400\text{ cm}^{-1}$  using the Perkin Elmer 3000 MX spectrometer. Scans were 32 per spectrum with a resolution of  $4\text{ cm}^{-1}$ . The IR spectra were analysed using the spectroscopic software Win-IR Pro Version 3.0 with a peak sensitivity of  $2\text{ cm}^{-1}$  (Mudgil et al., 2012; Huang et al., 2007).

### **X-Ray Diffraction Analysis (XRD)**

The powdered samples were pelletized and sieved to 0.074mm. which were later placed in an aluminium alloy grid (35mm x 50mm) on a flat glass plate and enclosed with a paper. Wearing hand gloves, the samples were gently compressed with the hand. Each sample was run through the Rigaku D/Max-III C X-ray diffractometer developed by the Rigaku Int. Corp. Tokyo, Japan and set to make diffractions at scanning rate of 2°/min in the 2 to 50° at room temperature with a CuK $\alpha$  radiation set at 40kV and 20mA.

The diffraction information (d value and relative intensity) obtained was compared to that of the standard data of minerals from the mineral powder diffraction file, ICDD which contained and includes the standard data of more than 3000 minerals. Similar diffraction information means the same minerals to standard minerals which exist in the soil sample. (Mudgil, Barak and Khatkar 2012).

### X-Ray Fluorescence (XRF)

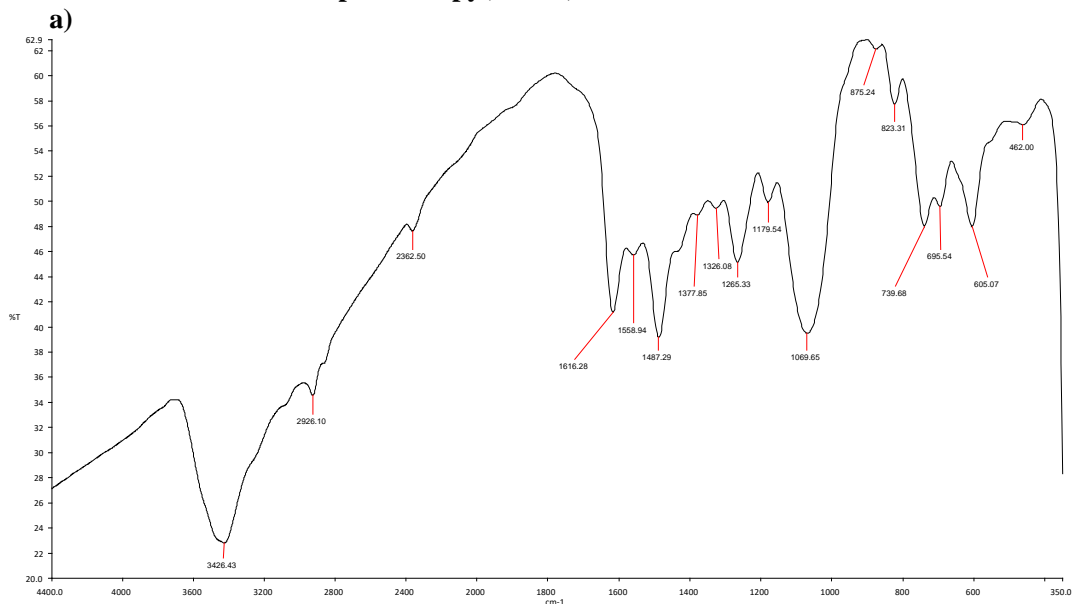
Crushing of each sample with an electric crusher and then pulverized for 60 seconds using Herzog Gyro-mill (Simatic C7-621). After which pellets were set from the pulverized sample, first by grinding 20g of each sample with 0.4g of stearic acid for 60 seconds. After each grinding, the Gyromill was further cleansed to prevent contamination. 1g of stearic acid was weighed into an aluminium cup to serve as binding agent and the cup was subsequently filled with the sample to the level point.

The cup then taken to Herzong pelletizing equipment where it was passed at a pressure of 200KN for 60 seconds. The 2mm pellets were introduced into a sample holder of the x-ray equipment (Phillips PW-1800) for analysis.

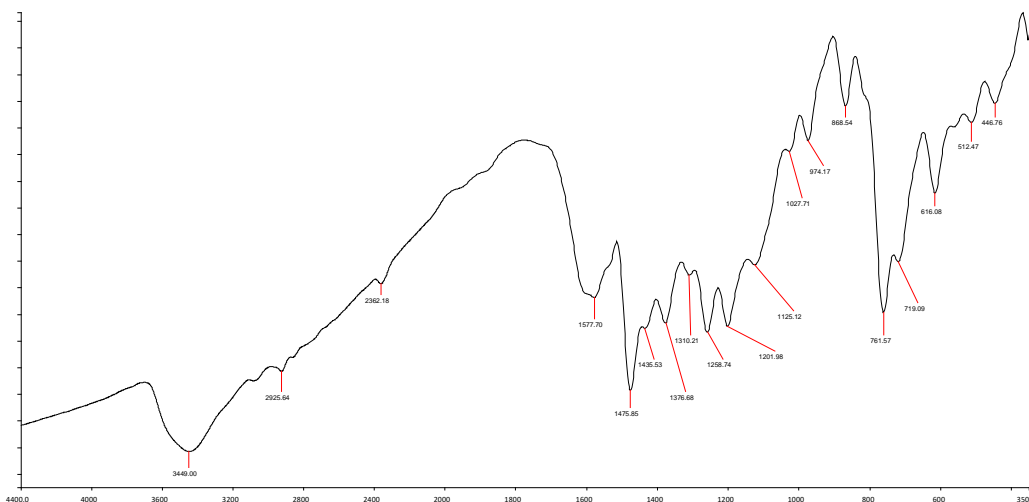
### Discussion of results

The comparison is aimed at improving the yield of cashew tree gum with imported industrial natural gum.

### Fourier transform infrared spectroscopy(FT-IR)





**Figure 1:** Fourier Transform Infrared Spectroscopy (FT-IR) Result of Cashew Tree Gum

b)

**Figure 2:** Fourier Transform Infrared Spectroscopy (FT-IR) Result of Imported Industrial Gum (Xanthan Gum)

Fourier transforms infrared spectroscopy (FTIR): Infrared Spectroscopy provides information regarding the evidence of the presence of different functional groups as well as molecular structure. FTIR spectra of cashew tree gum and imported industrial gum were recorded to compare the changes in their chemical structure and observed characteristic IR wave number.

From (Figure 1), a broad peak at  $3298\text{cm}^{-1}$  due to O-H stretching vibration of polymer and water involved in hydrogen bonding while a peak at  $2916\text{cm}^{-1}$  might be due to C-H stretching modes of methylene group of sugar. In the same spectrum a peak observed at  $1739\text{cm}^{-1}$  was due to the presence of C=O stretching vibrations, associated water molecule resulted in the band at  $1652\text{cm}^{-1}$  in the spectra.

The region around  $1373\text{cm}^{-1}$  due to  $\text{CCCC}_2$  deformation was also observed, however the peaks observed between  $800$  and  $1200\text{cm}^{-1}$  represented the highly coupled aldehyde and ether stretching modes of polymer backbone. In addition to that, a peak observed at  $1217\text{cm}^{-1}$  which might be due to the presence of aliphatic amines.

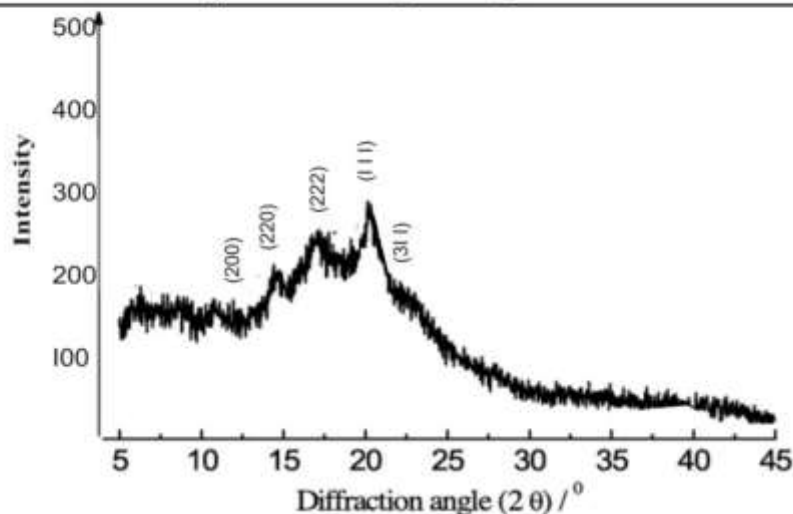
From (Figure 2), O-H stretching vibrations were observed at  $3257\text{cm}^{-1}$  as well as C-H stretching vibrations of  $\text{CCCC}_2$  at  $2920\text{cm}^{-1}$ . In purified gum, sharpening of absorption band around  $2358\text{cm}^{-1}$  showed its increased association with water molecule, which could be a justification of its improved solubility compared to cashew tree gum, while a peak at  $1217\text{cm}^{-1}$  as missing in purified sample. A slight modification can be observed in the well defined spectrum of purified guar gum. Similar behaviour of cashew tree gum and imported industrial gum samples were also reported previously (Huang et al., 2007; Sharma and Lalita, 2011; Dodi et al., 2011).

In case of cashew tree gum, C-H stretching vibration was observed at  $2923\text{cm}^{-1}$  and O-H stretching at  $1290\text{cm}^{-1}$ .

But in case of imported industrial gum, absorption bands of C-H and O-H stretching vibrations were not as sharp as in hydrolysis. Except these two bands, all other bands are sharp in basic sample. It is considered that crystallinity of polymer is represented by the region between 700 and 500 $cccc^{-1}$ .

### 3.2 X-Ray Diffraction Analysis (XRD)

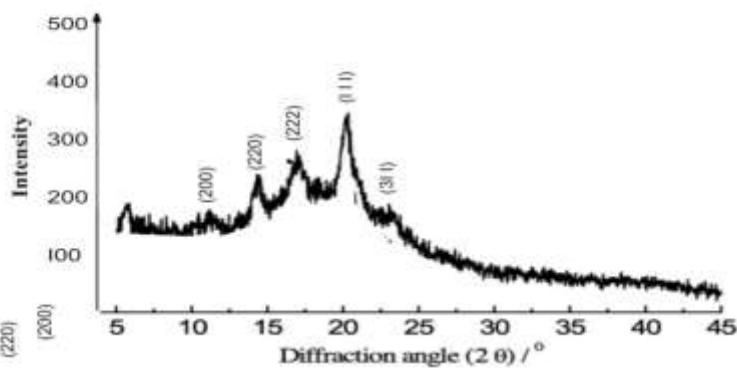
Sample	: Sample A	File	: Sg2~1.ASC	Date	: Jan 27 8:30:22	Operator	:
Comment	: Qualitative	Memo					
Method	: 2nd differential	Typical width	: 0.065 deg.	Min. Height		300:00 c p s	



c)

Figure 3: Experimental Result of XRD for Cashew tree gum.

Sample	: Sample B	File	: Sg2~1.ASC	Date	: Oct 27 8:35:45	Operator	:
Comment	: Qualitative	Memo					
Method	: 2nd differential	Typical width	: 0.065 deg.	Min. Height		350:00 c p s	



d)

Figure 4: Experimental Result of XRD for Imported Pharmaceutical Gum.

X-Ray Diffraction Analysis (XRD): X-ray diffractometer analysis of lyophilized samples of cashew tree gum and imported industrial gum (in powder form) was analyzed by using X-ray

diffractometer (Rigaku MAX III I022, Japan). Measurements were carried out with a diffraction angle range of 5– 60° at room temperature with a scan step of 0.01 (Mudgil et al., 2012). X-ray diffraction (XRD) is a powerful non destructive technique for characterizing crystalline materials. Cashew tree gum and imported industrial gum showed different behaviour in regular structure. Cashew tree gum was largely amorphous and two peaks were observed at the scattering angle ( $2\theta$ ) at 17.5° and 20.4° (Figure 3).

The biopolymer imported industrial gum was of low crystallinity, possibly due to intramolecular interactions and the  $2\theta$  observation was at 6.2° and 20.2° (Figure 4). Whereas the crystalline regions of hydrolyzed (base) cashew tree gum were seen at 20.4° and 48.9° (Figure 3).

This means that cashew tree gum resulted in negligible change in XRD curve. However, it was observed that imported industrial gum slightly increased the crystallinity of partially cashew tree gum. Present results are in accordance with the results reported by (Dass et al. 2000; Cunha et al. 2005 and Mudgil et al. 2012) who reported the increased crystalline behaviour of the guar gum upon partial hydrolysis.

### X-Ray Fluorescence (XRF)

#### Inorganic Geochemical Analysis Using X-Ray Fluorescence Spectrophotometer (XRF).

**I. Table 1: Experimental Results of XRF**

COMPONENTS	RAW CASHEW TREE	IMPORTED
GUM PHARMACEUTICAL GUM		
<b>SiO<sub>2</sub></b>	89.30	81.80
<b>Al<sub>2</sub>O<sub>3</sub></b>	0.51	0.73
<b>Fe<sub>2</sub>O<sub>3</sub></b>	0.28	0.45
<b>MnO</b>	0.01	0.01
<b>CaO</b>	6.29	10.90
<b>P<sub>2</sub>O<sub>5</sub></b>	0.04	0.07
<b>K<sub>2</sub>O</b>	0.07	0.11
<b>TiO<sub>2</sub></b>	0.04	0.06
<b>MgO</b>	0.17	0.25
<b>Na<sub>2</sub>O</b>	0.05	0.06
<b>LOI</b>	27.70	25.67
<b>Cl</b>	0.03	0.02
<b>SO<sub>3</sub></b>	0.02	0.02
<b>Rb</b>	0.05	0.02
<b>Zr</b>	0.10	0.12
<b>Cr</b>	0.10	0.05

<b>Cu</b>	0.03	0.05
<b>Ni</b>	0.09	0.10
<b>Pb</b>	0.10	0.10

From table 1 above, the results show that cashew tree gum contains the higher amount of silica by mass of 89.30%, followed by imported pharmaceutical gum with 81.80%. Imported pharmaceutical gum contains higher amount of Alumina, 0.73% followed by cashew tree gum with 0.51%. Imported pharmaceutical gum indicated the highest amount of Ferric oxide, 0.45%, closely followed by cashew tree gum with 0.28% while the CaO contains the least with just 6.29%. Imported pharmaceutical gum has the greatest quantity of 10.90% by mass of potassium oxide, followed by cashew tree gum with 0.07% while imported pharmaceutical gum contains the least amount of just 0.11%. So also, the imported pharmaceutical gum contains higher amount of magnesium oxide, 0.25% followed by cashew tree gum with 0.17% while solid waste contains the least with just 0.05%. All other minerals present are in such negligible proportion that their presence would not constitute threats to the performances of the gum as refractory materials

#### Observed Similarities and Differences between Cashew Tree Gum and Imported Industrial Gum

**Table 2: Similarities and Differences between Cashew Tree Gum and Imported Industrial Gum.**

	FTIR		XRD		XRF	
	CTG( cccc-l)	IIG(cccc <sup>-1</sup> )	CTG	IIG	CTG( % )	IIG(%)
<b>SIMILARITIES</b>	Peak 3298 due to OH. 2916 Due to CH.	Peak 3257 due to OH. 2920 due to CCCC <sub>2</sub> .	Increased crystalline behaviour.	Increased crystalline behaviour.	PP2005 is 0.04. is TiOO <sub>2</sub> is 0.04. is NNNN <sub>2</sub> is 0.05. KK <sub>2</sub> is 0.07.	PP2005 is 0.07. TiOO <sub>2</sub> is 0.06. NNNN <sub>2</sub> is 0.06. KK <sub>2</sub> is 0.11.
<b>DIFFERENCES</b>	C-H of 2923, O-H of 1290	C-H and O-H where not as sharp as in hydrolysis.	Largely amorphous, (2θ) was at 17.5° and 20.4°, base was	Low crystallinity, (2θ) was at 6.2° and 20.2°	Higher silica, Lower Alumina, Lower Ferric	Lower silica, Higher Alumina, Higher Ferric

			20.4° and 48.9°		Oxide, Lower CaO.	Oxide, Higher CaO
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CTG → Cashew Tree Gum  
IIG → Imported Industrial Gum

### Conclusion

From the result of the analysis above, the local cashew exudate and xanthan gum(imported) have substantially similar characteristics and properties. These suggest that the local gum can be used for pharmaceutical applications after the removal of the possible impurities. The analysis carried out on both gum sample shows that there may be need for pharmaceutical industries and scientists in the country to embark on minimal optimisation of gums from local cashew trees. This will help save cost of acquiring these imported gums thereby making it economical for both drug production and market sales. The X-ray diffraction (XRD) shows that the present results of the cashew tree gum is very similar to the standard results reported for Xanthan gum..

In Fourier transform infrared spectroscopy (FTIR) It is considered that crystallinity of polymer is represented by the region between 700 and 500 $cm^{-1}$ , similar behaviour of cashew tree gum and imported industrial gum samples were also reported and X-ray fluorescence (XRF) showed that there are lots of similarities between the oxides of the two gum samples with little differences which can be harnessed through beneficiation of the crude.

### References

- Amiri M., Mohammed S., Zadeh V., Yazdi M., Barani M., Rahdar A., Kyzas G. Z. (2021). Plant Based Gums and Mucilages. Applications in Pharmacology and Nanomedicine.: A Review on Molecules, 26(6).
- Cunha R. L. P., Castro R. R., Rocha C. A. F., Paula M. C. R., Feitosa A. P. J. (2005). Low Viscosity Hydrogel of Guar Gum. Preparation and Physiochemical Characterization.: International Journal Biological Macromol, 37: 99-104.
- Dass J. P., Schols A. H., Jongh H. H. (2000). On the Galactosyl Distribution of Commercial Galactomannans. Carbohydrate Research, 329: 609-619.
- Dodi G., Hritcu D., Popa M. I. (2011). Carboxymethylation of Guar Gum: Synthesis and characterization . Cellulose Chemical Technology. 45: 171-176
- Douglas C. N., Michael P. D. (1977). Organic Chemistry, 2<sup>nd</sup> Edition , John Wiley and Sons Inc,105.
- Glicksman M., Sand R. E. (1973). Industrial Gums, Polysaccharide and their Derivatives. Academic Press Inc, 199-230.

- Glicksman, (1969). Gum Technology in the Food Industry(Food Science and Technology). Academic Press Inc, 11-15.
- Huang Y., Lu J., Xiao C. (2007). Thermal and Mechanical Properties of Cationic Guar Gum/Poly(acrylic acid) Hydrogel Membranes. *Polymer Degradation Stability*, 92: 10721081.
- Lankalapalli S., Sandhala D. (2019). Natural Gums and their use as Pharmaceutical Excipients.: *An International Journal of Pharmaceutical Science & Research*, 10(12). A review.
- Lima R. D. N., Lima J. R., Salis C. R., Moreira R. A. (2014). Cashew Tree (Anacardium Occidentale) Exudates Gum: A Novel Bioligand Tool: *A Journal of Biotechnology and Biochemistry*, 35(1): 45-53.
- Mudgil D., Barak S., Khatkar B. S. (2012). X-ray Diffraction, IR Spectroscopy and Thermal Characterization of Partially Hydrolyzed Guar Gum.: *International Journal of Biological Macromol*, 50: 1035-1039.
- Sharma S., Kothiyal C. N. (2011). Removal of Cr (iv) from Aqueous Solution by Polymer Based Guar Gum and Activated Charcoal Adsorbents. *The Holistic Approach to Environment*. 2: 3-22.
- Tekade B. W. (2011). Evaluation of Acacia Gum as a Binder in Tablet Formulations.: *An International Journal of Research in Pharmaceutical Sciences*, 2:616-620.

**MODEL DEVELOPMENT FOR THE PREDICTION OF RAINFALL IN MINNA,  
NIGER STATE NIGERIA USING ATMOSPHERIC PARAMETERS IN MACHINE  
LEARNING TECHNIQUES**

**JIYA, Samuel Babanma**

Department of Geography,  
Niger State College of Education, Minna,  
Niger State, Nigeria

**YISA, Dorcas N**

Department of Geography,  
Niger State College of Education, Minna,  
Niger State, Nigeria

**IORNONGO Terseer**

Department of Geography,  
Federal University of Technology, Minna,  
Niger State, Nigeria

**ABSTRACT**

Rainfall prediction remains a serious concern and has attracted governments, industries, risk management entities, and the scientific communities. This study is to develop a model for the prediction of rainfall in Minna, Niger State Nigeria. Four-year atmospheric data consisting of rainfall, minimum temperature, maximum temperature and relative humidity spanning from 2018 to 2021 was acquired from the Department of Geography, Niger State College of Education Minna, Niger State. Three machine learning models were used for the rainfall prediction. There are linear regression, decision tree and random forest. The idea is to experiment with the three models and select the best prediction model for the data. The data was split into two, the training set and the testing set at a ratio of 80:20. The results show that the random forest model out-performed the other models with a Mean Absolute Error (MAE) of 1.60 mm and Root Mean Square Error (RMSE) of 4.05 mm. This is followed by the decision tree model with MAE of 2.48 mm and RMSE of 6.04 mm and the worst performing model is the linear regression with a MAE of 4.24mm and a RMSE of 6.90 mm. Hence random Forest was selected and used to formulate a computer-based rainfall prediction Application (App) using python tool. The App's user-friendly Graphical User Interface (GUI) provides easy access to rainfall prediction especially for less technical users. It is recommended that accurate data be incorporated for a better rainfall prediction.

**Keywords:** Prediction, Machine language, model development, weather parameters

## INTRODUCTION

Rainfall prediction remains a serious concern and has attracted governments, industries, risk management entities, and the scientific community. Rainfall is a climatic factor that affects many human activities like agricultural production, construction, power generation, forestry, and tourism. To this extent, rainfall prediction is essential since this variable has the highest correlation with adverse natural events such as landslides, flooding, mass movements and avalanches. These incidents have affected society for years. Therefore, having an appropriate rainfall prediction approach makes it possible to take preventive and mitigation measures for these natural phenomena (Nikhil, 2019).

Rainfall is a complex atmospheric process, which depends upon many weather-related features. Therefore, accurate and timely rainfall prediction can be helpful in many ways, such as planning the water resources management, issuing early flood warnings, managing the flight operations and limiting the transport & construction activities (Martinez *et al*, 2020).

Rainfall forecasts have significant value for resource planning and management, such as reservoir operations, agricultural practices and flood emergency responses. To mitigate this, effective planning and management of water resources are necessary. In the short term, this requires a good idea of the upcoming season. In addition, it needs realistic projections of scenarios of future variability and change. Johnston, *et al* (2016)

## LITERATURE REVIEW

Rainfall is one of the most significant atmospheric occurrences useful for the environment itself and all the living beings on the earth. It affects everything directly or indirectly and because it is one of the most important natural phenomena; it is also important to ponder the precipitation changes with climate change (Alpers and Melsheimer, 2014). Rainfall has a significant impact on the universal gauge of atmospheric circulation and affects the local weather conditions. Rainfall helps balance the increasing temperature and the survival of human beings (Trenberth, 2011). The increasing temperature of the world is associated with global warming, and that water is one of the scarce and most useful resources that, as a result of this increase in temperature, is evaporating quickly from the reserves. Rainfall is, therefore, a compensation to all these reserves and a necessary for agriculture as well. The phenomenon of rainfall differs with the difference in latitude and longitude. Rainfall phenomenon also differs from different regions, planes, mountains, and plateaus (Alpers and Melsheimer, 2014).

Rainfall prediction is not an easy job, especially when expecting the accurate and precise digits for predicting the rain. Rainfall prediction is commonly used to protect agriculture and production of seasonal fruits and vegetables and sustain their production and quality to the amount of rain required (Lima and Guedes, 2015). Rainfall prediction uses several networks and algorithms and obtains the data to be given to the agriculture and production departments. Rainfall prediction is necessary and mandatory, especially in the areas where there is heavy rainfall, and it is more often expected (Amoo and Dzwauro, 2016). There are huge economies like those of Asia like India and



China that earn a large proportion of their revenue from agriculture and for these economies; rainfall prediction is very important (Darji, *et al.*, 2015).

Abbas *et al.* (2011) compared modified K-means and genetic algorithm-based clustering methods for rainfall prediction in Iran's southeast. They used the two clustering techniques to develop seasonal precipitation prediction guidelines based on the sea surface temperature (SST) variations in some selected geographical zones in Iran. Their results showed that the two models could be effectively used for below and above normal precipitation prediction for seasonal rainfall.

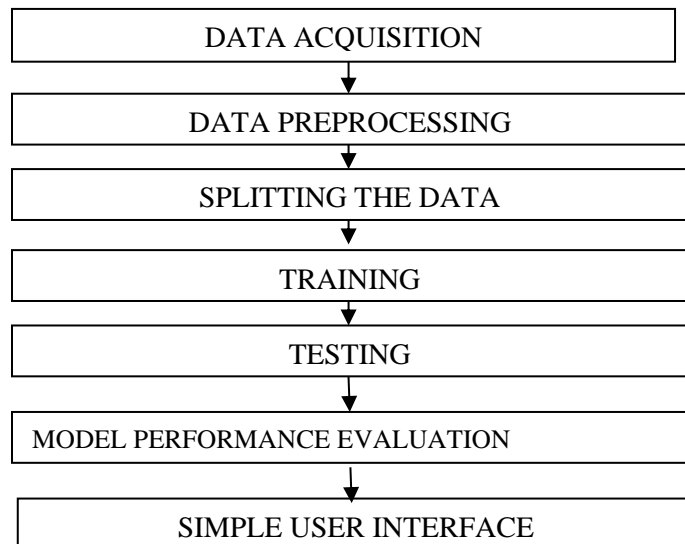
Wichitarapongsakun *et al.*, (2016), uses K-Nearest Neighbor (KNN), Artificial Neural Network (ANN), and Extreme Learning Machine (ELM) for the seasonal forecasting of the summer monsoon and post-monsoon rainfall for the Kerala state of India. Their findings indicated that the three techniques performed reasonably well in rainfall prediction. Generally, ELM technique showed better performance with minimal mean absolute percentage error scores for rainfall prediction than KNN and ANN techniques. They concluded that artificial intelligence approaches could predict rainfall in India's Kerala state with minimal prediction error scores.

Kashiwao *et al.*, (2017), adopted neural network-based for local rainfall prediction system in Japan. Local rainfall was predicted in regions of Japan using data from the Japan Meteorological Agency. The findings of two prediction models Neural Network (NN) models for the system, we used a Multi-Layer Perceptron (MLP) with a hybrid algorithm composed of back-propagation (BP) and Random Optimisation (RO) methods, and Radial Basis Function Network (RBFN) with a Least Square Method (LSM)) were compared for their prediction performance. The results showed that precipitation in Japan could be predicted by the proposed method and that the prediction performance of the MLP model was superior to that of the RBFN model for the rainfall prediction problem.

## MATERIALS AND METHODS

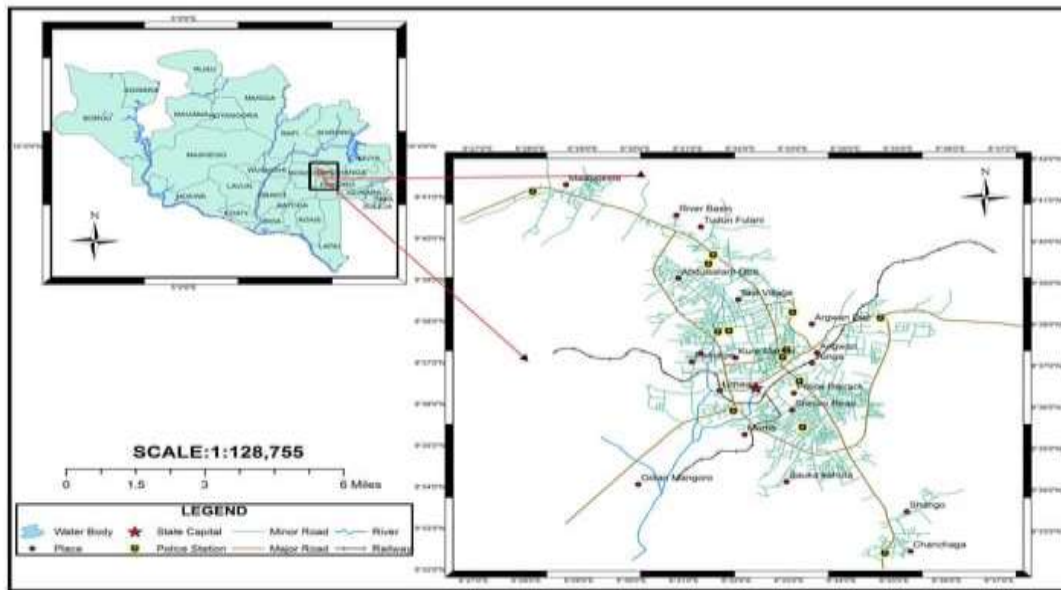
### 3.1 Preamble

The methodologies implored during the research, including the data collection and pre-processing, the algorithms for training the machine learning models, tools used in training and lastly, the tests conducted to ascertain the accuracy of the predicted results shall be discussed. In addition, to expand the models' usability, a simple user interface that simplifies interaction with the model was built. Figure 3.1 shows the flow diagram of the steps involved in the methodology.



**The Study Area**

The study area is Minna. Minna city is the administrative headquarters of Niger State, with an estimated population of 304,113 based on a 2007 census and a land area of about 6,789 square kilometres. Minna lies on latitudes 9°37N and longitudes 6°16E-6°65E on a geological base of undifferentiated basement complex, mainly made up of gneiss and magnetite. The climate of Minna lies within a region described as a tropical climate. (National Oceanic, 2019).



**Figure 1.1 The study Area**

**Source:** (Geography Department Federal University of Technology Minna, 2021)

**Table 3.3 Summary of the data acquired**

	Year	MinTemp	MaxTemp	Relative humidity	Rainfall
Count	4	1460	1460	1460	1460
Mean		23.49925	34.575411	73.833082	2.695753
Std		2.108738	3.772177	23.45748	9.124641
Min	2018	14	22	17	0
Max	2021	36	45	108	110

**Data Analysis**

**Data Slitting**

The data was split into two, the training and testing set to provide a benchmark for evaluation. The entire data are 4032 in number. The data was split randomly in the ratio 80:20. Thus, 80% of the data amounting to 3225.6 was used for training, while 20% of the data amounting to 806.4 was used to test the result of the model

**Training of Network**

The scikit-learn machine learning tool was leveraged upon to develop a prediction model. Three prediction packages adopted in this work are linear regression, Random Forest and Decision Tree. Each requiring network train to tune the three algorithms. The training set apportioned during data splitting (80%) was used to train the machine learning model.

**Testing of Network**

The already tuned network (model) was subjected for evaluation (testing) using the earlier apportioned testing data (20%).

**Model Performance Evaluation**

To test the accuracy of the model arrived at and to identify the best performing model, the following error checking mechanisms were employed:

**Mean Absolute Error (MAE)**

Mean Absolute Error (MAE) measures the common magnitude of the errors during a set of predictions while not taking their direction into thought. It is used to check the variations between prediction and actual observation wherever all individual variations have equal weight.

$$MAE = \frac{1}{n} \sum_{j=1}^n |y_j - \hat{y}_j| \tag{3.1}$$

where, n represents the number of observations, y is the actual rainfall value and  $\hat{y}$  is the predicted rainfall value.

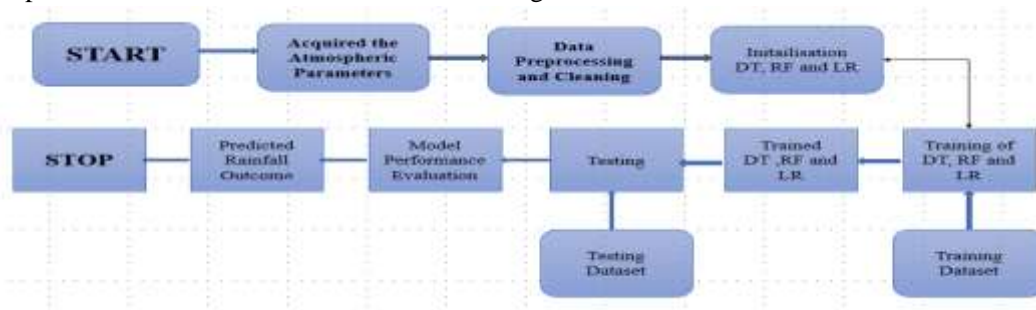
**3.5.2 Root Mean Square Error**

Root Mean Square Error (RMSE) is a quadratic marking rule that measures the common magnitude of the error in the predicted rainfall. It is the root of the common square variations between prediction and actual observation.

$$RMSE = \sqrt{\frac{1}{n} \sum_{j=1}^n (y_j - \hat{y}_j)^2} \tag{3.2}$$

where, n represents the number of observations, y is the actual rainfall value and  $\hat{y}$  is the predicted rainfall value.

A more encompassing flowchart showing specific steps of the system architecture as previously explained from start to finish is shown in the Figure 3.2



**Figure 3.2 System Architecture**

### User Interface (Rainfall prediction App)

It is an objective of this work to bring rainfall prediction to the doors of the ordinary man. In view of this the Python library Tkinter was used to build a simple User Interface also known as Application (APP). This effort simplifies interaction with the model, which is highly technical. The rainfall prediction interface provides a wide array of access, especially to users who have less expertise within this domain.

The Python programming language was employed for this project. It was chosen due to its open-source nature, large collaborative community and great support for desktop and web application development. In addition, Python has the following packages which were of interest to this research:

**Scikit-Learn:** Scikit-Learn, also known as **sklearn**, is Python's premier general-purpose machine learning library. Scikit-Learn's versatility makes it the best starting place for most Machine Learning problems.

**NumPy:** is a library for the Python programming language, adding support for large, multi-dimensional arrays and matrices and a large collection of high-level mathematical functions to operate on these arrays.

**Pandas:** is a fast, powerful, flexible and easy to use open-source data analysis and manipulation tool built on top of the Python programming language.

**Tkinter:** It is the standard Python interface to the Tk Graphical user interface (GUI) toolkit and is Python's de-facto standard Graphic User Interface.

## DISCUSSION OF NRESULTS

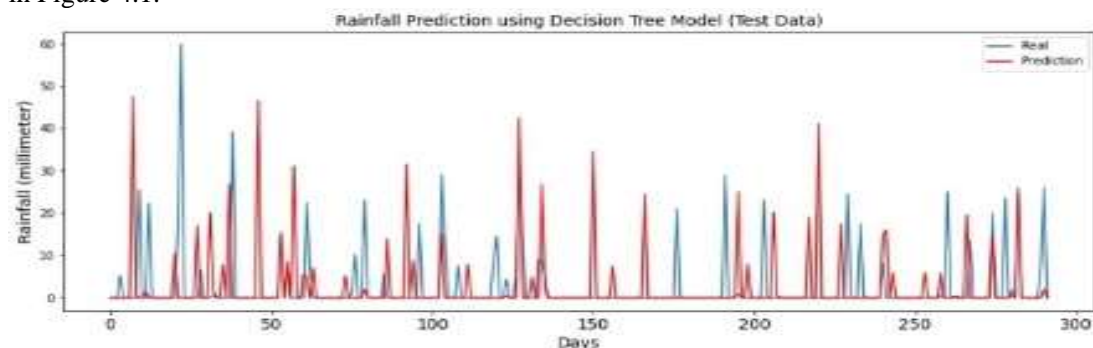
### Rainfall Prediction

The goal of this work is to predict Rainfall using Machine learning. Three machine learning models, linear regression, decision tree and random forest were used for the prediction. The idea is to experiment with the three machine learning models and select the best prediction model.

As previously stated in section 3.3, the data was slitted into two at ratio 80:20. 80% of the data was used to train the model, while 20% was reserved and used for testing the model's performance. These exercises were carried out for each of the Python prediction packages and the results are presented here.

### Rainfall Prediction Result using Decision Tree

On the decision tree package, the prediction protocol was observed and the result obtained is shown in Figure 4.1.

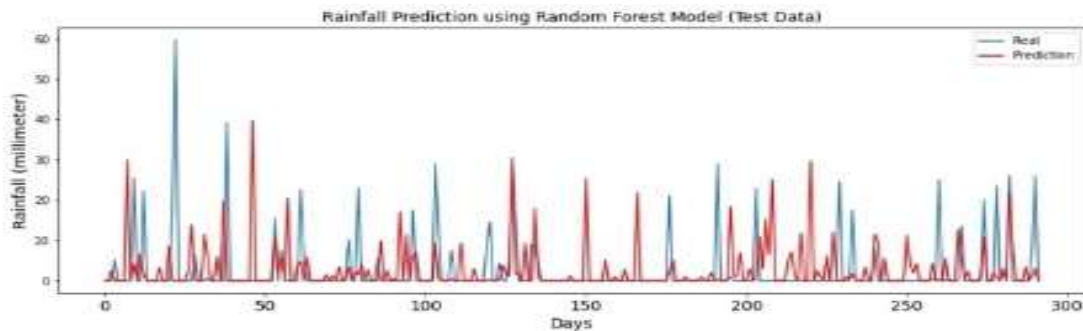


**Figure 4.1 Decision Tree Model of Rainfall Prediction**

In Figure 4.1, a rainfall prediction graph using decision tree was presented. The model makes judgement based on **simple decision (or judgement) based on relevant question rules it has asked and answered during training. Here it does its prediction by following the answered path to see if it arrives to the actual rainfall values from top to bottom.** The actual values are the blue lines and the predicted values are the red lines. The graph shows a level of correlation between the predicted values and the actual values.

### Rainfall Prediction Result using Random Forest

The prediction steps of data splitting, network training and network testing was executed using the random forest. Figure 4.2 shows the prediction result obtained.

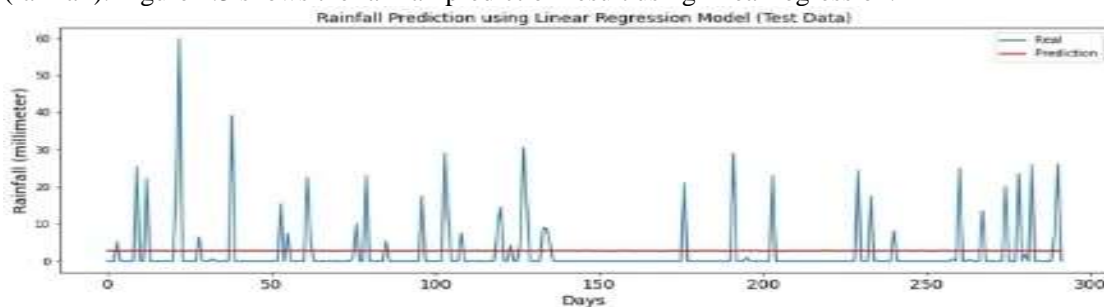


**Figure 4.2 Random Forest Model of Rainfall Prediction**

Figure 4.2 presents a rainfall prediction graph using random forest. The algorithm works similarly to that of the decision tree above by creating a forest with several decision trees that functions as an ensemble and the class with the most votes become the model's prediction. The actual values are the blue lines and the predicted values are the red lines. The graphs show a better correlation between the predicted rainfall values and the actual rainfall values. Since it operates by constructing a multiple of decision trees at training times, it generally outperforms the decision trees prediction.

### Rainfall Prediction Result using Linear Regression

Same data was subjected to the linear regression environment to observe how best the input variables of relative humidity, maximum and minimum temperature can best explain the output (rainfall). Figure 4.3 shows the rainfall prediction result using linear regression.



**Figure 4.3 Rainfall Prediction Result using Linear Regression**

Figure 4.3 is the linear regression model of rainfall prediction. Here, the multiple linear regression model, having multiple input variables, tries to find out a linear relationship between multiple input variables of relative humidity, maximum and minimum temperature and the output, that is rainfall. The model tries to reach the best values that minimise the error between the predicted rainfall value and true rainfall value. As seen in the prediction graph, the actual values are the blue lines and the predicted values are the red lines. It does not show a good correlation between the predicted rainfall values and the actual rainfall values when compared to the other two models. A regression line through the plots shows disparity between the two.

Thus far, the best performing model is the random forest because, it was observed graphically that the predicted rainfall values to a greater extent aligns with the acquired rainfall values and was therefore adopted as the rainfall model for this work based on graphical performance. However, there is need to statistically compare the predicted rainfall results with the real values (acquired value) to check the accuracy of the predicted values and to what extent these values deviate from the real values.

### Prediction Performance Evaluation

The predictive capabilities of each of the models in predicting the rainfall of Minna was put to test. Next, is to tell how well the prediction was done statistically. It is essential to have different metrics to test the result to ensure that the selected model is suitable for the data type. To do this, the accuracy of each model was subjected to analysis of their Mean Absolute Error (MAE) and Root Mean Square Error (RMSE). It checks the variations between predicted rainfall and actually acquired rainfall data (test target) and identifies the best performing model. Table 4.1 is the prediction performance evaluation result.

**Table 4.1: Prediction Performance Evaluation Result**

Model	MAE	RMSE
<b>Trained Values</b>		
Random Forest	3.776	7.560
Decision Tree	4.175	11.061
Linear Regression	4.655	9.121
<b>Tested Values</b>		
Random Forest	1.604	4.056
Decision Tree	2.484	6.047
Linear Regression	4.285	6.909

Author's Computation, 2021

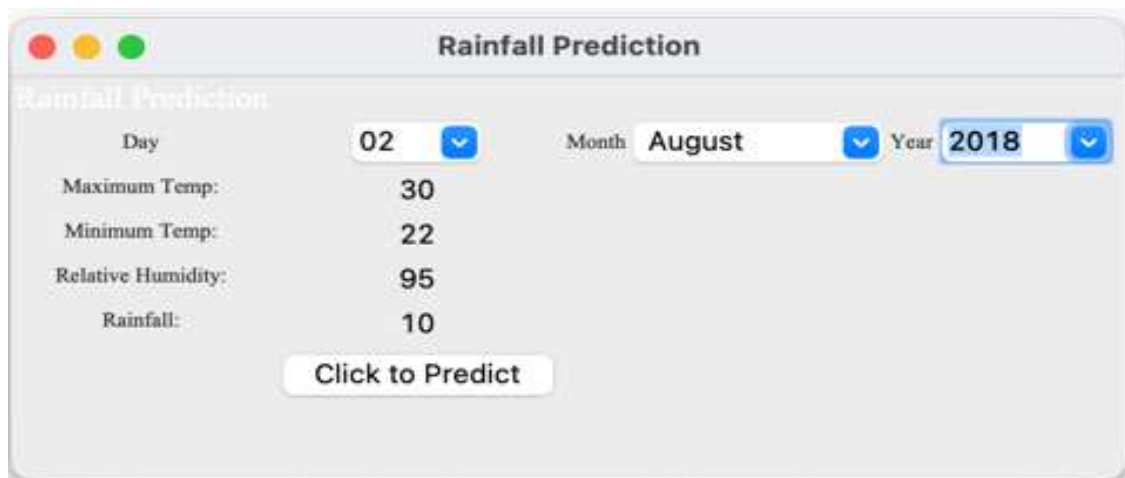
Two categories of evaluation results were presented in Table 4.1 for each model, the trained and tested evaluation results. It is observed that for random forest, 3.78 and 7.56 values were obtained for MAE and RMSE respectively for the trained data while 1.60 and 4.06 values were respectively obtained for MAE and RMSE in the test categories. Same observation of a wider error in the trained

result can be noticed with all the models. This is so expected because, for the test values, the model is exposed to an already trained and adjusted model; hence, an understanding of previous trend exists. This being the reason for more accurate rainfall predictions (lesser error values) was obtained from the test results and hence the test result was adopted as the model's evaluation result. Secondly, the idea to experiment with the three machine learning models is to identify the best prediction model from the data. It is observed that, 1.60 and 4.06 values obtained for MAE and RMSE for the random forest model were the least error values across all the models under consideration. This was followed by the decision tree with 2.48 and 6.05. On the other hand, the worst performing model is the Linear regression with MAE of 4.28 and RMSE of 6.9.

The emergence of random forest as the best performing model is not a surprise, as it is generally accepted in data science that since random forest is made up of a large number of relatively uncorrelated models operating as a committee, it will outperform any of the individual constituent models. Therefore, random forest is hereby identified and adopted as the best rainfall prediction model for Minna metropolis based on graphical alignment and performance evaluation results.

### Rainfall Prediction User Interface (Rainfall Prediction Application)

In section 4.3 random forest was identified and adopted as the best rainfall prediction model for Minna metropolis. Same was also selected for use in the development of a rainfall prediction Application (App). The App is a Graphical User Interface (GUI) that allows easy access to the prediction system. It ensures the system can be used by a wide variety of users with little to no technical understanding of the core working of the model. Figure 4.7 shows the User Interface of the rainfall prediction system.



**Figure 1.7 Graphical User Interface of rainfall prediction Application**

In order to test the App, a user simply input the date of the day to predict. The system takes the date and outputs the relative predicted values. The App was developed using Python. The selected prediction model (random forest) and same data acquired for this research. The App was designed

in such a way that it does not only predict rainfall, but other atmospheric parameters such as relative humidity, maximum and minimum temperature. The programming was done in such a way that once the date is inputted, it first recalls the atmospheric parameters required for rainfall prediction, that is relative humidity, maximum and minimum temperature. By this developed rainfall prediction App, rainfall prediction has been demystified and made accessible to a wide variety of users with little or no technical understanding of the core working of the model. The rainfall prediction App's performance was evaluated by predicting for days with known rainfall values (from acquired data). Results obtained for the predicted rainfall and other parameters were in agreement with actual values.

However, the rainfall prediction by the App is only limited to five years in advance. This limitation is due to insufficient data, as a work of this magnitude will require about thirty years data.

## CONCLUSION

In concluding this work, the rainfall variability of Minna metropolis over the entire period ranging from 2018 to 2021 was analysed. 2019 recorded the highest volume of rainfall of 1180.3mm while 2021 recorded the least volume of 854.1mm. For the monthly variations, peak rainfall values of 267.9 mm, 320.8mm, 253.3mm and 294.2mm were recorded in the months of September, September, July and August for the year 2018, 2019, 2020 and 2021 respectively.

Three machine learning models, namely linear regression, decision tree and random forest was used to predict rainfall of Minna metropolis. Using three different machine learning techniques shows the feasibility of using machine learning to predict rainfall in Minna metropolis. The Random Forest techniques outperformed the other two machine learning models employed with a Mean Absolute Error (MAE) of 1.60 and a Root Mean Square Error (RMSE) of 4.05 and thus, was selected as the best rain prediction model for the study area.

The best performing model, the random forest was used to develop a rainfall prediction Application. The App's Graphical User Interface (GUI) ensures that rainfall prediction and its benefits are brought to the door step of a wide variety of users with no technical understanding of the core working of the model.

## REFERENCES

- Abbas, G.A., & Menezes, J.M. (2011). "Multistep-Ahead Prediction of Rainfall Precipitation Using the NARX Network." *Researchgate*
- Alpers, W., & Melsheimer, C. (2014). Rainfall. SAR Marine User Manual, US Dept of Commerce, NOAA.
- Amoo and Dzwauro, (2016). "Multistep-Ahead Prediction of Rainfall Precipitation Using the NARX Network." *Researchgate*.
- Johnston, J., Letha, J., & Jairaj, P. G. (2016). Daily Rainfall Prediction using Generalised Linear Bivariate Model - A Case Study. *International Conference on Emerging Trends in Engineering, Science and Technology (ICETEST- 2015)*, 24, 31–38. <https://doi.org/10.1016/j.protcy.2016.05.006>
- Lima and Guedes, (2015).. (2015). Daily Rainfall Prediction using Generalised Linear Bivariate Model - A Case Study. *International Conference on Emerging Trends in Engineering,*



- Science and Technology (ICETEST- 2015)*, 24, 31–38.  
<https://doi.org/10.1016/j.protcy.2016.05.006>
- Martinez et al. 2020. "Innovative Techniques in the Context of Actions for Flood Risk." *eng MDPI*.
- Nikhil. 2019. Predicting Rainfall using Machine Learning Techniques School of Electrical Engineering and Computer Science (EECS), University of Ottawa, Ottawa, Canada
- Kashiwao, T., Nakayama, K., Ando, S., Ikeda, K., Lee, M., & Bahadori, A. (2017). A neural network-based local rainfall prediction system using meteorological data on the Internet: A case study using data from the Japan Meteorological Agency. *Applied Soft Computing Journal*, 56, 317–330. <https://doi.org/10.1016/j.asoc.2017.03.015>
- Trenberth, K. E. (2011). Changes in precipitation with climate change. *Climate research*, 47, 114.
- Wichitarapongsakun, P., Sarin, C., & Klomjek, P. (2016). Rainfall prediction and meteorological drought analysis in the Sakae Krang River basin of Thailand. *Agriculture and Natural Resources*, 50, 490–498. <https://doi.org/10.1016/j.anres.2016.05.003>

## ENVIRONMENTAL IMPACT OF INDISCRIMINATE LOCATION OF PETROL RETAIL STATIONS IN URBAN MINNA, NIGER STATE NIGERIA

**Mammman Ibrahim,**

Dept. of Geography,  
Federal University of Technology, Minna,  
Niger State, Nigeria

**Suleiman Y. Mohammed,**

Dept. of Geography,  
Federal University of Technology, Minna,  
Niger State, Nigeria

**Jibrin Abdullahi**

Department of Urban and Regional Planning,  
Federal polytechnic Bida,  
Niger State, Nigeria

### Abstract

The study aim's at assessing the environmental impact of indiscriminate location of petrol retail stations in urban Minna. The study Map out the Petrol Retail Stations in Minna Township, Examined the distributional pattern of the petrol retail stations and assess their conformity with planning standards; even though most petrol retail station do not comply with the standard of 50-meter distance from well water sources. The research adopted field survey, coordinate of the stations were obtained using Geographical Positioning System (GPS) to collect primary data; Garmin™ Etrex handheld Global Positioning System (GPS) receiver of 4.5 m accuracy. A Buffer width of 250meters recommended by Palfrey and Bradley, was used to provide a buffer zone. Results were presented on imageries and Maps. (GIS) was also used in identifying the existing petrol filling stations as well as conducting queries to assess the level of compliance of the petrol filling stations with extant planning standards. The research throws light on to the physio-chemical analysis of Well water sources in Minna metropolis, eight different well were compared: The parameters such as water temperature, total dissolved solid, pH, conductivity and Total petrol hydrocarbon (TPH) were analysed. In this study, Total petroleum hydrocarbon concentration affects different aspects of the water quality, it can be concluded that eight (8) underground water sources out of the ten (10) shows the presence of Total Petroleum Hydrocarbons (TPH). Only one well (Well 5) with 4.8 TPH concentrations was within the permissible limit of 5.0 mg/l. The study recommends wells that are to be used for domestic purposes should be cited far away from Petroleum Filling stations so as to reduce the number of Hydrocarbons that may get into the underground water sources and in unavoidable cases, water treatment should be embraced.

**Keywords:** Keywords: Filling stations; water quality, Physicochemical Parameters, spatial distribution, Total Petroleum Hydrocarbons (TPH).

### INTRODUCTION

In recent times, there has been a tremendous proliferation of petrol retail outlets at strategic locations due to high demand for fuel and the justification for such unprecedented increase is due to the country's population and the attendant increase in the purchase of vehicles (Taylor,

Sichinsambwe, & Chansa, 2016). The attractive price of petrol both at control price and black-market price makes more people to go into petrol retailing businesses (Tah, 2017). Petrol retail businesses today are the key driver of industrial activities as its upsurge our economy so much creating job opportunities for residence in areas and communities where these petrol stations are located (Mwenda and Oloko, 2016).

The deregulation policy of the petroleum sector introduced in 2003 by president Olusegun Obasanjo has caused drastic changes in the industry, owing to this policy there is free entry in the oil marketing industry and this has seriously generated a ripple effect increasing competition among Oil Marketing Companies due to a general price war and increase of fuel stations along major roads (Godfrey, 2015). Given this development, many marketers take advantage of this to build service stations haphazardly without considering the possible environmental effect of the locations of the stations (Akinsulire & Fadare, 2020).

Since 1996, statistics shows that there has been a rapid increase in the establishment of fuel stations across the world for example, in Asia-Pacific region there are about 17,281 fuel stations compared to 10,938 in 2012 and 34,200 in 1996 (International Association for Natural Gas Vehicles-IANGV, 2017). Similar is the story for North America with fuel stations increasing from 47 in 1996 to 1,919 in 2017 as posited by author above. Also, International Association for Natural Gas Vehicles-(IANGV, 2017) vigorously pointed out that between 1996 and 2016, the number of fuel stations across the globe increased astronomically about 2,432% with fuel stations in Africa increasing about 17,500%. The high rise of these petrol retail stations especially in Africa raises some much questions about the kind of land and spaces on which these stations occupy (Marian, 2019).

### **Statements of Research Problem**

Minna metropolis is one of the towns in Nigeria that is faced with the action of indiscriminate siting of petrol retail stations, the proliferation of petrol retail stations along the major roads and within Minna metropolis is quite disturbing (Yisa *et al.*, 2019). A drive through major roads and within Minna city indicate that Niger state urban development board (NUDB) and the Department of Petroleum Resources (DPR) does not comply with its own statutory requirements of the regulations and guidelines in the establishment of Petroleum Retail Stations in Urban Minna (Niger State Urban Development Board - NUDB, 2016). Planners should at all times assess possible hazards in planning and promote ways of avoiding or mitigating damage that might cause hazards, risk and vulnerability (Mshelia *et al.*, 2015).

However, there are relevant research done by various scholars on Petroleum Filling Stations and their Impact on the Environment both local and international. Peprah (2018) investigated the level of compliance to standards set by the Ministry of Energy, and Town and Country Planning Department on existing oil and gas station in Tarkwa Ghana, using multi-criteria decision analysis and GIS approach. Mshelia *et al.* (2015) Assessed environmental effects of Petrol Stations at Close Proximities to residential buildings in Maiduguri and Jere, Borno State Nigeria. (Emakoji & Otah, 2018) worked on analysing the location of filling station in Afikpo-Ebonyi State Nigeria against the laws and regulations guiding their establishment; (Odekunle *et al.*, 2019) in their studies analysed the impacts of petroleum filling Stations in Minna Metropolis using global position system (GPS) to determine their spatial locations, all these studies reported violations of the spatial regulations of the Department of petroleum resources (DPR) and Urban planning standards, it is therefore against this background that the study fills the research gap by examining the spatial pattern of these petrol stations and the associated water hazards in Urban Minna.

### **Aim and Objectives of the Study**

The aim of the study is to assess the environmental impact of indiscriminate location of petrol retail stations in Minna.

The specific objectives of the study are to:

- i. Examine the distribution of petrol retail stations within Minna;
- ii. Analyse the proximity of well water sources by measuring their distances from storage tank;
- iii. Analyse the physiochemical properties of water source samples to ascertain the effect of petrol retail stations locations on them; and
- iv. Compare results with WHO and National standards for drinking water.

### **Research Questions**

- i. How are various fuel stations distributed in urban Minna?
- ii. Are filling stations located according to established planning standards, guidelines and regulations in Urban Minna?
- iii. Does the locations of petroleum filling stations in Minna has effect on groundwater sources?
- iv. Does the available Well water source meet the WHO and National planning standard for drinking water source?

### **Justification for the Study**

The resent proliferations of petrol retail station in Minna metropolis has prompted the adaption of this research. the research is justifiable because the number of filling stations in Minna metropolis is increasing astronomically as indicated by (Ahmed *et al.*, 2014). These Petroleum filling stations are generally ought to be located at the periphery of cities and towns; however, with the passage of time, the residential and commercial areas in the study area get surrounded by these petrol retail stations.

This study will assist Town planning authorities to carry out necessary actions on already existing petrol retail stations that have contravened planning standards that are ill-sited as well as verify with ease and implement standards for those yet to be constructed. Few researches have been done on the subject matter in existing literatures, it will therefore serve as a guide for individuals or developers and even the government together with other stakeholders in the urban planning and downstream petroleum industry sector and also for further research and decision making.

### **Scope of the Study**

This study mainly focused on the evaluation of water quality parameters of well water sources close to petrol filling stations in some parts of Minna metropolis. The study covers Minna township, from Minna city gate along Minna – Paiko road, through Bosso road to Maikunkele City gate and also from Maitumbi, through the Eastern and Western bye pass. These areas were chosen because most of the filling Stations were located along the high capacity urban road in the study area and most of these vulnerable wells are within the premises of these Filling Stations.

### **Description of the Study Area**

The Study area is located between longitude  $6^{\circ}31'08''\text{E}$  and  $6^{\circ}37.31''\text{E}$  and latitude  $9^{\circ}11.11''\text{N}$  and  $9^{\circ}60.50''\text{N}$  of the Greenwich Meridian as indicated in Figure 1.1. Minna shares borders with the following Local Government Areas; Shiroro LGA to the North, Wushishi LGA to the West, Gbako LGA to the South-West, Katcha LGA to the South-East and Paikoro LGA to the East as shown in

page 9. Minna is made up of settlements such as: Chanchaga, Shango, Maitumbi, kpakungu, Dutsen-Kura, Bosso, Maikunkere, Barkin Sale, Tudun Fulani, Keteren Gwari. The Study area is located between longitude  $6^{\circ}31'08''\text{E}$  and  $6^{\circ}37.31'\text{E}$  and latitude  $9^{\circ}11.11'\text{N}$  and  $9^{\circ}60.50'\text{N}$  of the Greenwich Meridian as indicated in Figure 1.1. The study area experiences tropical continental type of climate with distinct wet and dry seasons controlled by the shifting position of the inter-tropical convergence zone. The vegetation of the study area can generally be described as typical Guinea Savanna with a mixture of trees, shrubs, herbs and tall grasses.

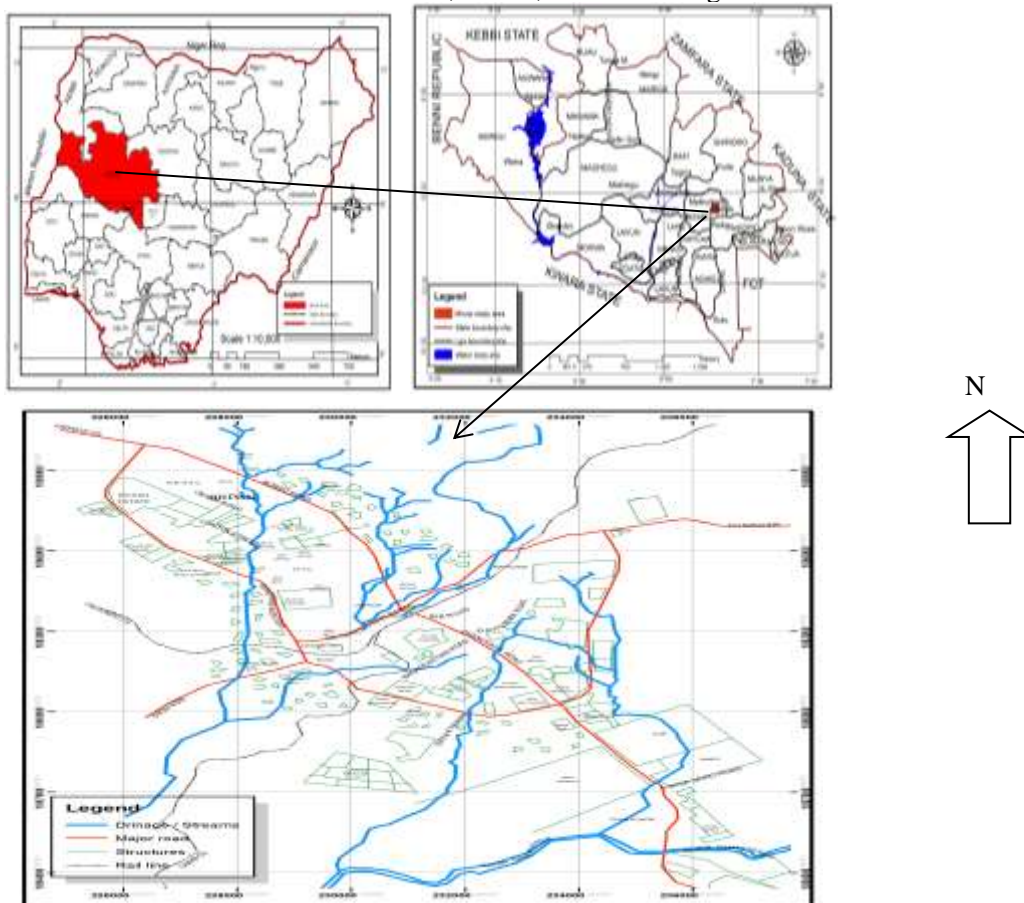


Figure 1.1: The study area (Minna metropolis, Niger State, Nigeria)

Source: Niger State Geographic Information System

### Literature Review

Literature on locations of filling stations or its synonymous names, i.e., petrol filling station, fuel station, gas station, petroleum outlet are virtually scanty. What prevails in the global literature is the paucity of research documentation on the technological remediation of service sites closures due to the environmental risks associated with both soil and underground water pollution (Thomas *et al.*, 2016).

Rana & Garg (2014) noted that location of petrol fuel stations is a very significant issue and needs to consider impact of various relevant parameters such as distance, population and access time on a location. Location theory has turned out to be an essential component of economic geography, regional science, and spatial economics and furthermore, the theory supports various forms of locational analysis and highlights the significance of spatial proximity (Marian, 2019).

Sneha *et al.* (2016) pointed out that water quality is directly related to the physical, chemical, biological and radiological property of water and these properties of water are affected because of the pollution of water due to various human activities. According to Sneha investigation water bodies change the standard quantity of parameters in water.

Similarly, Pawan & Pradeep (2015) carried out a study and collected water samples from 12 different sampling stations to evaluate water quality status of river Narmada, a total of 16 water quality samples were determined, minimum and maximum value of air temperature, water temperature, turbidity, pH, electrical conductivity, total dissolved solids, free carbon dioxide, total alkalinity, chloride, total hardness, Calcium Hardness dissolved oxygen, nitrate, orthophosphate, biochemical oxygen demand and chemical oxygen demand were noted from the study.

Dipankar *et al.* (2019) further investigated drinking water quality in some parts of Perak state, Malaysia, in this aspect of study a detailed physiochemical analysis of drinking water samples was conducted in different residential and commercial areas of the state.

Smutko *et al.* (2012) observed that ground water is vulnerable to contamination from numerous anthropogenic activities and these anthropogenic activities are controlled by the influence of man, one of the best-known classes of groundwater contaminants includes petroleum-based fuels such as petroleum and diesel.

## **MATERIALS AND METHODS**

This research is designed to determine and analyse the vulnerability of residents living on water source within proximity to filling stations in Minna, Niger State Nigeria. In this study, GIS was used to examine spatial relations between water wells, their recharge zones, and the potential sources of groundwater contamination. The primary data employed in this research was collected directly from the field, that is, geographical coordinates of petroleum filling stations as well as the coordinate points of groundwater sources were obtained with the aid of a Garmin™ Etrex handheld Global Positioning System (GPS) receiver of 4.5m accuracy. For the purpose of this research work, secondary data and information were obtained through the following means; published and unpublished textbooks, journals, articles, conference proceedings, internet and some agencies.

Purposive sampling was used to select seventy-eight (78) fuel stations, selection was based on their close proximity to residential neighbourhoods especially those that fall within the criteria set, that is 50 meters proximity to the filling station. Water samples were collected in 500ml plastic bottles, the samples were labelled Well 1 to Well 10 and stored in an ice chest prior to taking them to the laboratory. Conductivity was determined using the Hydrochek Conductivity Meter CMD8000. Total dissolved solid of water samples were carried out by using TDS metre. Also, Gas chromatography (GC) was used to measure Total Petroleum Hydrocarbon in water.

## **Results and Discussion**

### **Distributional Pattern of the Petrol Retail Stations in Minna town**

The findings revealed 78 existing petroleum filling stations at the time of study, These Petrol retail stations are located along the six (6) major roads in Minna. However, the petrol retail stations are

not equally distributed between the roads as can be observed from Figure 4.1. Nnamdi Azikwe road has the highest number of stations (21) followed by Bida road with (17) and Bosso road (15) each respectively, these roads account for more than 70% of the filling stations in the area. This result is not surprising because the roads are the major roads in Minna metropolis; they are served as a link to inter-state with major cities.

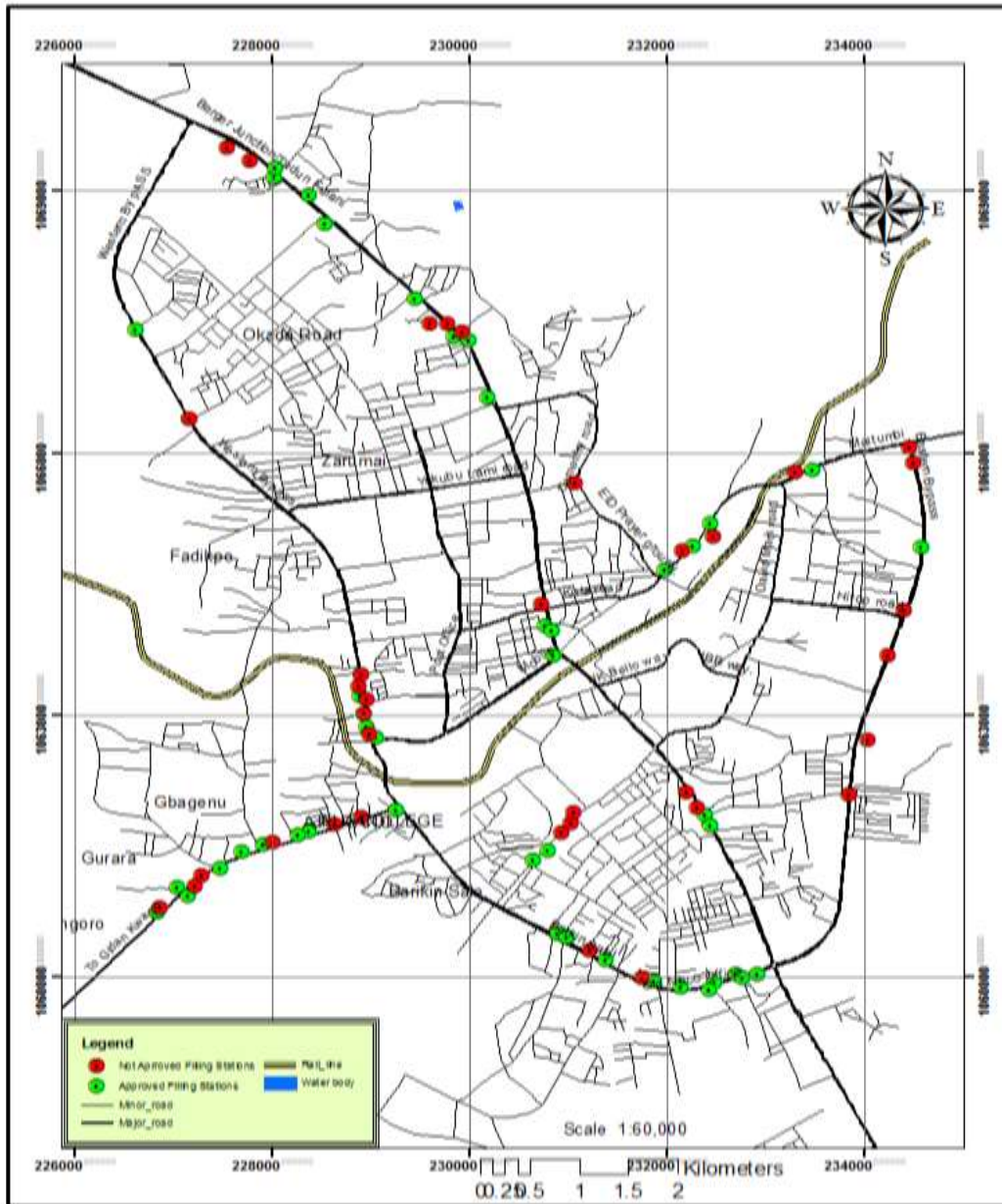
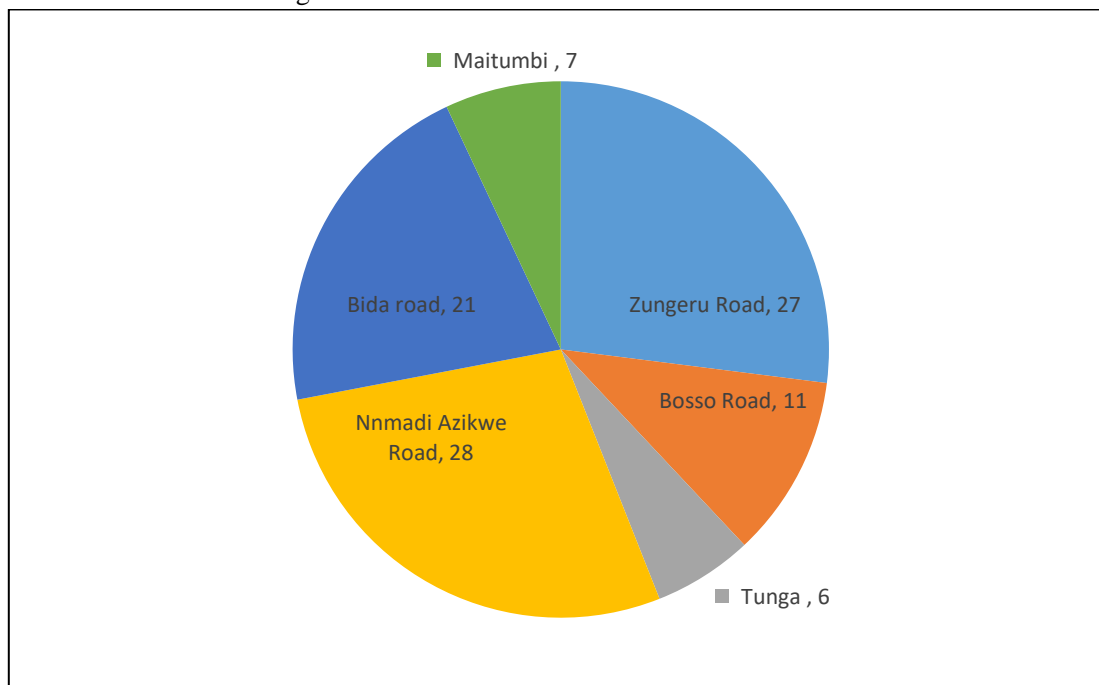


Figure 4.1: Spatial location of Petroleum Filling Stations in Minna Township.  
Source: Authors Analysis, 2022

### Proximity of well water sources to location of petroleum Filling stations

The study identified a total of 30 different domestic well water sources within the proximity of less than 50meters to petroleum filling stations in Minna. Most of the wells identified were within the premises of the petroleum filling station and the wells were made available for domestic uses by residents around the filling stations.



**Figure 4.2: Percentage of Vulnerable Domestic Well Water Source in the Study Area.**

Figure 4.2 shows the concentration of vulnerable domestic well water proximal to petroleum filling stations in Minna metropolis, majority of vulnerable domestic wells were along Nnamdi Azikiwe road with 28% of the total well identified, followed by Zungeru road with 27%, then Bida road with 21%, Bosso Road 11%, Maitumbi 7% while Tunga area has the lowest vulnerable domestic well water source with 6%.

### Physiochemical analysis of water samples to check water contamination

In examining the physiochemical analysis of sampled well water, the selection of parameters and the determination of maximum allowable limits were conducted by taking into consideration the WHO and National Standard for drinking water quality. The parameter considered were Temperature, pH, conductivity, Total Dissolve Solid and Total Petroleum Hydrocarbon (TPH). The amount of TPH found in the well water sampled is a useful indicator of petroleum contamination in that water. The permissible limit for total petroleum hydrocarbons is 5.0 mg/l



(WHO, 2008) However, in this study, eight (8) well water source samples out of the out of ten (10) studied had values exceeding this standard. In addition, according to (Valentinett *et al.*, 2002), petroleum hydrocarbons enter underground water through several sources such leakages from underground storage tank This was evident in this study where most well water sampling points had the influx of mechanic shops as well as fuel storage tanks close to them.

### Temperature (°C)

This study revealed that all the sample well water have their water temperature above the WHO and Nigeria Standard for drinking water requirement. the well with the least temperature is well number 5, located along Zungeru- Bosso road) with 28.3<sup>0</sup> and the highest are wells 1 and 3 (located at Berger Junction, Zungeru road and Saiko road) with 29.7<sup>0</sup> respectively. High water temperature enhances the growth of microorganisms and may increase taste, odour, colour and corrosion problems. However, the disparity in water temperature from World health organization (WHO, 2008) standard does not make the water to be unfit for drinking.

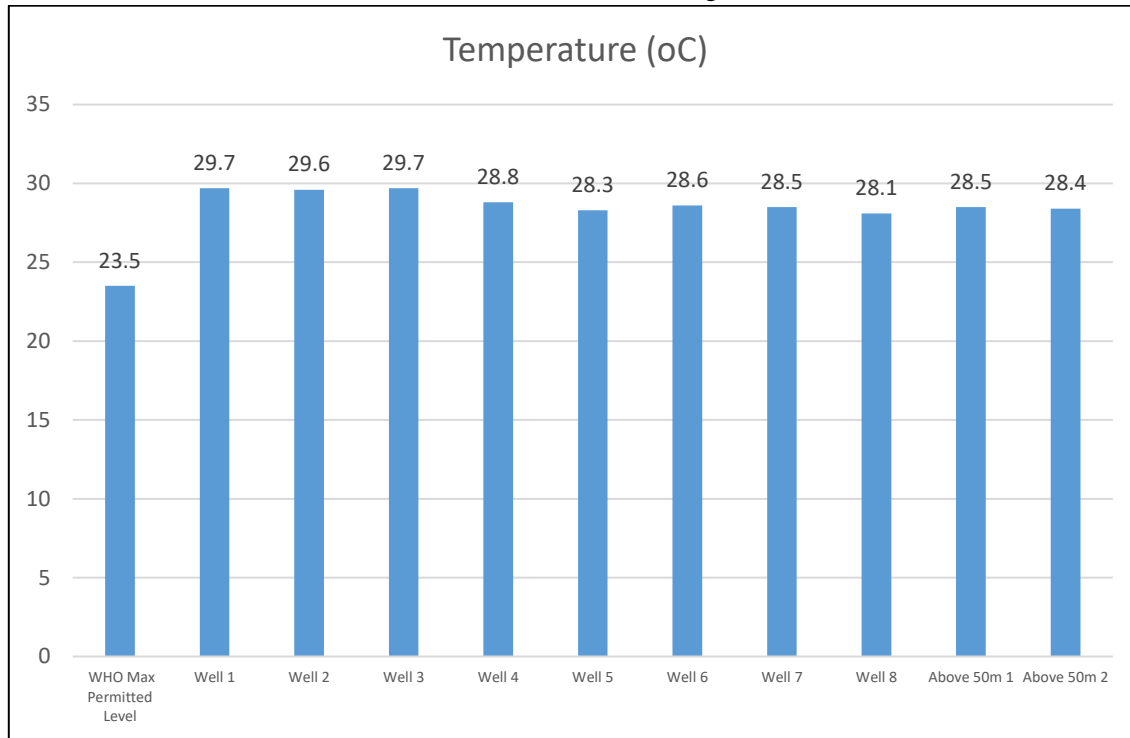


Figure 4.3: Level of Temperature of Sampled Well water in the study area.

Source: Authors Field Survey, 2022

### 4.3.2 pH level of acidity and alkalinity of water

The pH of well water normally is between 6.0 and 8.5. Figure 4.3 shows that none of the well water sample is above the WHO standard of 8.5, the least in pH is Well 1 (located at Berger Junction,

Zungeru road) with a pH of 6.12 and the highest was well 3 (located at Saiko road) with 8.14. Water with pH lower than 5.0 may cause problems due to corrosion because many metals become more soluble in low pH waters. A pH value of higher than 8.5 indicates that a significant amount of sodium bicarbonate may be present in the water.

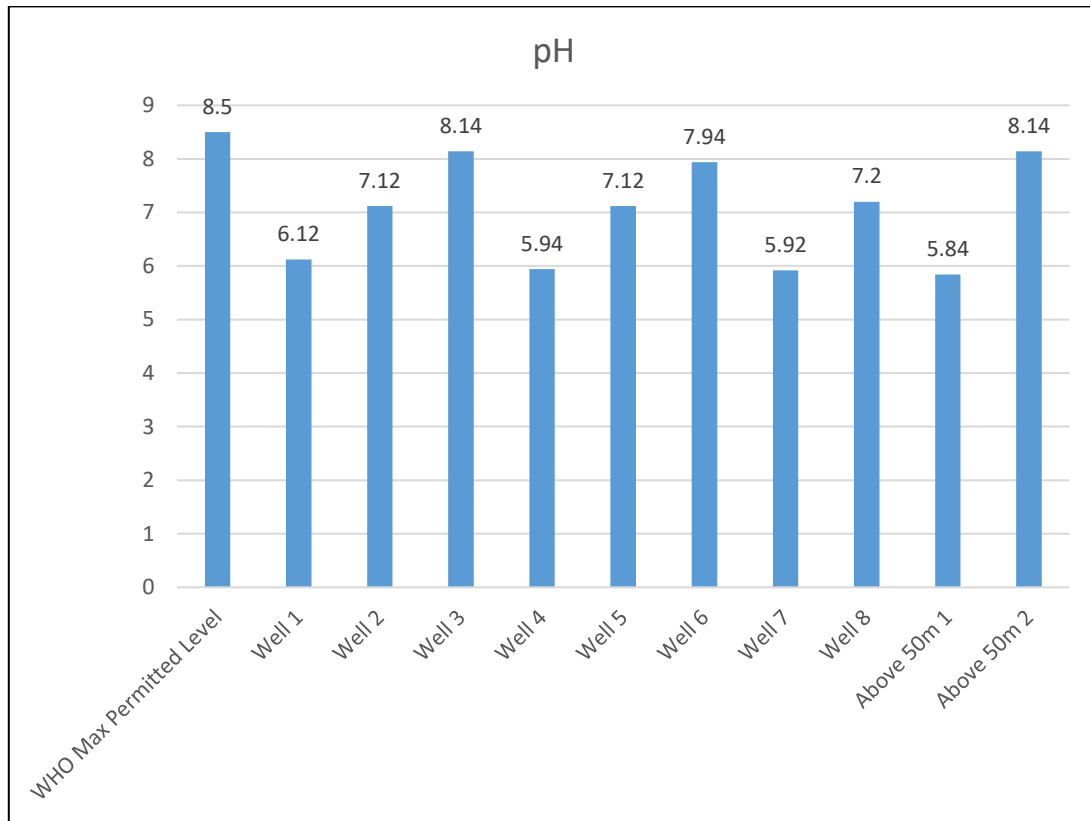


Figure 4.4: Level of pH in Sampled Well water in the study area.

Source: Authors Field Survey, 2022

#### **Total dissolved solid (TDS)**

Total dissolved solid (TDS) is the total amount of material remaining after evaporation of water. Permissible level value of less than 500 ppm (mg/L) and up to 1,000 ppm (mg/L) can be tolerated. The following samples are presented in figure 4.5 below; well 1 (located at Berger Junction, Zungeru road) has 638.5 ppm, well 2 (also located at Berger Junction, Zungeru road) has 686.8 ppm, well 3 (located at Saiko road) has 913.9 ppm respectively which are the major well water samples. Muoghalu and Omocho (2000) reported that high TDS values have the tendency to absorb heat from the sun thereby raising the temperature and increasing the turbidity of water. Since all these falls within 500 ppm (mg/L) and 1,000 ppm (mg/L) they can be tolerated with little health effects.

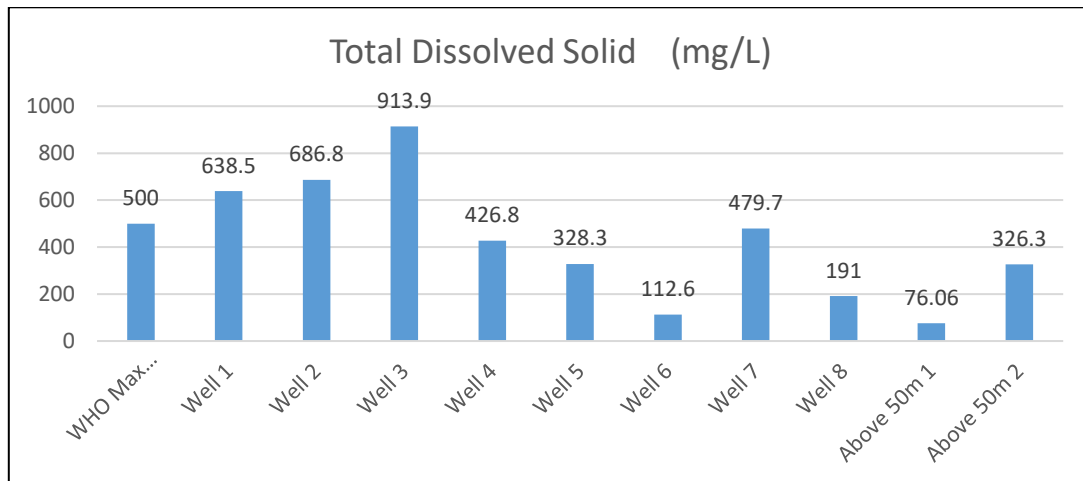


Figure 4.5: Level of TDS in Sampled Well water in the study area.  
 Source: Authors Field Survey, 2022

**4.3.4 Conductivity**

The Conductivity concentration as recommended by WHO standard in domestic water is 1000mg. Figure 4.6 shows that well 3 that is located at Saiko road has the highest concentration of conductivity with 1364mg followed by well 2 (located at Berger Junction, Zungeru road) with 1025mg. The least well with conductivity concentration is well 6 (located at Nnamdi Azikiwe road) with 168 mg. the findings shows that well 2 and well 3 has conductivity above the WHO limit, while other sampled wells have the limit recommended standard.

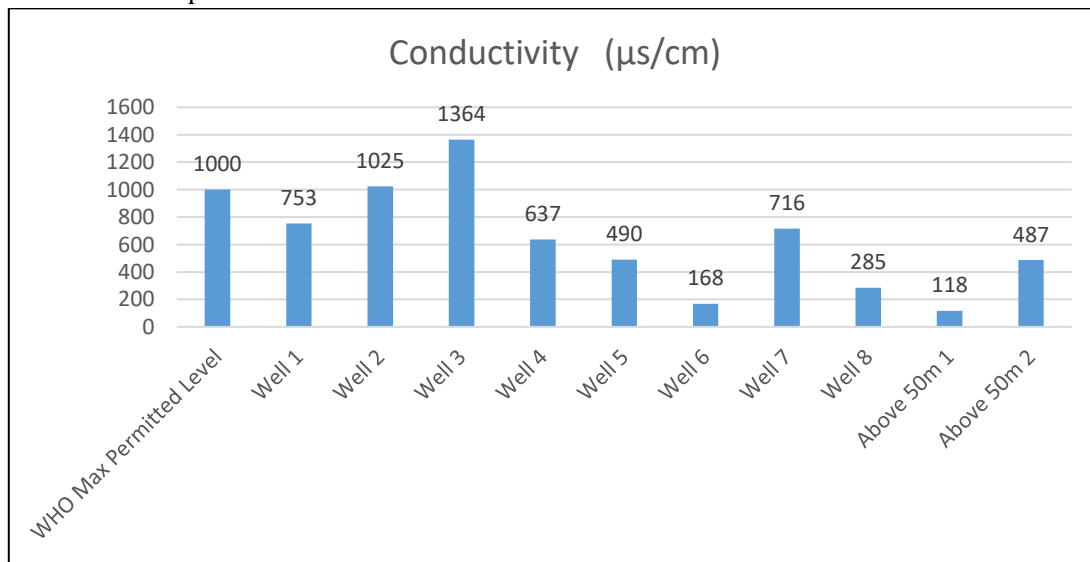


Figure 4.6: Level of conductivity in Sampled Well in the study area.  
 Source: Authors Field Survey, 2022

### Total petroleum hydrocarbon (TPH)

The permissible limit for Total Petroleum Hydrocarbon (TPH) concentration for drinking water is 5.0 mg/l (WHO, 2008); Figure 4.7 shows that all the sampled well was above WHO permitted limit level of drinking water, it was discovered that the highest mean concentration of TPH was 8.2 mg/l recorded at Well 6 (located at Nnamdi Azikiwe road), followed by 7.1 at well 1, (located at Berger Junction, Zungeru road). The least was well 5 (located at Bosso, Zungeru road) with 4.8mg/l. The two sampled wells were water above the 50meter setback and did not show the present of Total Petroleum Hydrocarbon. This analysis showed evidence of contamination of underground water due to the operation of petroleum filling stations in the study area.

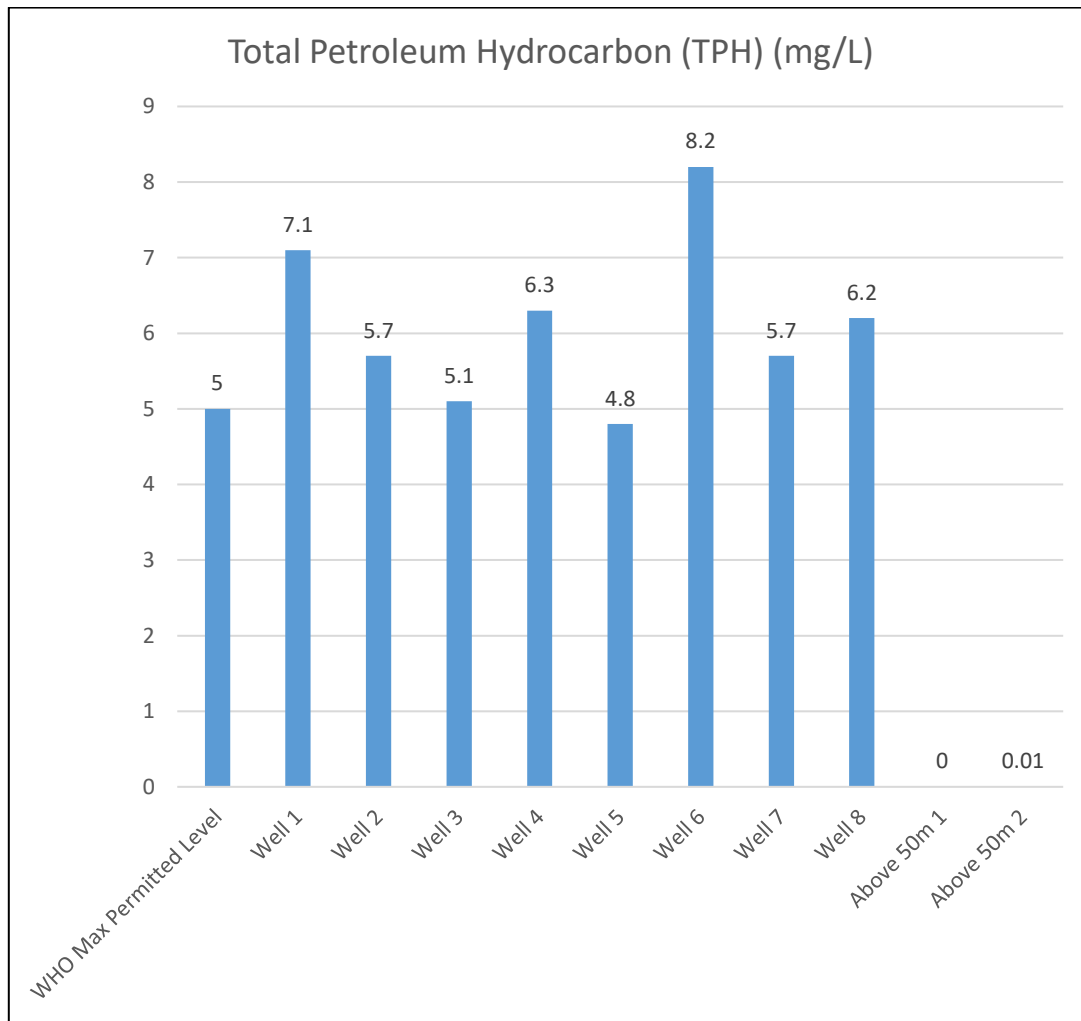


Figure 4.7: Level of TPH in Sampled Well in the study area.

Source: Authors Field Survey, 2022

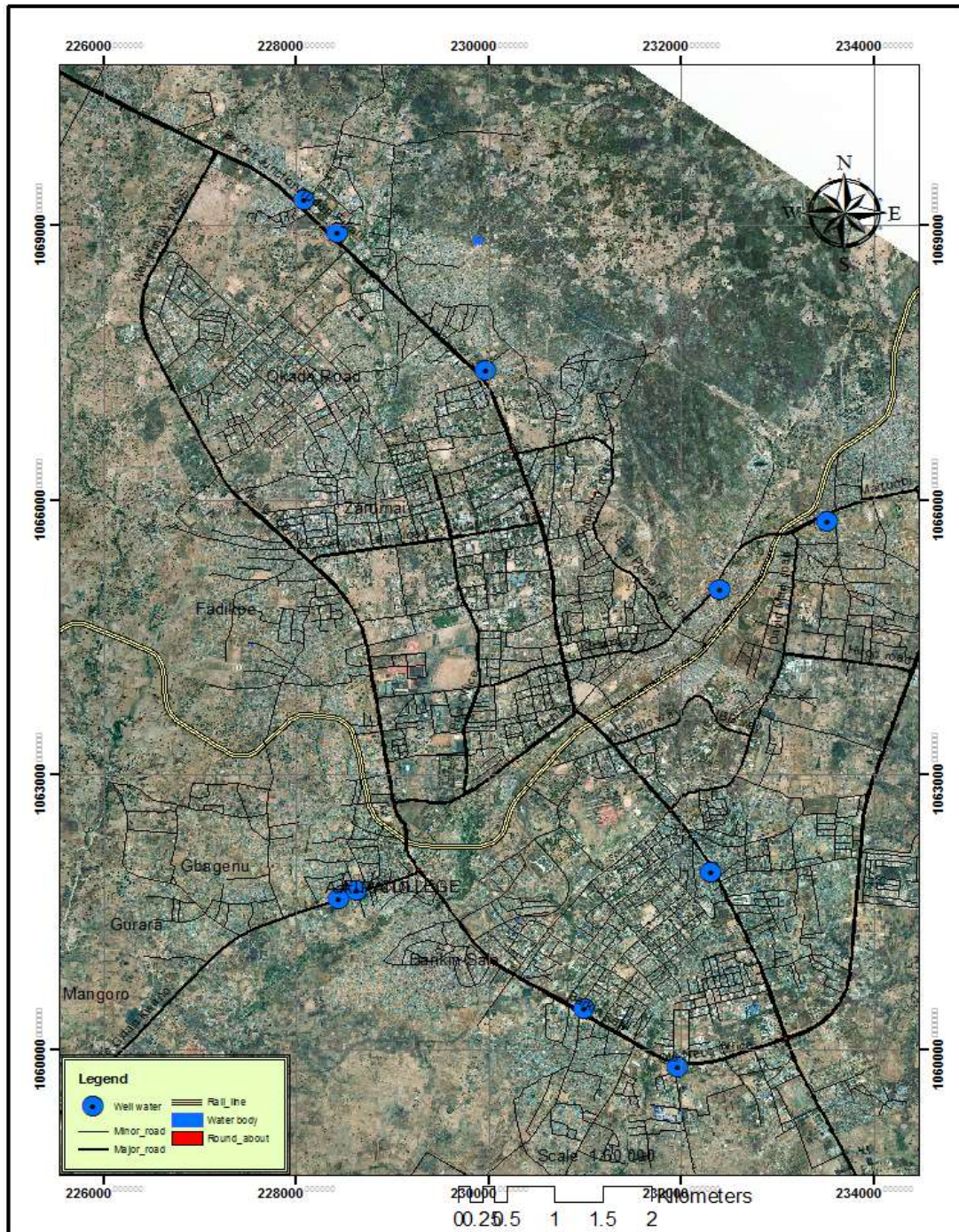


Figure 4.8: Locations of well water samples in the study area  
Source: Authors Analysis, 2022

### Compare results with WHO and National Standards for drinking water quality

Chemical analysis was performed at Niger State Environmental Protection Agency's laboratory. Samples were prepared using standard methods required for gas chromatography analysis. The results obtained were compared with the World Health Organization (WHO) and National standard for drinking water quality specifications in table 4.1 bellow.

**Table 4.1 Results of Physicochemical analysis**

PARAMETER	WHO/NSDWQ Max Permitted Level	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Well 8	Above 50m 1	Above 50m 2
Temperature (°C)	23.5	29.7	29.6	29.7	28.8	28.3	28.6	28.5	28.1	28.5	28.4
Conductivity (µs/cm)	1000	753	1025	1364	637	490	168	716	285	118	487
Total Dissolved Solid (mg/L)	500	638.5	686.8	913.9	426.8	328.3	112.6	479.7	191	76.06	326.3
pH	8.5	6.12	7.12	8.14	5.94	7.12	7.94	5.92	7.2	5.84	8.14
Total Petroleum Hydrocarbon (TPH) (mg/L)	5.0	7.1	5.7	5.1	6.3	4.8	8.2	5.7	6.2	0	0.01

: Authors Survey, 2022

Table 4.1 above, revealed that all the sample well water has their water temperature above the WHO and National Standard's requirement. The well with least temperature is well number 5 which has a temperature of 28.3<sup>0</sup> and the highest are wells number 1 and 3 with water temperature of 29.7<sup>0</sup> respectively, this indicate that all of the well water sampled Temperature were above the WHO and National standard for drinking water. Also, pH Study confirmed that all the water samples are in slight acidic range, I can say near about neutral, well 1 with pH of 6.12 and the highest were well 3 with pH of 8.14 and 7.94. It was also discovered that total dissolved solid; well 1(638.5 ppm), Well 2(686.8 ppm), well 3 (913.9 ppm) respectively which are majorly samples from well water. Whereas, conductivity of Tested water was higher in well 3, with conductivity of 1364(µs/cm) followed by well 2 with 1025(µs/cm). The study showed that Total Petroleum Hydrocarbon is present in all the sampled well, except for the two (2) sampled well that were above 50meters proximity to the petroleum retail stations which is an evidence of contamination of underground water.

### Summary of Findings

The findings revealed that 78 existing petrol filling stations within the area of coverage as at the time of this study are located along six (6) major roads in Minna. However, the filling stations are not equally distributed between the roads. The study identified a total of 30 different domestic well water sources within the proximity of less than 50 meters to petroleum filling stations in Minna. Most of the well identified were within the premises of the petroleum filling station and were made available for domestic uses by residents close to the filling stations and some were within the next closest building less than 50 meters. The findings show that the majority of vulnerable domestic wells water were along Nnamdi Azikwe road with 28% of the total well identified, followed by Zungeru road with 27%, then Bida road with 21%, Bosso Road 11%, Maitumbi 7% while Tunga area has the lowest venerable domestic well water source with 6%. The findings show that out of the seventy-eight (78) identified petroleum filling stations in Minna Township only thirty-two (32) has approval from the Niger State Urban Development Board, and forty-six (46) did not have approval from the board. In examining the physiochemical analysis of sampled well water, the selection of parameters and the determination of maximum allowable limits were conducted by taking into consideration the WHO guideline for domestic water quality. The parameter considered were Temperature, pH, conductivity, Total Dissolve Solid and Total Petroleum Hydrocarbon (TPH). The study further revealed that all the sample well water have their water temperature above the WHO requirement and National Standards for drinking water. The well with least temperature is well number 5 which has a temperature of 28.3<sup>0</sup> and the highest are wells number 1 and 3 with water temperature of 29.7<sup>0</sup> respectively. The study indicates that none of the pH of well water sample exceed WHO standard of 8.5, the least is Well 1 with pH of 6.12 and the highest were well 3 with 8.14.

### CONCLUSION AND RECOMMENDATIONS

In Conclusion, this study has successfully analysed various Physicochemical Properties of water samples Collected from 10 major water sources and also presented the levels of physicochemical parameters such as Temperature, pH, Conductivity, Total dissolved solids (TDS) and Total Petroleum Hydrocarbons (TPH) contents in the well water samples collected.

The outcome of this study raises issues of public health and safety; therefore, the following recommendations are made.

1. wells used for domestic purposes should be cited far away from Petrol retail stations so as to reduce the number of Hydrocarbons that may get into the underground water sources and in unavoidable cases, water treatment should be embraced. Water quality should be controlled in order to minimize acute problem of water related diseases, which are endemic to the health of man.
2. State legislature should enact law forbidding either government or individuals from given out plots of land for location of petrol stations within Minna Township. Any attempt by either of the two sides to convert the use of any land within the township should be resisted by the Niger state planning Authority and the court.

3. To control the siting of fuel stations at unauthorized places, Niger state planning Authority and department for petroleum resources (DPR) should ensure that building permit and authorization for the siting of fuel stations are only issued to applicants having proof of location based on the urban planning standards and land use regulations of Nigeria and the land-use plan of Minna town.
4. Ministry of Environment in collaboration with all the petrol retail stations should constantly mount public enlightenment campaign using posters, bill boards and media houses to educate the public on the hazards associated with petroleum products with respect to human health and the environment so as to discourage residing close to petrol retail stations.

## REFERENCES

- Akinsulire, E. O., & Fadare, S. O. (2020). An Assessment on the Locational Pattern of Petrol Filling Stations along Lasu- Isheri Road Corridor. *American International Journal of Multidisciplinary Scientific Research*, 6(2), 6–30. <https://doi.org/10.46281/aijmsr.v6i2.705>
- Dipankar Nath, Arzoo Newar, Rishi Choudhury, Koushal Singh, Utsav Sharma, & Puja. (2019). Newar Basic Physicochemical Analysis of Water Samples collected from East Sikkim. *World Journal of Pharmaceutical and Life Sciences*, 5(1), 79–89.
- Emakoji M A, & Otah K N. (2018). Managing Filling Stations Spatial Database using an innovative GIS tool- a case study of Afipko City in Nigeria. *Asian Journal of Geographical Research*, 1(2), 1–9.
- Godfrey, N. O. (2015). Deregulation of the downstream Sector of the Nigerian Petroleum Industry : The role of leadership deregulation of the downstream sector of the Nigerian petroleum Industry : Therole of leadership. *European Journal of Business and Management*, 7(8), 35–46.
- IANGV. (2017). *International Association for Natural Gas Vehicles IANGV 2017*, [www.ngvglobal.org](http://www.ngvglobal.org).
- MARIAN, B. B. (2019). *Locational analysis of fuel stations in Sunyani municipality. Thesis Submitted to the Department of Geography and Regional Planning of Faculty of Social Sciences of the College of Humanities and Legal Studies, University of Cape Coast, in partial fulfilmen.*
- Mshelia, A. M., Abdullahi, J., & Dawha, E. D. (2015). *Environmental Effects of Petrol Stations at Close Proximities to Residential Buildings in Maiduguri and Jere , Borno State , Nigeria.* 20(4), 1–8. <https://doi.org/10.9790/0837-20440108>
- Mwenda S, & Oloko M. (2016). *Determinants of Motorists Choice of a Petrol Station in Kenya a Survey of Thika Sub County. International Journal of Social Sciences and Information Technology*, 2(IX), pp.1370-1383, 2016.
- NUDB. (2016). *Niger State Urban Development Board. Effective Development Control: The way forward. Unpublished Report.*
- Odekunle M O, Adesina E A, Lateef Q A, Acha S, & Ahmed Y. (2019). *Geospatial Distribution and Locational Impacts of Filling Stations in Minna Metropolis* (pp. 350–365).
- Peprah. (2018). Suitability analysis of siting oil and gas filling station using multi-criteria decision analysis and GIS approach- a case study of Tarkwa and environs- Ghana: *Journal of Geomatics.*, 12(2), 158–166.
- Rana R, & Garg D. (2014). *Algorithm for obnoxious facility location problem, International Journal of Advancements in Technology*, 5(4), 96-106.
- Singh, P. K., & Gawande S. (2015). Analysis of water quality of river narmada. *International*



- Journal of Current Research*, 7(12), 24073–24076.
- Smutko, L. S., Danielson L E, & Hoag D L. (2012). *Protecting Groundwater Resources. North Carolina State University, Agricultural and Resource Economics, Applied Resource Economics and Policy Group, AREP 93 - 4.*
- Sneha, S. P., & Gawande S. (2016). Review Paper on Development of Water Quality Index; *International Journal of Engineering Research and Technology (IJERT)*, 5(5), 765-767.
- Tah, D. S. (2017). GIS-baed locational analysis of petrol filling stations in Kaduna metropolis. *Science World Journal*, 12(2), 8–13.
- Taylor, T. K., Sichinsambwe, C., & Chansa, B. (2016). *Public perceptions on location of filling stations in the City of Kitwe in Zambia. International Journal of Advanced Engineering Sciences and Technologies*, 7(1), 110 – 121.
- Thomas Kweku Taylor, Chanda Sichinsambwe, & Blessings Chansa. (2016). *Public Perceptions on Location of Filling Stations in the City of Kitwe in Zambia*. 6(6), 133–151.
- Valentinetti R A, KostECKI P T, & Calabrese E J. (2002). *Federal Underground Storage Tank Regulations and Contaminated Soils in Petroleum Contaminated Soils, Chelsea MI: Lewis Publishers*, 1(1), 55-60.
- WHO. (2016). *Safe piped water: Managing microbial water quality in pipe distribution system.*
- WHO. (2008). *Progress on Drinking Water and Sanitation. Retrieved 3rd January 2010 from <http://www.who.int/./index.htm/16/06/11>.*
- Yisa J, Olubadewo-joshua, Oluwaseun Okosun, & Oboh Satur. (2019). Utilization of GIS Techniques as Decision Support System for Location of Filling Stations in Minna , Niger State , Nigeria. *Https://Jurnal.Unej.Ac.Id/Index.Php/GEOSI*, 4(3), 247–263. <https://doi.org/10.19184/geosi.v4i3.9713>

## **DETERMINANTS OF COMMERCIAL REAL ESTATE RENTAL VARIATION IN ILORIN, NIGERIA**

**Fatima Bintu Abdulmalik,**

Department of Estate Management and Valuation,  
Federal University of Technology Minna,  
Niger State, Nigeria.

**Namnso Bassey Udoekanem**

Department of Estate Management and Valuation,  
Federal University of Technology Minna,  
Niger State, Nigeria.

### **Abstract:**

The goal of any real estate investor is to maximize return. However, property investment is characterized by a huge initial capital outlay and is influenced by some key factors. Thus, it is pertinent that the nature and characteristics of the rental value are understood to enhance property market penetration. This study assessed the influence of these key factors on commercial property rental variation in the commercial areas of Ilorin, Kwara State. Primary data for the study were collected from commercial property occupiers and estate surveyors and valuers operating within these areas. The study utilized descriptive analytical techniques and multiple regression to analyze the variation in rental performance on the rental value and general investment performance of commercial properties in Ilorin. Results of data analysis revealed an increasing trend of rental values over the years under study, influenced by a combination of economic and non-economic determinants. With the economic challenges currently faced due to the COVID-19 pandemic, the economic implications of the pandemic on the rental performance of commercial properties in the city require a carefully designed strategy to minimize the vacancy rate.

**Keywords:** Commercial Real Estate, Rents, Rental Variation, Ilorin.

### **Introduction**

In common parlance, the term "real estate" denotes ownership of or an interest in property owned by a person (Ugwu 2018). In general, the terms real estate and real property indicate the same thing. Real estate and other assets are what determine the wealthiest people's worth around the globe. When utilized for purposes other than owner-occupier, notably for commercial use, it has evolved into a repository of wealth for generating returns (rents). Rent is a regular payment for real estate interest. It is a turnover for the potential use of real estate as an investment in various scenarios (Ugwu 2018). A significant difficulty for real estate investors in Nigeria has been recognized as selecting the best alternative form of investment (Oyewole 2013). Investment opportunities abound among the several real estate-related options open to prospective investors,

with an important choice among them being an investment in commercial real estate. According to Boon and Higgins (2007), commercial real estate developments are an important component of the urban environment. The report portrays commercial real estate as a defining characteristic and a driving force behind urban growth. Which over time has evolved into a sign of a functional city in terms of both its economics and aesthetics. Participants in the real estate market use "rental value" as a benchmark to evaluate the economic feasibility of their investment commitment (Boon & Higgins, 2007).

Real estate investments in commercial properties depend on the developers' return in the form of "rent" to prosper. Early theories of rent, like those put forth by Barlowe as reported by Barkley (1986), saw variations in rent as the result of some factors, especially spatial location, and accessibility brought on by distance and transportation costs in relation to other significant locations in a city, depending on the needs of people (Boon & Higgins, 2007; Udoekem *et al.*, 2014). The demand for a property represents the profitability or utility that can be derived from using it, even though the primary goal of commercial properties is derived financial gains. The higher the rent the user is ready to pay for a certain property, the more advantage they stand to earn from it. Benefits derived from the property have been linked to the complexities of the real estate market, particularly the interplay between supply and demand for houses. Rent is viewed in this context as a factor of supply, demand, and other external factors, whose composition fluctuates in the context of the coverage of the real estate market (whether the property market is local, regional, or international). Due to the diversity of real estate, rents passing on properties are certain to be affected. These elements may be either intrinsic or extrinsic to the specific real estate market. These factors include proximity and complementarity (Iroham 2014), size, structural traits (Iroham 2014; Tay *et al.* 1999), accessibility, and location (Iroham 2014; Michael *et al.* 1998). Over the years, researchers in the field have carried out several studies to assess the effectiveness of real estate investments. A few others have evaluated the relative success of real estate investment alternatives, particularly residential and commercial real estate investments. Prominent among these were Baker (2001), Tonelli *et al.* (2004), Bello (2003), and Udobi *et al.* (2018).

Oyewole (2013), Iroham (2014), and Udobi *et al.* (2018) all found that investing in commercial real estate outperforms investing in residential property. However, Ugwu (2018) found that the rental value of both residential and commercial real estate in Nigeria varies. This has to do with the degree of risk often connected to investments in commercial real estate. Therefore, conducting an accurate assessment of variances in expected return from such investment possibilities has become necessary. The determination of the causes of these rental changes is also crucial. Therefore, the purpose of this study is to assess the patterns of commercial real estate investments as well as the factors that affect the variation in commercial real estate rental rates in Ilorin, Nigeria.

### **Methodology**

The survey research design was chosen for this investigation. To choose samples from the total population for data analysis, a survey design was adopted. This makes it possible to determine the traits of the population based on the sample. In order to get the necessary data from the pertinent

population, a well-structured questionnaire was used as the study technique in this case. Through the directories of the Nigerian Institution of Estate Surveyors and Valuers, the Kwara State Bureau of Land, and the Kwara Inland Revenue Service, the total number of estate surveying and valuation firms in Ilorin was determined. For the examination of economic factors, official information from the Central Bank of Nigeria and the National Bureau of Statistics were also utilized.

### Study population

Within the three main axes/zones of commercial activity in Ilorin, the study population consists of tenants of retail commercial shopping complexes and managing partners of estate surveying and valuation firms. As a result of the findings from Oyewole (2013), the commercial area in Ilorin has been divided into these categories. Commercial Axis A (which includes Oja Tuntun (New Market)/Oja Oba (Emirs Market), Gambari Axis, and Ipata/Ojagboro Axis), Commercial Axis B (Murtala Muhammad Road/ Yoruba road, Unity/ Taiwo road, and Offa Garage), and Commercial Axis C (Fate Road and Umar Audi/ University Road (Tanke)) are the axes/zones that are taken into consideration

### Data Analysis

Different data analysis tools and techniques were employed in this study to proffer answers to specific objectives. Descriptive and inferential statistics utilized for the analysis of data are shown in

Table 1.

Table 1: Method of data analysis and data requirements for the study.

S/N	Objectives	Data Requirement	Source	Method of Data Analysis
1	Examine the trend of investment in commercial properties in Ilorin.	Annual rental data from shopping complexes housing offices and shops or warehouses in Ilorin between 2004 – 2020	Field Survey	Time Series Analysis and Simple descriptive statistics using tables and charts
2	Assess the extent of variation in rental values of commercial real estate in Ilorin	Annual rental values of commercial properties 2004 – 2020	Field Survey	Descriptive and inferential analysis using Analysis of variance.
3	To assess the rental performance of commercial real estate in Ilorin for the period of the study	Average rental data from Commercial Properties in Ilorin between 2004-2020	Field Survey Data	Average rental growth rate, rental index, and standard deviation

## Results and Discussions

Inferences drawn from the data obtained are also discussed in this section along with the analysis of the field data. Data on commercial properties in various Ilorin locales were collected via distributed questionnaires and were categorized into zone A, zone B, and zone C. Registered estate surveyors, registered estate valuers, and the residents of these properties were contacted for information. However, secondary information on the macroeconomic factors influencing the market for commercial real estate in Ilorin was obtained from the National Bureau of Statistics Bulletins and the Central Bank of Nigeria.

### Questionnaire Administration

The registered estate surveying and valuation firms were given a total of 26 questionnaires (Table 2), 21 of which were retrieved and correctly completed. On the other hand, 120 out of a total of 150 questionnaires (Table 3) that were given to property occupiers were recovered (80%). Table 3 details how the questionnaire was distributed to the tenants of the commercial complexes.

Table 2: Questionnaire Administration Summary (Estate Surveying and Valuation Firms)

Questionnaires administered	
The total number of firms identified	26
Total Questionnaires administered	26
Total number of questionnaires retrieved	21
Percentage of questionnaires retrieved	80.8

Source: Author Field Survey, 2021

Table 3: Questionnaire Administration Summary (Property Occupiers)

Location of Properties	No. of Questionnaires Distributed	No. of Questionnaires Retrieved	Respondents' percentage
Zone A	40	32	80.0
Zone B	50	40	80.0
Zone C	60	48	80.0
<b>Total</b>	<b>150</b>	<b>120</b>	<b>80.0</b>

Source: Authors Field Survey, 2021

## Findings and Discussion of Results

### Rental Performance of Commercial Real Estate Investment in Ilorin

Investment opportunities in commercial real estate may become less appealing over time. However, in today's advanced society, more data-driven analysis of the market is necessary to gain insight into the local real estate market dynamics. The average rental trend for commercial real

estate investment is shown in **Error! Reference source not found.** for each of the three zones. It demonstrates a consistent annual rent increase with varying magnitudes throughout the study. This suggests a positive trend in the rental market for commercial real estate in Ilorin. More specifically, accounts for changes brought on by changes in economic and controlling factors by reflecting variations in the annual rental value of properties. So, from the perspective of an investor, the study field offers opportunities for investments.

Table 4: Rental growth rate and performance in Ilorin

<b>Years</b>	<b>Zone A</b>	<b>Zone B</b>	<b>Zone C</b>
2005	0.00	0.00	0.00
2006	0.20	1.02	0.07
2007	0.50	2.06	0.07
2008	2.17	2.25	1.85
2009	0.42	2.15	0.71
2010	0.27	3.41	0.06
2011	1.04	1.81	1.92
2012	0.67	0.47	0.41
2013	0.57	2.89	0.14
2014	0.48	1.79	0.76
2015	1.29	0.68	0.62
2016	0.14	1.49	0.23
2017	0.70	3.05	1.11
2018	0.45	1.20	0.65
2019	0.33	0.80	0.15
2020	0.31	1.02	0.67
Average Growth Rate	0.58	1.79	0.63
Standard Deviation	0.53	0.97	0.60
<b>Coefficient of Variation</b>	<b>0.91</b>	<b>0.54</b>	<b>0.95</b>

According to Table 4, Zone B has the fastest growth rate, with an average annual growth rate of 179%, while Zones A and C experience slower growth rates of 58% and 63%, respectively. As a result, investors can recover their initial investment cash earlier by renting out homes in Zone B,

where rent increases more quickly. A shrewd investor will almost certainly invest in a place that guarantees a rental growth rate of over 100% annually, but this may carry a risk because the growth rate appears bullish. The standard deviation, which depicts the likelihood of obtaining this average, is also shown in Table 4. The departure from the mean is measured by the standard deviation. It serves as a gauge for the dependability of investment possibilities. Furthermore, Zones C and A are suitable for risk-averse investors, whereas zone B, which offers larger returns, is suitable for risk-seeking investors. The Coefficient of Variation represents rent inconsistency, therefore the lower its number, the more accurate the estimate and the safer and better the investment choice.

### Analysis of Variance in Rent Passing on Commercial Real Estate in Ilorin

Here, the properties' current yearly rent passing was considered. Data for this was obtained directly from the property occupiers. One-way analysis of variance (ANOVA) was used to assess the respondents' responses regarding how much rent they each paid in each of the three study zones. The outcome is presented in Table 5. The analysis's F-value is 16.7, and the F-critical is 3.09, according to the table. Following the decision rule for the analysis of variance, we reject the null hypothesis and support the alternative hypothesis when the f-critical is less than the f-calculated. This demonstrates that the rental value of business complexes in Ilorin has a statistically significant fluctuation. The P-value for the analysis is 0.000000529. This is an extremely low number that is less than 0.0. This indicates that there is a statistically significant, albeit minor, probability of variance of 5 in 10,000,000.

Table 5: Analysis of Variance in Rent Passing on Commercial Real Estate in Ilorin

ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	9.77E+12	2	4.88E+12	16.70809	5.29E-07	3.085465
Within Groups	2.98E+13	102	2.92E+11			
Total	3.96E+13	104				

**Source:** Authors field Survey and Analysis, 2021

### Conclusions

Based on the findings from the study it can be deduced that:

1. The trend of the rental value is rising and will keep rising over the next two years.
2. Inflation, exchange rates, real estate loan interest rates, GDP, location and accessibility, stock availability, neighborhood quality, security and safety, and other variables all affect how much commercial real estate is worth.
3. The market for commercial real estate in Ilorin has the potential to increase by up to 100% annually, according to the report. The time series analysis of a value prediction made using the average rent in the zones suggests this possibility.

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### References

- Aderamo, A. J. (2002). The structure of intra-urban road network development in Ilorin, Nigeria. *Global Journal of Social Sciences*, 1(1). <https://doi.org/10.4314/gjss.v1i1.22777>
- Alexander, K. (2013). Facilities management: Theory and practice. In *Facilities Management: Theory and Practice*. <https://doi.org/10.4324/9780203475966>
- Appraisal institute. (2013). *Understanding the Appraisal*.
- Baker, B. (2001). *Residential Rental Real Estate: an Investment in Need of a Theory*. Department of Accounting & Finance, Faculty of Business & Economics, Monash University.
- Barkley, P. W. (1986). Barlowe, Raleigh. Land Resource Economics: The Economics of Real Estate, 4th ed. Englewood Cliffs NJ: Prentice-Hall. *American Journal of Agricultural Economics*, 68(4), 1030–1030. <https://doi.org/10.2307/1242159>
- Bello, O. M. (2003). A Comparative Analysis of the Performance of Residential Property Investment and Investment in Securities in Lagos, Nigeria. *Journal of Nigerian Institution of Estate Surveyors and Valuers*, 28(1).
- Blackledge, M. (2009). Introducing Property Valuation. *Journal of Property Investment & Finance*. <https://doi.org/10.1108/14635781311293015>
- Boon Foo, N. G., & Higgins, D. (2007). Modelling the Commercial Property Market: An Empirical Study of the Singapore Office Market. *Pacific Rim Property Research Journal*, 13(2), 176–193. <https://doi.org/10.1080/14445921.2007.11104229>
- Born, W., & Pyhrr, S. (1994). Real Estate Valuation: The Effect of Market and Property Cycles. In *Journal of Real Estate Research* (Vol. 9, Issue 4, pp. 455–485). <https://doi.org/10.1080/10835547.1994.12090765>
- Giussani, B., Hsia, M., & Tsolacos, S. (1993). A Comparative Analysis of the Major Determinants of Office Rental Values in Europe. *Journal of Property Valuation and Investment*, 11(2), 157–173. <https://doi.org/10.1108/14635789310031487>
- Ibrahimly, C., & Alipour, H. (2017). Mechanisms of regulation of commercial activities in variable demands of the global economy. *Marketing and Branding Research*, 4(1), 14–24. <https://doi.org/10.33844/mbr.2017.60366>
- Iroham, C. O. (2014). Assessing the Trend in Rental Values of Commercial Properties Along Oyemekun Road Akure, Nigeria. *International Journal of Sustainable Land Use and Urban Planning*, 1(2). <https://doi.org/10.24102/ijslup.v1i2.380>
- Iroham, C. O., Ogunba, O. A., & Oloyede, S. A. (2014). Effect of Principal Heuristics on Accuracy of Property Valuation in Nigeria. *Journal of Land and Rural Studies*, 2(1), 89–111. <https://doi.org/10.1177/2321024913515104>
- Kothari, C. R. (2004). *Research Methodology, Methods and Techniques*. New Age International (P) Limited.
- Marshall, P. (1976). Equated yield analysis: a valuation method of the future? In *Estates Gazette* (Vol. 239).
- Michael, B., Colin, L., & Bryan, D. M. (1998). *The economics of commercial property markets*. Routledge.
- Ogunleye, B. M. (2015). Analysis of Investment Performance of Residential Property in Government Housing Estates in Akure, Nigeria. *Journal of Emerging Trends in Economics and Management Sciences (JETEMS)*, 6(3), 193–201.
- Olanrewaju, R. (2009). The Climate Effect of Urbanization in A City of Developing Country: The Case Study Of Ilorin, Kwara State, Nigeria. *Ethiopian Journal of Environmental Studies and Management*, 2(2), 67–72. <https://doi.org/10.4314/ejesm.v2i2.45921>
- Oni, A. O. (2009). *Developing Predictive Models of Commercial Property Values in Emerging Economy:*



- Case Study of Ikeja, Nigeria. 1977, 1–23.*
- Oyegun, R. O. (1985). The Use and Waste of Water in a Third World City. *GeoJournal*, 10(2), 205–210.
- Oyewole, M. O. (2013). A Comparative Analysis of Residential and Retail Commercial Property Investments Performance in Ilorin, Nigeria. *Journal of Economics and Sustainable Development*, 4(3).
- Plazzi, A., Torous, W., & Valkanov, R. (2008). The Cross-Sectional Dispersion of Commercial Real Estate Returns and Rent Growth: Time Variation and Economic Fluctuations. *Real Estate Economics*, 36(3), 403–439. <https://doi.org/10.1111/j.1540-6229.2008.00218.x>
- Ricardo, D. (1817). On The Principles of Political Economy and Taxation. *History of Economic Thought Books*, 379.
- Scarrett, D. (2008). Property Valuation: The five methods,. In *Property Valuation: The five methods, Second edition*.
- Schoenmaker, J. D. A. (2016). *Commercial real estate development and valuation in the Netherlands*. University of Groningen.
- Slade, B. A. (2000). Office Rent Determinants During Market Decline and Recovery. *Journal of Real Estate Research*, 20(3), 357–380.
- Tay, R., Lau, C., & Leung, M. (1999). The Determination of Rent in Shopping Centers: Some Evidence from Hong Kong. *Journal of Real Estate Literature*, 7(2), 183–196. <https://doi.org/https://doi.org/10.1023/A:1008704604930>
- Tonelli, M., Cowley, M., & Boyd, T. (2004). Forecasting Office Building Rental Growth Using a Dynamic Approach. *Pacific Rim Property Research Journal*, 10(3), 283–304. <https://doi.org/10.1080/14445921.2004.11104164>
- Udechukwu, C. (2006). *Principles of valuation*. Treem Nigeria Limited.
- Udobi, A. N., Onyejiaka, J. C., & Chikwado, N. G. (2018). Analysis of The Performance of Commercial And Residential Property Investments in Onitsha Metropolis, Anambra State, Nigeria. *British Journal of Earth Sciences Research*, 6(2), 21–32.
- Udoekanem, N., Ighalo, J., & Sanusi, Y. (2015). Predictive Modeling Of Office Rent In Selected Districts Of Abuja, Nigeria. *Real Estate Management and Valuation*, 23(4), 95–104. <https://doi.org/10.1515/remav-2015-0040>
- Udoekanem, N B, Ighalo, J. I., Sanusi, Y. A., & Nuhu, M. B. (2015). Office Rental Determinants in WUSE Commercial District of Abuja, Nigeria. *University of Mauritius Research Journal*, 21(0), 2001–2012.
- Udoekanem, Namnso Basse, Ighalo, J. I., & Nuhu, M. B. (2014). Determinants of Commercial Property Rental Growth in Minna, Nigeria. *EUL Journal of Social Sciences*, 1(June).
- Ugwu, A. (2018). A Comparative Analysis of Rental Variation in Residential and Commercial Properties in Nigeria. *Afribary.Com (2018)*. Accessed April 02, 2021. <https://Afribary.Com/Works/a-Comparative-Analysis-of-Rental-Variation-in-Residential-and-Commercial-Properties-in-Nigeria-8947>.
- USTAOĞLU, E. (2003). *Hedonic price analysis of office rents: a Case Study of the Office Market in Ankara. September*.
- Von Thünen, H. J., Wartenberg, C. M., & Hall, P. (1966). *Von Thünen's isolated State.pdf*. Oxford London Edinburgh Frankfurt [u.a.] Pergamon Press 1966.
- Wahab, M. B., Morenikeji, G. B., & Adeogun, A. S. (2017). Risk-return Performance of Residential Property Investment in Abuja , Nigeria. *ATBU Journal of Environmental Technology*, 10(1), 95–108.
- Yusoff, W. Z. W., Juanil, D. M., Alias, A., & Ali, A. S. (2010). A study of return on investment for commercial property in Johore State, Malaysia. *COBRA 2010 - Construction, Building and Real Estate Research Conference of the Royal Institution of Chartered Surveyors, January*.

## ENVIRONMENTAL IMPACT OF FILLING STATIONS ON WATER QUALITY IN URBAN MINNA, NIGER STATE NIGERIA

**Mammman Ibrahim,**

Dept. of Geography,  
Federal University of Technology, Minna,  
Niger State, Nigeria

**Suleiman Y. Mohammed**

Dept. of Geography,  
Federal University of Technology, Minna,  
Niger State, Nigeria

### Abstract

This study is aim at assessing the impact of Filling stations on water quality in urban Minna. The study Map out the Petrol Filling Stations in Minna Township. In other to examined the distributional pattern of the petrol Filling stations with the aid of GIS and to know their conformity with planning standards; even though most petrol filling station do not comply with the standard of 50-meter distance from water sources. coordinate of the stations were obtained using Garmin™ Etrex handheld Global Positioning System (GPS) receiver of 4.5 m accuracy; ArcMap 10.1 was used to develop the map of the study area that made it easy to identify the water sources in the study area. Buffer width of 250meters recommended by Palfrey and Bradley (2002) was used to provide a buffer zone, results were presented on imageries and Maps. The research throws light on to the physio-chemical analysis of Well water sources in Minna metropolis. Ten different Hand-dug well water samples were collected and compared for physiochemical analysis. The selections of parameters and the determination of Maximum allowable limit were conducted by taking in to consideration the WHO and Nigeria Standards for drinking water quality: The parameters such as water temperature, Total dissolved solid (TDS), pH, Electrical conductivity (EC) and Total petroleum hydrocarbon (TPH) were analysed. In this study, Total petroleum hydrocarbon concentration affects different aspects of the water quality and it can be concluded that eight (8) underground water sources out of the ten (10) shows the presence of Total Petroleum Hydrocarbons (TPH). Only one well (Well 5) with 4.8 TPH concentrations was within the permissible limit of 5.0 mg/l. The study recommends Hand dug-wells that are to be used for domestic purposes should be cited far away from Petroleum Filling stations so as to reduce the number of Hydrocarbons that may get into the underground water sources.

**Keywords:** Keywords: Filling stations; water quality, Physicochemical Parameters, spatial distribution, Total Petroleum Hydrocarbons (TPH).

### INTRODUCTION

In recent times, there has been a tremendous proliferation of petrol retail outlets at strategic locations due to high demand for fuel and the justification for such unprecedented increase is due to the country's population and the attendant increase in the purchase of vehicles (Taylor,

Sichinsambwe, & Chansa, 2016). The attractive price of petrol both at control price and black-market price makes more people to go into petrol retailing businesses (Tah, 2017). Petrol retail businesses today are the key driver of industrial activities as its upsurge our economy so much creating job opportunities for residence in areas and communities where these petrol stations are located (Mwenda and Oloko, 2016). The deregulation policy of the petroleum sector introduced in 2003 by president Olusegun Obasanjo has caused drastic changes in the industry, owing to this policy there is free entry in the oil marketing industry and this has seriously generated a ripple effect increasing competition among Oil Marketing Companies due to a general price war and increase of fuel stations along major roads (Godfrey, 2015). Given this development, many marketers take advantage of this to build service stations haphazardly without considering the possible environmental effect of the locations of the stations (Akinsulire & Fadare, 2020). Charles and Willy (2015) observed that the newly established petroleum retail outlets have been constructed within residential areas, commercial places and some water catchment areas vital for water filtering and purification thus, posing environmental problems and provoking public concern. One of the best-known classes of groundwater contaminants includes petroleum-based fuels such as petroleum and diesel, considering the inorganic chemicals as greater contaminants in drinking water in comparison to organic chemicals (Charles and Willy 2015).

### **Statements of Research Problem**

Minna metropolis is one of the towns in Nigeria that is faced with the action of indiscriminate siting of petrol retail stations, the proliferation of petrol retail stations along the major roads and within Minna metropolis is quite disturbing (Yisa et al., 2019). A drive through major roads and within Minna city indicate that the Department of Petroleum Resources (DPR) does not comply with its own statutory requirements of the regulations and guidelines in the establishment of Petroleum Retail Stations in Urban Minna.

However, there are relevant research done by various scholars on Petroleum Filling Stations and their Impact on the environment and water quality both local and international. Peprah (2018) investigated the level of compliance to standards set by the Ministry of Energy, and Town and Country Planning Department on existing oil and gas station in Tarkwa Ghana, using multi-criteria decision analysis and GIS approach.

Mshelia et al. (2015) Assessed environmental effects of Petrol Stations at Close Proximities to residential buildings in Maiduguri and Jere, Borno State Nigeria. Odekunle et al. (2019) in their studies analysed the impacts of petroleum filling Stations in Minna Metropolis using global position system (GPS) to determine their spatial locations, all these studies reported violations of the spatial regulations of the Department of petroleum resources (DPR) and Urban planning standards, it is therefore against this background that the study fills the research gap by examining the spatial pattern of these petrol stations and the associated water hazards in urban Minna.

### **Aim and Objectives of the Study**

The aim of the study is to assess the impact of Petrol Filling stations on water quality in Minna.

The specific objectives of the study are to:

- i. Examine the distribution of petrol retail stations within Minna;
- ii. Analyse the proximity of well water sources by measuring their distances from storage tank;
- iii. Analyse the physiochemical properties of water source samples to ascertain the effect of petrol Filling stations locations on them; and
- iv. Compare results with WHO and National standards for drinking water specifications.

### **Research Questions**

- i. How are various fuel stations distributed in urban Minna?
- ii. Are filling stations located according to established planning standards, guidelines and regulations in Urban Minna?
- iii. Does the locations of petroleum filling stations in Minna has effect on groundwater sources?
- iv. Does the available Well water source meet the WHO and Nigeria standard for drinking water quality specifications?

### **Justification for the Study**

The resent proliferations of petrol retail station in Minna metropolis has prompted the adaption of this research. The research is justifiable because the number of filling stations in Minna metropolis is increasing astronomically as indicated by (Ahmed et al., 2014). These Petroleum filling stations are generally ought to be located at the periphery of cities and towns; however, with the passage of time, the residential and commercial areas in the study area get surrounded by these petrol retail stations.

This study will assist Town planning authorities to carry out necessary actions on already existing petrol retail stations that have contravened planning standards that are ill-sited as well as verify with ease and implement standards for those yet to be constructed. Few researches have been done on the subject matter in existing literatures, it will therefore serve as a guide for individuals or developers and even the government together with other stakeholders in the urban planning and downstream petroleum industry sector and also for further research and decision making.

### **Scope of the Study**

This study mainly focused on the evaluation of water quality parameters of well water sources close to petrol filling stations in some parts of Minna metropolis. The study covers Minna township, from Minna city gate along Minna – Paiko road, through Bosso road to Maikunkele City gate and also from Maitumbi, through the Eastern and Western bye pass.

These areas were chosen because most of the filling Stations were located along the high capacity urban road in the study area and most of these vulnerable wells are within the premises of these Filling Stations.

### **Description of the Study Area**

The Study area is located between longitude  $6^{\circ}31'08''\text{E}$  and  $6^{\circ}37.31''\text{E}$  and latitude  $9^{\circ}11.11''\text{N}$  and  $9^{\circ}60.50''\text{N}$  of the Greenwich Meridian as indicated in Figure 1.1. Minna shares borders with the

following Local Government Areas; Shiroro LGA to the North, Wushishi LGA to the West, Gbako LGA to the South-West, Katcha LGA to the SouthEast and Paikoro LGA to the East as shown below. Minna is made up of settlements such as: Chanchaga, Shango, Maitumbi, kpakungu, Dutsen-Kura, Bosso, Maikunkere, Barkin Sale, Tudun Fulani, Keteren Gwari. The Study area is located between longitude  $6^{\circ}31'08''E$  and  $6^{\circ}37.31''E$  and latitude  $9^{\circ}11.11''N$  and  $9^{\circ}60.50''N$  of the Greenwich Meridian as indicated in Figure 1.1. The study area experiences tropical continental type of climate with distinct wet and dry seasons controlled by the shifting position of the intertropical convergence zone. The vegetation of the study area can generally be described as typical Guinea Savanna with a mixture of trees, shrubs, herbs and tall grasses.

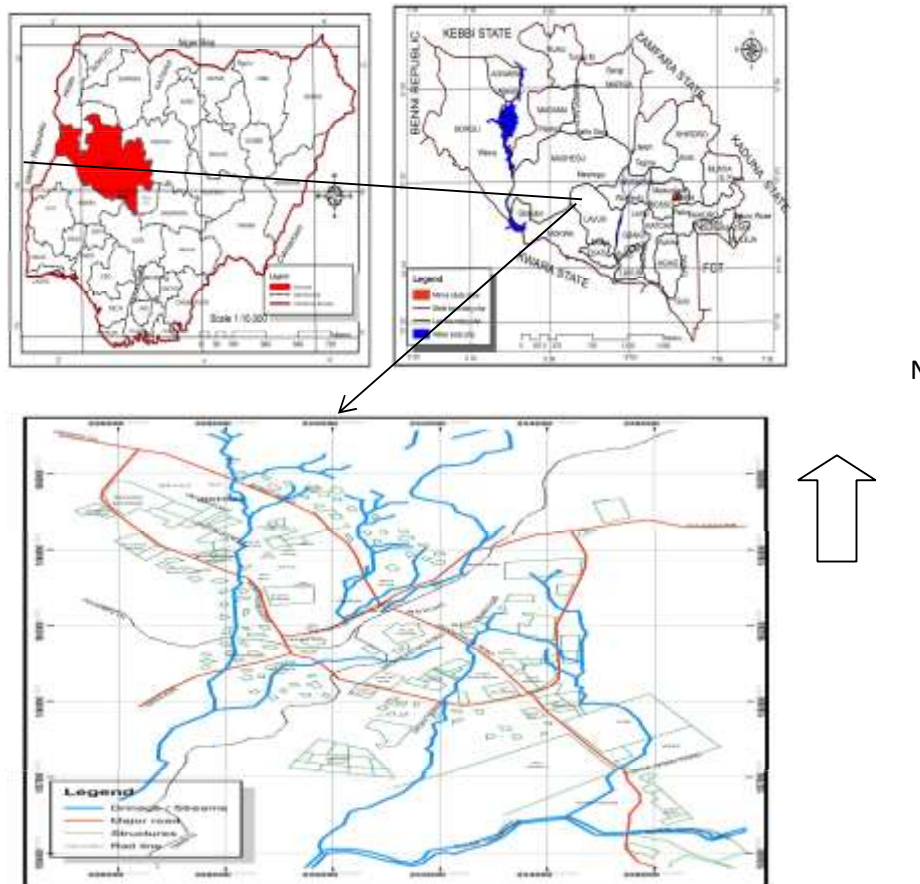


Figure 1.1: The study area (Minna metropolis, Niger State, Nigeria)  
Source: Niger State Geographic Information System

**Literature Review**

Literature on locations of filling stations or its synonymous names, i.e., petrol filling station, fuel station, gas station, petroleum outlet are virtually scanty. What prevails in the global literature is the paucity of research documentation on the technological remediation of service sites closures

due to the environmental risks associated with both soil and underground water pollution (Thomas et al., 2016).

Rana & Garg (2014) noted that location of petrol fuel stations is a very significant issue and needs to consider impact of various relevant parameters such as distance, population and access time on a location. Location theory has turned out to be an essential component of economic geography, regional science, and spatial economics and furthermore, the theory supports various forms of locational analysis and highlights the significance of spatial proximity (Marian, 2019).

Sneha et al. (2016) pointed out that water quality is directly related to the physical, chemical, biological and radiological property of water and these properties of water are affected because of the pollution of water due to various human activities. According to Sneha's investigation, water bodies change the standard quantity of parameters in water. Similarly, Pawan & Pradeep (2015) carried out a study and collected water samples from 12 different sampling stations to evaluate water quality status of river Narmada, a total of 16 water quality samples were determined, minimum and maximum value of air temperature, water temperature, turbidity, pH, electrical conductivity, total dissolved solids, free carbon dioxide, total alkalinity, chloride, total hardness, Calcium Hardness dissolved oxygen, nitrate, orthophosphate, biochemical oxygen demand and chemical oxygen demand were noted from the study.

Dipankar et al. (2019) further investigated drinking water quality in some parts of Perak state, Malaysia, in this aspect of study a detailed physiochemical analysis of drinking water samples was conducted in different residential and commercial areas of the state.

Smutko et al. (2012) observed that ground water is vulnerable to contamination from numerous anthropogenic activities and these anthropogenic activities are controlled by the influence of man, one of the best-known classes of groundwater contaminants includes petroleum-based fuels such as petroleum and diesel.

## **MATERIALS AND METHODS**

This research is designed to determine and analyse the vulnerability of residents living on water source within proximity to filling stations in Minna, Niger State Nigeria. In this study, GIS was used to examine spatial relations between water wells, their recharge zones, and the potential sources of groundwater contamination. The primary data employed in this research was collected directly from the field, that is, geographical coordinates of petroleum filling stations as well as the coordinate points of groundwater sources were obtained with the aid of a Garmin™ Etrex handheld Global Positioning System (GPS) receiver of 4.5m accuracy. For the purpose of this research work, secondary data and information were obtained through the following means; published and unpublished textbooks, journals, articles, conference proceedings, internet and some agencies. Purposive sampling was used to select seventy-eight (78) fuel stations, selection was based on their close proximity to residential neighbourhoods especially those that fall within the criteria set, that is 50 meters proximity to the filling station. Water samples were collected in 500ml plastic bottles, the samples were labelled Well 1 to Well 10 and stored in an ice chest prior to taking them to the laboratory. The sample frame for the study area is the total number of petroleum filling stations.

within Minna town ship, the area coverage is estimated to have 78 petroleum filling stations and 30 hand dug wells which therefore form my sample frame. Sample points for this study include, Well 1.

Bosso- mechanic junction, Well 2. Beger junction-Zungeru road, Well 3. Angwan Daji, Well 4. Saiko road, Well 5. Nnamdi Azikwe Western bypass, Well 6 Eastern bypasses, Well 7. Tunga, Well 8. sheroro, Well 9, Maitunbi, Well 10 Kpakungu, and Niger state Urban Development in charge of Development control activities in Minna metropolis.

**Results and Discussion**

**Distributional Pattern of the Petrol Retail Stations in Minna town**

The findings revealed 78 existing petroleum filling stations at the time of study, These Petrol retail stations are located along the six (6) major roads in Minna. However, the petrol retail stations are not equally distributed between the roads as can be observed from Figure 4.1. Nnamdi Azikwe road has the highest number of stations (21) followed by Bida road with (17) and Bosso road (15) each respectively, these roads account for more than 70% of the filling stations in the area.



Figure 4.1: Spatial location of Petroleum Filling Stations in Minna Township.  
Source: Authors Analysis, 2022

4.2 Proximity of well water sources to location of petroleum Filling stations The study identified a total of 30 different domestic well water sources within the proximity of less than 50meters to petroleum filling stations in Minna. Most of the wells identified were within the premises of the petroleum filling station and the wells were made available for domestic uses by residents around the filling stations.

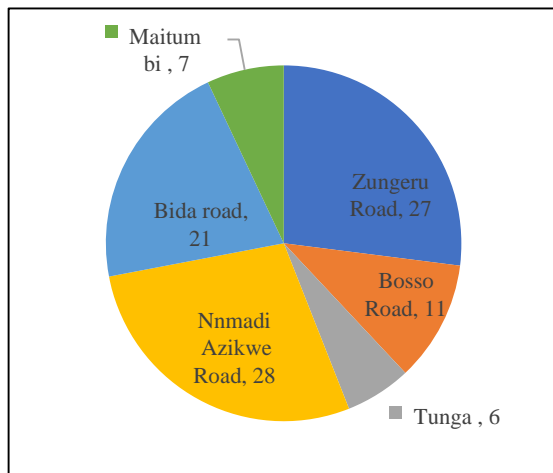


Figure 4.2: Percentage of Vulnerable Domestic Well Water Source in the Study Area.

Figure 4.2 shows the concentration of vulnerable domestic well water proximal to petroleum filling stations in Minna metropolis, majority of vulnerable domestic wells were along Nnamdi Azikiwe road with 28% of the total well identified, followed by Zungeru road with 27%, then Bida road with 21%, Bosso Road 11%, Maitumbi 7% while Tunga area has the lowest vulnerable

domestic well water source with 6%.

4.3 Physiochemical analysis of water samples to check water contamination In examining the physiochemical analysis of sampled well water, the selection of parameters and the determination of maximum allowable limits were conducted by taking into consideration the WHO and National Standard for drinking water quality. The parameter considered were Temperature, pH, conductivity, Total Dissolve Solid and Total Petroleum Hydrocarbon (TPH). The amount of TPH found in the well water sampled is a useful indicator of petroleum contamination in that water. The permissible limit for total petroleum hydrocarbons is 5.0 mg/l (WHO, 2008) However, in this study, eight (8) well water source samples out of the out of ten (10) studied had values exceeding this standard. In addition, according to (Valentinett et al., 2002), petroleum hydrocarbons enter underground water through several sources such leakages from underground storage tank This was evident in this study where most well water sampling points had the influx of mechanic shops as well as fuel storage tanks close to them.

#### Temperature (°C)

This study revealed that all the sample well water have their water temperature above the WHO and Nigeria Standard for drinking water requirement. the well with the least temperature is well number 5, located along Zungeru- Bosso road) with 28.3<sup>0</sup> and the highest are wells 1 and 3 (located at Berger Junction, Zungeru road and Saiko road) with 29.7<sup>0</sup> respectively. High water temperature enhances the growth of microorganisms and may increase taste, odour, colour and corrosion



problems. However, the disparity in water temperature from World health organization (WHO, 2008) standard does not make the water to be unfit for drinking.

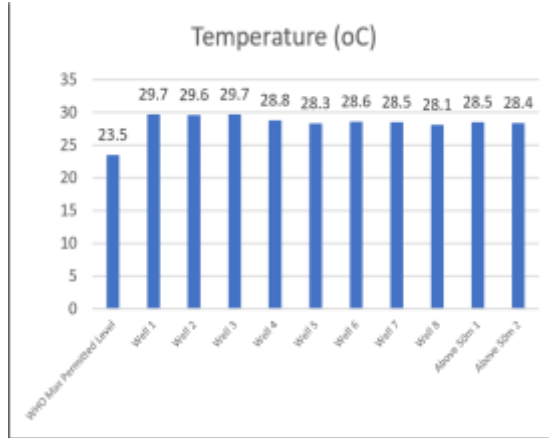


Figure 4.3: Level of Temperature of Sampled Well water in the study area.

Source: Authors Field Survey, 2022

**pH level of acidity and alkalinity of water**

The pH of well water normally is between 6.0 and 8.5. Figure 4.3 shows that none of the well water sample is above the WHO standard of 8.5, the least in pH is Well 1 (located at Berger Junction, Zungeru road) with a pH of 6.12 and the highest was well 3 (located at Saiko road) with 8.14. Water with pH lower than 5.0 may cause problems due to corrosion because many metals become more soluble in low pH waters. A pH value of higher than 8.5 indicates that a significant amount of sodium bicarbonate may be present in the water.

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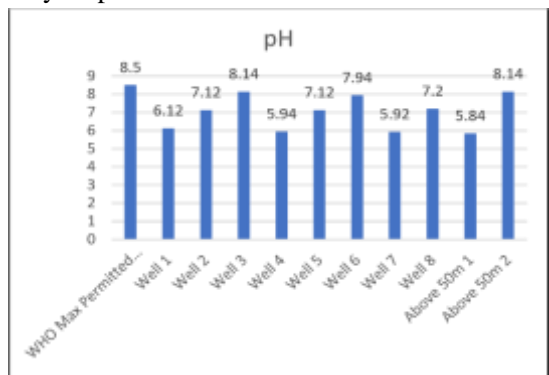


Figure 4.4: Level of pH in Sampled Well water in the study area.

Source: Authors Field Survey, 2022

**4.3.3 Total dissolved solid (TDS)**

Total dissolved solid (TDS) is the total amount of material remaining after evaporation of water. Permissive level value of less than 500 ppm (mg/L) and up to 1,000 ppm (mg/L) can be tolerated. The following samples are presented in figure 4.5 below; well 1 (located at Berger Junction, Zungeru road) has 638.5 ppm, well 2 (also located at Berger Junction, Zungeru road) has 686.8 ppm, well 3 (located at Saiko road) has 913.9 ppm respectively.

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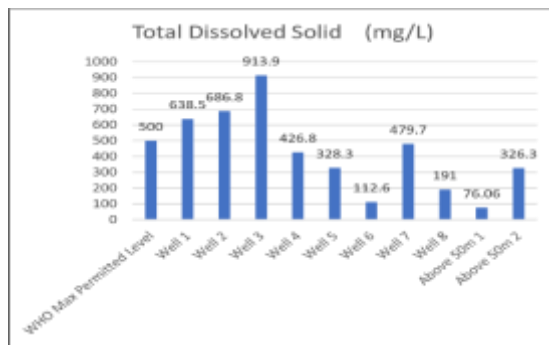


Figure 4.5: Level of TDS in Sampled Well water in the study area.

Source: Authors Field Survey, 2022

**Conductivity**

The Conductivity concentration as recommended by WHO standard in domestic water is 1000mg. Figure 4.6 shows that well 3 that is located at Saiko road has the highest

concentration of conductivity with 1364mg followed by well 2 (located at Berger Junction, Zungeru road) with 1025mg. The least well with conductivity concentration is well 6 (located at Nnamdi Azikiwe road) with 168 mg. the findings shows that well 2 and well 3 has conductivity above the WHO limit, while other sampled wells have the limit recommended standard.

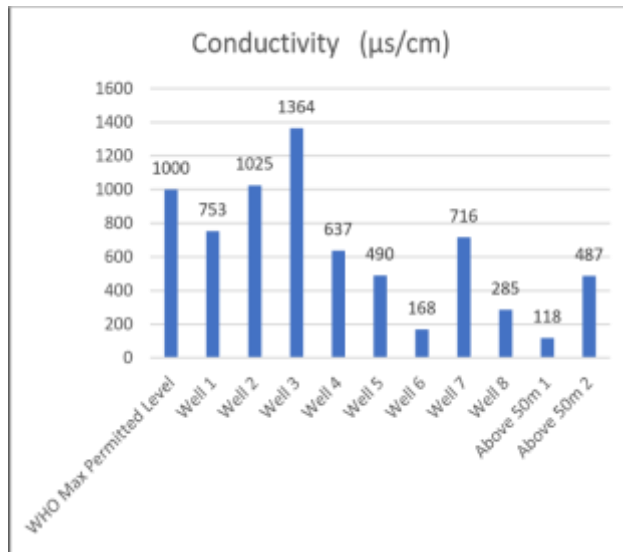


Figure 4.6: Level of conductivity in Sampled Well in the study area.

Source: Authors Field Survey, 2022

**Total petroleum hydrocarbon (TPH)**

The permissible limit for Total Petroleum Hydrocarbon (TPH) concentration for drinking water is 5.0 mg/l (WHO, 2008); Figure 4.7 shows that all the sampled well was above WHO permitted limit level of drinking water, it was discovered that the highest mean concentration of TPH was 8.2 mg/l recorded at Well 6 (located at Nnamdi Azikiwe road), followed by 7.1 at well 1, (located at Berger Junction, Zungeru road). The least was well 5

(located at Bosso, Zungeru road) with 4.8mg/l. The two sampled wells were water above the 50meter setback and did not show the present of Total Petroleum Hydrocarbon.

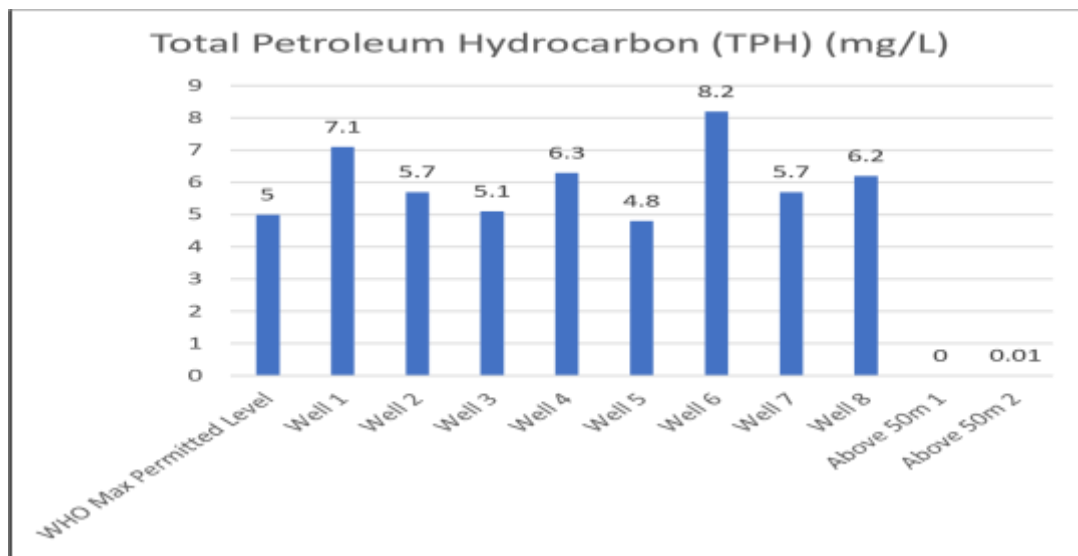


Figure 4.7: Level of TPH in Sampled Well in the study area.

Source: Authors Field Survey, 2022

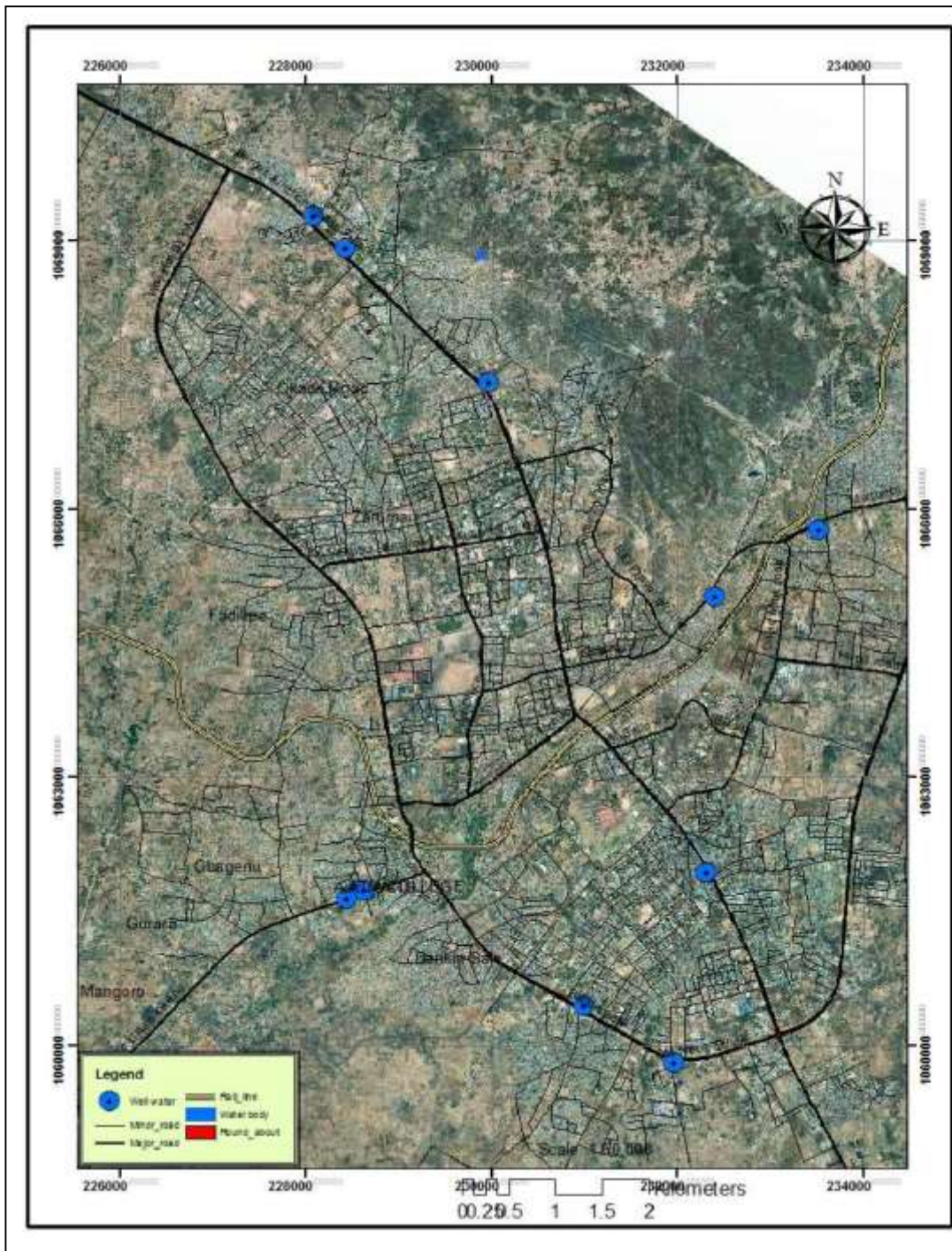


Figure 4.8: Locations of well water samples in the study area  
Source: Authors Analysis, 2022

Table 4.1 Results of Physicochemical analysis

PARAMETER	WHO/NS	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Well 8	Above 50m 1	Above 50m 2
DWQ Max Level	Permitted										
Temperature (°C)	23.5	29.7	29.6	29.7	28.8	28.3	28.6	28.5	28.1	28.5	28.4
Conductivity (µs/cm)	1000	753	1025	1364	637	490	168	716	285	118	487
Total Dissolved Solid (mg/L)	500	638.5	686.8	913.9	426.8	328.3	112.6	479.7	191	76.06	326.3
pH	8.5	6.12	7.12	8.14	5.94	7.12	7.94	5.92	7.2	5.84	8.14
Total Petroleum Hydrocarbon (TPH) (mg/L)	5.0	7.1	5.7	5.1	6.3	4.8	8.2	5.7	6.2	0	0.01

Authors Survey, 2022

Table 4.1 above, revealed that all the sample well water has their water temperature above the WHO and National Standard's requirement. The well with least temperature is well number 5 which has a temperature of 28.3<sup>0</sup> and the highest are wells number 1 and 3 with water temperature of 29.7<sup>0</sup> respectively, this indicate that all of the well water sampled Temperature were above the WHO and National standard for drinking water. Also, pH Study confirmed that all the water samples are in slight acidic range, I can say near about neutral, well 1 with pH of 6.12 and the highest were well 3 with pH of 8.14 and 7.94. It was also discovered that total dissolved solid; well 1(638.5 ppm), Well 2(686.8 ppm), well 3 (913.9 ppm) respectively which are majorly samples from well water. Whereas, conductivity of Tested water was higher in well 3, with conductivity of 1364(µs/cm) followed by well 2 with 1025(µs/cm). The study showed that Total Petroleum Hydrocarbon is present in all the sampled well, except for the two (2) sampled well that were above 50meters proximity to the petroleum retail stations which is an evidence of contamination of underground water.

### Summary of Findings

The findings revealed that there are 78 existing petroleum filling stations in Minna Township as at the time of this study and were located along six (6) major roads in Minna. However, the filling stations are not equally distributed between the roads. The study identified a total of 30 different domestic well water sources within the proximity of less than 50meters to petroleum filling stations in Minna. Most of the well identified were within the premises of the petroleum filling station and were made available for domestic uses by residents close to the filling stations and some were within the next closest building less than 50 meters. From the findings, the majority of vulnerable wells water were along Nnamdi Azikwe road with 28% of the total well identified, followed by

Zungeru road with 27%, then Bida road with 21%, Bosso Road 11%, Maitumbi 7% while Tunga area has the lowest venerable domestic well water source with 6%. The findings also discovered seventy-eight (78) identified petroleum filling stations in Minna Township only thirty-two (32) has approval from the Niger State Urban Development Board, and forty-six (46) did not have approval from the board. In examining the physiochemical analysis of sampled well water, the selection of parameters and the determination of maximum allowable limits were conducted by taking into consideration the WHO guideline for domestic water quality. The parameter considered were Temperature, pH, conductivity, Total Dissolve Solid and Total Petroleum Hydrocarbon (TPH). The study further revealed that all the sample well water have their water temperature above the WHO requirement and National Standards for drinking water. The well with least temperature is well number 5 which has a temperature of 28.3<sup>0</sup> and the highest are wells number 1 and 3 with water temperature of 29.7<sup>0</sup> respectively. The study indicates that none of the pH of well water sample exceed WHO standard of 8.5, the least is Well 1 with pH of 6.12 and the highest were well 3 with 8.14.

### **CONCLUSION AND RECOMMENDATIONS**

In Conclusion, this study has successfully analysed various Physicochemical Properties of water samples Collected from 10 major water sources and also presented the levels of physicochemical parameters such as Temperature, pH, Conductivity, Total dissolved solids (TDS) and Total Petroleum Hydrocarbons (TPH) contents in the well water samples collected. The outcome of this study raises issues of public health and safety; therefore, the following recommendations are made.

1. wells used for domestic purposes should be cited far away from Petrol retail stations so as to reduce the number of Hydrocarbons that may get into the underground water sources and in unavoidable cases, water treatment should be embraced. Water quality should be controlled in order to minimize acute problem of water related diseases, which are endemic to the health of man.
2. State legislature should enact law forbidding either government or individuals from given out plots of land for location of petrol stations within Minna Township. Any attempt by either of the two sides to convert the use of any land within the township should be resisted by the Niger state planning Authority and the court.
3. To control the sitting of fuel stations at unauthorized places, Niger state planning Authority and department for petroleum resources (DPR) should ensure that building permit and authorization for the siting of fuel stations are only issued to applicants having proof of location based on the urban planning standards and land use regulations of Nigeria and the land-use plan of Minna town.
4. Ministry of Environment in collaboration with all the petrol retail stations should constantly mount public enlightenment campaign using posters, bill boards and media houses to educate the public on the hazards associated with petroleum products with

respect to human health and the environment so as to discourage residing close to petrol retail stations.

## REFERENCES

- Akinsulire, E. O., & Fadare, S. O. (2020). An Assessment on the Locational Pattern of Petrol Filling Stations along Lasu- Isheri Road Corridor. *American International Journal of Multidisciplinary Scientific Research*, 6(2), 6–30. <https://doi.org/10.46281/aijmsr.v6i2.705>
- Dipankar Nath, Arzoo Newar, Rishi Choudhury, Koushal Singh, Utsav Sharma, & Puja. (2019). Newar Basic Physicochemical Analysis of Water Samples collected from East Sikkim. *World Journal of Pharmaceutical and Life Sciences*, 5(1), 79–89.
- Emakoji M A, & Otah K N. (2018). Managing Filling Stations Spatial Database using an innovative GIS tool- a case study of Afipko City in Nigeria. *Asian Journal of Geographical Research*, 1(2), 1–9.
- Godfrey, N. O. (2015). Deregulation of the downstream Sector of the Nigerian Petroleum Industry : The role of leadership deregulation of the downstream sector of the Nigerian petroleum Industry : Therole of leadership. *European Journal of Business and Management*, 7(8), 35–46.
- IANGV.(2017).International Association for Natural Gas Vehicles IANGV 2017, [www.ngvglobal.org](http://www.ngvglobal.org).
- MARIAN, B. B. (2019). Locational analysis of fuel stations in Sunyani municipality.Thesis Submitted to the Department of Geography and Regional Planning of Faculty of Social Sciences of the College of Humanities and Legal Studies, University of Cape Coast, in partial fulfilmen.
- Mshelia, A. M., Abdullahi, J., & Dawha, E. D. (2015). Environmental Effects of Petrol Stations at Close Proximities to Residential Buildings in Maiduguri and Jere , Borno State Nigeria. 20(4), 1–8. <https://doi.org/10.9790/0837-20440108>
- Mwenda S, & Oloko M. (2016). Determinants of Motorists Choice of a Petrol Station in Kenya a Survey of Thika Sub County. *International Journal of Social Sciences and Information Technology*, 2(IX), pp.1370-1383, 2016.
- NUDB. (2016). Niger State Urban Development Board. Effective Development Control: The way forward. Unpublished Report.
- Odekunle M O, Adesina E A, Lateef Q A, Acha S, & Ahmed Y. (2019). Geospatial Distribution and Locational Impacts of Filling Stations in Minna Metropolis (pp. 350– 365).
- Peprah. (2018). Suitability analysis of siting oil and gas filling station using multi-criteria decision analysis and GIS approach- a case study of Tarkwa and environs- Ghana: *Journal of Geomatics.*, 12(2), 158–166.
- Rana R, & Garg D. (2014). Algorithm for obnoxious facility location problem, *International Journal of Advancements in Technology*, 5(4), 96-106.
- Singh, P. K., & Gawande S. (2015). Analysis of water quality of river narmada. *International Journal of Current Research*, 7(12), 24073–24076.
- Smutko, L. S., Danielson L E, & Hoag D L. (2012). Protecting Groundwater Resources. North Carolina State University, Agricultural and Resource Economics, Applied Resource Economics and Policy Group, AREP 93 - 4.
- Sneha, S. P., & Gawande S. (2016). Review Paper on Development of Water Quality Index; *International Journal of Engineering Reasearch and Technology (IJERT)*, 5(5), 765-767.
- Tah, D. S. (2017). GIS-baed locational analysis of petrol filling stations in Kaduna metropolis. *Science World Journal*, 12(2), 8–13.
- Taylor, T. K., Sichinsambwe, C., & Chansa, B. (2016). Public perceptions on location of filling stations in the City of Kitwe in Zambia. *International Journal of Advanced Engineering Sciences and Technologies*, 7(1), 110 – 121.
- Thomas Kweku Taylor, Chanda Sichinsambwe, & Blessings Chansa. (2016). Public Perceptions on Location of Filling Stations in the City of Kitwe in Zambia. 6(6), 133–151.

- Valentinetti R A, Kostecki P T, & Calabrese E J. (2002). Federal Underground Storage Tank Regulations and Contaminated Soils in Petroleum Contaminated Soils, Chelsea MI: Lewis Publishers, 1(1), 55-60.
- WHO. (2016). Safe piped water: Managing microbial water quality in pipe distribution system.
- WHO. (2008). Progress on Drinking Water and Sanitation. Retrieved 3rd January 2010 from <http://www.who.int/./index.htm/16/06/11>.
- Yisa J, Olubadewo-joshua, Oluwaseun Okosun, & Oboh Satur. (2019). Utilization of GIS Techniques as Decision Support System for Location of Filling Stations in Minna , Niger State,Nigeria.[https://Jurnal.Unej.Ac.Id/Index.Php/GEOSI,4\(3\),247-263](https://Jurnal.Unej.Ac.Id/Index.Php/GEOSI,4(3),247-263).  
<https://doi.org/10.19184/geosi.v4i3.9713>

## **ANTI-CORRUPTION, DEMOCRACY AND DEVELOPMENT: AN EXPLORATION OF BUHARI'S ADMINISTRATION**

**Dr. Adamu Mohammed**

Department of Political Science,  
Faculty of Management and Social Sciences,  
Federal University Gusau,  
Zamfara State

**Abbas Iliyasu Wali**

Department of Political Science,  
Faculty of Social and Management Sciences,  
Umaru Musa Yar'adua University, Katsina,  
Katsina State

**Akilu Mikailu**

Department of Political Science,  
Faculty of Social and Management Sciences,  
Umaru Musa Yar'adua University, Katsina,  
Katsina State

### **ABSTRACT**

This paper investigates Anti-Corruption, Democracy and Development; an Exploration of Buhari's Administration. Corruption has eaten deep into the fabrics of the Nigerian society and no economy thrives in it. The question, therefore, is whether the fight against corruption and corrupt practices in Nigeria by President Buhari is a reality or mere rhetoric, a gimmick to deceive the populace again like his predecessors. And, what would be the impact of this war on the masses who have been impoverished by the political leaders through the act and science of corruption that made him, President Buhari to state that "if Nigeria does not kill corruption, this number one enemy may eventually kill Nigeria." The causes of corruption are from various institutional and political factors stemming from the flawed structure and monopoly of the economy by the federal government. Its effects on the nations socio-political and economic development are numerous and devastating. It has damaged the image of the country abroad to the extent that Nigeria is tagged as one of the most corrupt countries in the world. This has discouraged foreign investors and caused inflation and the depreciation of our currency. On a final note, the fight against corruption in Nigeria by the Buhari administration is being encouraging indeed; but it should be holistic and transparent, not targeting only a section of the country, a particular political party members and or his passive enemies if he wants Nigerians to believe and have faith in his war against corruption.

**Keywords:** Anti-corruption, Corruption, Democracy, development, Buhari Administration.



## Introduction

Corruption has eaten deep into the fabrics of the Nigerian society and no economy thrives in it. It involves the violation of established norms and rules for personal gains and profit. According to President Buhari, “corruption is the greatest form of human right violation” (Buhari, 2015). Notably, before the Buhari’s administration, preceding administrations have instituted various legal instruments, measures and policies designed to combat corruption in the country. Some of these include the criminal code, The Penal Code (applicable in the North); The criminal justice (Miscellaneous Provisions) Decree 1996; The Corruption Practices, Decree 1975, which established the Corrupt Practice Investigation Bureau; The ethical Revolution of President ShehuShagari; The War Against Indiscipline (W.A.I) of Buhari/Idiagbon; Mass Mobilization for Social Justice, Self-Reliance and Economic Review (MAMSER) by General Babangida; The code of conduct Bureau and Tribunal Act (Cap 56, Law of the Federation of Nigeria, 1990); The Recovery of Public property (Special Military Tribunal Act (Cap. 387, Law of the Federation of Nigeria) as amended in 1991; The War Against indiscipline and Corruption of Late Gen. SaniAbacha; The Failed Banks Recovery of Debts and Financial Malpractices in Banks, Decree 1994 as amended in 1999; The Recovery of Public Property Special Military Tribunal Act, Cap. 389, laws of the Federation of Nigeria 1990, as amended in 1999 by Gen. AbdulsalamiAbubakar, and many others.

However, the massive corruption allegations that characterized President Goodluck Jonathan’s administration in Nigeria from 2010-2015 prompted President Muhammadu Buhari to declare in his inaugural speech that “he belongs to nobody and he belongs to everybody”. The President has vowed to combat corruption in Nigeria no matter whose ox is gored. Indeed, his perceived stand by Nigerians as a strong character made his victory and that of his party possible in the 2015 general election as the then President, Dr. Goodluck Jonathan was accused of timidity and lack of will to solve Nigeria’s problems especially corruption.

Thus, Nigerians believe that the “national ethics” as itemized in section 23 of the Federation of Nigeria, 1999 constitution that deals with discipline, integrity, and dignity of labour are all characteristics that are antithetical to corruption and which, if imbibed and practiced by Nigerians will check corruption and restore the nation to path of greatness could have been one of the legal frameworks among others-like. Moreover, the Nigerian Constitution of 1999, section 88 and 89 that empowered the National Assembly to expose corruption, inefficiency and waste in government through probe and investigations; The Nigerian extant Constitution of 1960 section 15(5) that deals with abolishment of all corrupt practices that was assumed to have influenced Buhari’s formation age, are indeed the legal frameworks that made President Buhari to declare war on corruption as vowed. In addition, the constitution of his ruling party - All Progressives Congress (APC), in item No.4 takes a clear position to fight corruption if voted into power as it is now. Albeit, after a year of President Buhari’s administration; war against corruption and corrupt practices, Nigerians are beginning to ask questions if the policy is a reality or an illusion?

The question, therefore, is whether the fight against corruption and corrupt practices in Nigeria by President Buhari is a reality or mere rhetoric, a gimmick to deceive the populace again like his predecessors. And, what would be the impact of this war on the masses who have been impoverished by the political leaders through the act and science of corruption that made him, President Buhari to state that "if Nigeria does not kill corruption, this number one enemy may eventually kill Nigeria" (Buhari, 2015).

### Conceptual Clarifications

#### ➤ **Democracy**

The word democracy has been conceptualized by scholars and statesmen alike from different perspectives, which had tended to emphasize different aspects of the process. Democracy as a form of government holds a strong appeal among countries of the world. It possesses certain basic elements without which no society can truly call itself democratic. These include the principle of equality; sovereignty of the people; respect for human life; the rule of law; and liberty of the individual. Democracy is a concept that in theory and practice holds the right of the people to choose their leaders who in turn, must be accountable to the people as of right (Orasanye, 2016).

According to Omoleke (2018), democracy is a system of government, a set of institutions that fulfill at least two essential requirements, which are ability to elicit as accurately as possible the opinion of as many people as possible on who shall be their representatives and on how the country ought to be governed. This means that democracy connote universal suffrage, institutionalization of free and fair election at frequent intervals; and the elected representatives must be accountable to the electorate. The essential condition of democracy is that there shall be a consensus on the rules of the political game. Democracy therefore, entails a system of governance that is accountable and guarantees a wide range of social, economic and political rights.

#### ➤ **Development**

Development as a concept is a victim of definitional pluralism. It is a difficult word to define. However, attempts have been made by erudite scholars to conceptualize development. Some of these definitions will be explored for the purpose of this study. Gboyega (2013) captures development as an idea that embodies all attempts to improve the conditions of human existence in all ramifications. It implies improvement in material well-being of all citizens, not the most powerful and rich alone, in a sustainable way such that today's consumption does not imperil the future, it also demands that poverty and inequality of access to the good things of life be removed or drastically reduced. It seeks to improve personal physical security and livelihoods and expansion of life chances.

Naomi (2017) believes that development is usually taken to involve not only economic growth, but also some notion of equitable distribution, provision of health care, education, housing and other essential services all with a view to improving the individual and collective quality of life. Chrisman (2016) views development as a process of societal

advancement, where improvement in the well-being of people are generated through strong partnerships between all sectors, corporate bodies and other groups in the society. It is reasonable to know that development is not only an economic exercise, but also involves both socio-economic and political issues and pervades all aspects of societal life.

#### ➤ **Corruption**

The term corruption is one of the most common terms in discussion today. Yet, it eludes a one sentence definition. However, when seen it is easily identified even when it is not crafted in conceptual terms. According to President Buhari (2015), “corruption is the greatest form of human right violation” while to Oxford Learners Dictionary, corruption means “dishonest or illegal behaviour, especially of people in authority”. It connotes a behaviour which deviates from the formal duties of a public role, because of personal or private gains. This behaviour includes bribery, use of a reward to prevent the judgment of a person in a position of trust, nepotism and misappropriation or illegal appropriation of public resources for private uses. It implies any act of wrong doing, act of violating public norms or deviation from honesty to dishonesty. For example, examination malpractice committed by invigilators, parents or students is regarded as corruption, irrespective of the level of involvement.

#### **Level of Corruption and its Prevalence in Nigeria**

Corruption is a bane to all facet of Nigerian development (Liman, 2017). Moreover, Chucks (2002) also submitted that, Nigeria is in a state of disequilibrium as activities in various political, economic and social institutions have become rather unethical and synonymous with decadence. In fact, the Global Financial Integrity (GFI) estimates more than US\$157 billion in the past decade has left the country illicitly. Furthermore, the global anti-corruption watch dog, Transparency International (TI), ranked Nigeria low in its 2017 corruption index (CPI). The latest ranking has Nigeria in the 148<sup>th</sup> position out of 180 countries. The country, according to CPI, scored 28 out of 100, a figure lower than the average in Sub-Saharan region.

Consequently, corruption has hit hardest at the poor Nigerians; for it causes poverty and drives away investment. Nonetheless, it is injurious to the Nigeria’s rule of law and political processes; all of which have a bearing on democratic governance. Agreeably, it also incapacitates the judicial and the political system that should be working for public good. Thus, corrupt practices in Nigeria has become common on streets, highways, borders and port entry, educational sectors, health establishments. Also, federal government, state governments, Local governments, parastatals and government ministries, banks and other financial institutions, markets and even religions houses (Peter, 2003).

#### **Theoretical Framework of Analysis**

The problem of corruption in Nigeria is a complex and sad one: it can be analyzed from diverse perspective of morality, values and conscience. Theories of moral development have been well postulated by such notable scholars as Jean Piaget (1968) and expanded by Lawrence Kohlberg in

1971 and Kohlberg L, & Candee, D. (1984). These scholars' position shall be used for the analysis of this work.

By definition, morality simply refers to the relative goodness of people as it is reflected in their behaviour and beliefs. From Piaget (1968) and Kohlberg L, & Candee, D. (1984) submitted that, individuals redefine their behaviour towards good and bad, as they grow. It therefore means that societal conditions and influences affect people's behaviour and perception of corruption. For instance the Nigerian society's perception of success has changed from what it used to be in the past when people worked hard to earn it.

Today honour is given to those who can make it by all means (usually dubious means) and red-carpet receptions are given to undesirable men with questionable characters in society. This has adversely affected the citizen's perception of life. Indeed, the decline of morality at the expense of hard-work, honesty and integrity can be adduced to be facilitator of corruption in Nigeria. This is why Oyeboade (2006) concludes that corruption connotes impropriety and therefore encompasses all forms of reprehensive, indecorous and in famous conduct of some officials and performance of judicial responsibility while Adekunle, F. (1991) concludes that a society's social and moral values reflect are firmly anchored on specific material conditions.

### **Impacts of Corruption to Nigeria's Development**

**i. Undermining the Sustainable Development Goals:** Corruption hampers the attainment of the United Nations Sustainable Development Goals (SDGs). The SDGs are comprehensive and their susceptibility to be undermined by corruption is unsurprising: it is entirely conceivable that "a better and more sustainable future for all" often runs counter to the interests of a few and can be derailed through many forms of corruption (Abiodun, 2015).

**ii. Economic loss and inefficiency:** Although obtaining exact figures on the economic costs of corruption is difficult, a 2016 report from the International Monetary Fund (IMF) estimated the cost of bribery alone to be between \$1.5 to \$2 trillion per year. This represents a total economic loss of approximately 2% of global GDP.

**iii. Poverty and inequality:** Corruption is generally not the weapon of the weak. In Nigeria, an (in)famous bribery case, involving the international oil company Shell, deprived Nigerian people of over \$1.1 billion as the money went to corrupt officials instead of to the national budget (Global Witness, 2017). Meanwhile, according to the World Bank (2019), more than 50% of the population of the oil-rich country live in extreme poverty. This form of corruption has been one of the major reasons for the structural inequality in Nigeria which has led to more poverty, impoverishment and inequality.

**iv. Personal loss, intimidation and inconvenience:** When people experience corruption, it is rarely a positive experience. A bribe must be paid to receive medical attention, obtain a building permit, pick up a package, or enjoy phone services. A judge rules against a party, not based on the facts of the case, but because the opponent paid a bribe, knows a power broker, or comes from the same racial or ethnic background (Abiodun, 2015). All of these together can seriously hamper democratic consolidation and development.

**v. Public and private sector dysfunctionality:** The cumulative effect of individual corrupt acts is dysfunctionality. Whether offered by the public or private sectors, the quality of goods and services decrease, and the process of obtaining them becomes more expensive, time consuming and unfair (Abiodun, 2015).

**vi. Failures in infrastructure:** When a bridge collapsed in Genoa in August 2018, killing at least 39 people, there were many possible causes to consider (Herald, 2018). Corruption was not the most obvious one, but subsequent investigations have found that a Mafia-controlled construction company appears to have used "weakened cement" in the building process. It is widely known that the construction industry is a valuable source of profits and a channel for money-laundering operations by the Mafia (Abiodun, 2015).

**vii. Rigged economic and political systems:** What is described as dysfunctional above is actually functional and profitable for corrupt actors. Whether falling under the label of political cronyism, crony capitalism, political party cartels, oligarchy, plutocracy and even kleptocracy, widespread patterns of private and public corruption construct social systems that are rigged in the private interest. Citizens with strong ethical principles (and citizens who lack significant funds, connections, favours to dispense, "hard power" over others such as guns or private enforcers) lose representation, influence and power (Abiodun, 2015).

**viii. Impunity and partial justice:** When corruption pervades the justice system, people can no longer count on prosecutors and judges to do their jobs. The powerful may escape justice. And citizens, especially those with few resources or few powerful allies, may be unfairly accused of crimes, deprived of due process, and wrongly imprisoned (Abiodun, 2015).

**ix. Organized crime and terrorism:** Nefarious elements in society thrive as proceeds can be laundered, funding disguised, and judicial officials and politicians corrupted through bribes (including gifts, favours and other benefits). Levels of violence, illegal drugs, prostitution, sexual slavery, kidnapping and intimidation rise accordingly. The causal arrow goes in both directions. Not only does organized crime cause corruption, but opportunities for corruption left open by a weak, negligent or incapable State can also lead to organized crime (Abiodun, 2015).

**x. Diminished state capacity:** Even if citizens were to adamantly demand that the problems listed above be addressed, corruption undermines the power of politics. For example, to the extent that bribery, trading in influence and state capture are widespread, political systems become incapable of addressing social problems whose resolution would threaten vested interests (Abiodun, 2015).

**xi. Human rights violations:** The observation that corrupt rulers tend to view civil liberties as obstacles to the consolidation of power can be traced back to many historical sources, including the collection of eighteenth century essays on corruption and tyranny known as Cato's Letters. Most recently of all, perhaps, the United Nations Office of the High Commission for Human Rights (OHCHR) has noted significant connections between corruption and human rights violations (Abiodun, 2015).

#### **Evaluation of President Buhari's Anti-Corruption Policy**

When President Buhari took over the mantle of leadership on May 29, 2015, he vowed to combat corruption in Nigeria no matter whose ox is gored. This was clearly indicated in his inaugural

speech when he said, “I belong to everybody and I belong to nobody”, (Buhari, 2015). Immediately, according to Campuswaka (2015), he started by arresting Colonel Dasuki (rtd) the then National Security Adviser of President Jonathan who was as at 1983 a young Nigeria Army Colonel that arrested the then General Buhari when Buhari’s government as Military Head of State was overthrown on December 1983 by General Babaginda. Dasuki’s accomplices that are of the opposition party, People’s Democratic Party (PDP) and those in the military were arrested and charged to court by Economic and Financial Crimes Commission (EFCC) over the massive scam in weapons and defence procurements that led to the misuse of three trillion naira defence budget since 2011 under the guise of fighting the notorious Boko Haram menace.

The NNPC investigation where the former minister of petroleum Mrs. Diezani Alison-Madueke was asked to give holistic account of her stewardship while in office could have been one of the reasons why President Buhari vowed to combat corruption in Nigeria no matter whose ox is gored. The investigation exposed several oil deals committed in the NNPC. Among these are: (1) The \$2.2 billion USD illegal withdrawal from Excess Crude Oil Account according to ([www.punchng.com](http://www.punchng.com)) of which \$1 billion USD supposedly approved by the then President Jonathan to fund his re-election campaign without the knowledge of National Economic Council. (2) The investigation of the discovered \$11.6 billion USD (NLNG) dividend payments that is missing according to NEITI, Izeze (2015). (3) The non-remittance of \$11.63 billion USD paid to NNPC on crude swaps due to subsidy and domestic crude allocation that was not remitted to the federation account from 2005 to 2012, Izeze (2015). (4) The stealing of sixty million barrels of oil valued at \$13.7 billion USD under the watch of NNPC from 2009 to 2012, Izeze (2014). (5) The invasions of tax by Oil Prospecting Licenses (OPL) and Oil Mining Licenses (OML), (Daily Sun, 2016).

Other cases investigated outside NNPC were: (6) Diversion of 60% Of \$1 billion USD foreign loan obtained by the Federal Ministry of Finance from the Chinese, Izeze (2015). (7) Diversion and mismanagement of \$2.2 million USD meant for vaccination of children, Siteadmin (2014). (8) Diversion of N1.9 billion Nigeria naira being payment for Ebola fight, Abiodun (2015). Federal Ministry of Finance hurried payment of \$2.2 million USD to Federal Ministry of Health contractor in disputed invoices, Punch (2015). (8) NIMASA fraud that the investigation is ongoing ([www.punch.com](http://www.punch.com)). (9) The NDDC scam of N27 billion Nigeria naira contract award, Premium Times (8th August 2015). (10) The Police Service Commission scam investigation of N150million Nigerian Naira, Premium Times (2015). (11) The security contracts of the militants on oil and gas pipeline, Africa Oil and Gas Report (2016). (12) The alleged down payment of N50 billion Nigeria naira for the N1 trillion fine slammed on MTN by the Nigerian Communications Commission (NCC) for a breach of thenation’s laws on Subscriber Identification Module (SIM) registration which was allegedly diverted by government agencies involved (Daily Sun, 2016).

Broadly speaking, there have been attempts by the administration of President Buhari to investigate several cases of corruption during President Goodluck Jonathan’s administration. However, some critics of Buhari’s anti-corruption war have accused him of not being sincere and holistic in the fight against corruption as virtually all the people and corporate organizations investigated are all

of the opposition party – PDP, and his perceived enemies. Worse off, to them, none of the cases so far investigated and charged to court has been clinically concluded. This school of thought is also of the opinion that President Buhari has no moral pedigree to fight corruption because he, Buhari is corrupt. Cases such as the following were cited to drag home their points: (1) Buhari as Minister of Petroleum: Two Hundred and Eighty Billion United States of America Dollar (\$2.8b) Oil Money was unaccounted for in 1977 under the watch of Buhari as the Petroleum Minister that led to the then Military Head of State Lt. Gen Obasanjo to set up a “crude oil sales tribunal” to investigate the operations of the then Nigeria National Oil Company (NNOC) now known as Nigeria National Petroleum Corporation (NNPC).

The tribunal found out that in three years, the then NNOC has failed to collect its equity share of oil produced by Shell, Mobil and Gulf, which amount to \$2.8b USD ([www.thecable.nigerianmonitor.com](http://www.thecable.nigerianmonitor.com)). (2) Buhari as Military Head of State: The story of the fifty three (53) suitcases “filled with cash” that his Aide-de-Camp (ADC) then Major Mustapha Jokolo and his soldiers forcefully passed through Muritala Mohammed Airport (MMA) Lagos without security check after Gen Buhari as the Military Head of State announced a change of Nigeria currency and gave an order that all luggage entering or leaving the country borders, seaports and airports should be searched to ensure no currency was being smuggled. However, there seemed to be one rule for all and another for a privileged few as the 53 suitcases forcefully passed through without security checking. According to AtikuAbubakar, Nigeria’s Fourth Republic Vice President and the Controller of Customs as at the time of this incident at MMA Lagos, “he was pressurized by Buhari’s government to deny that the smuggling didn’t take place, but he refused and told the truth” ([therainbowonline.net](http://therainbowonline.net)). (3) Buhari as Petroleum Trust Fund Chairman (PTF): Mismanagement of Twenty Five Billion Seven Hundred and Fifty Eight Million Five Hundred and Thirty two Thousand Four Hundred and Forty Eight Naira (N25,758,532.448).

On July 7th 1999, the then President Obasanjo instituted Petroleum (Special) Trust Fund Interim Report and the report revealed that the committee had advised President Obasanjo to set up a high powered judicial panel to recover the huge public fund and to take necessary action against any officer, consultant or contractor such as the Afri-Project Consortium (APC), a company contracted by the Petroleum Trust Fund (PTF) as management and project consultant that the report indicated that the sum of N25,758,532.448 was mismanaged when Buhari was the Chairman ([www.naij.com](http://www.naij.com)). (4) Buhari’s Certificate Forgery: Nwokocho-Ahaaiwe, an Abuja legal practitioner has charged President Buhari to court for an alleged certificate forgery. He alleged that President Buhari is unqualified to aspire to the office of the President of Federal Republic of Nigeria because President Buhari did not sit for Cambridge West African School Certificate (WASC) in 1961 as claimed.

However, President Buhari’s hiring of the services of twenty three best Senior Advocates of Nigeria (SAN) on this certificate forgery allegation is a proof according to his critics on this subject that indeed, President Buhari has no Cambridge West African School Certificate (WASC) as he claimed thus, has no morality to fight corruption ([www.post-nigeria.com](http://www.post-nigeria.com)). (5) President Buhari

Harboring Corrupt Ministers in His Cabinet: The Lagos State chapter of People's Democratic Party (PDP) has faulted the claims by President Buhari that his Ministers are not corrupt. According to the party, President Buhari was obviously shielding some of his corrupt Ministers because of their financial contributions to his election. They accused President Buhari of pretending to be corruption-free, stating that he should make himself available for live question and answer if indeed he was very confident none of his Ministers are corrupt ([www.informationng.com](http://www.informationng.com)).

The corruption crisis rocking Buhari's ruling party, All Progressives Congress (APC) in recent time seems to be proving Buhari's anti-corruption war critics right. Cases like (6) The Party's National Leader, Senator Bola Ahmed Tinubu's accusation that the National Party Chairman, Chief John Oyegun is corrupt and Oyegun's hitting back at Tinubu, describing his allegation of corruption as personally insulting, reckless and baseless according to This Day (2016) points to the illusion concept of this subject as none has been invited or interrogated as at the time of writing this paper. (7) The confessional statement made by Hon Abdulmumin (Ph.D) of APC, Former Chairman of Appropriation Committee representing the people of Kiru-Bebeji Federal Constituency of Kano State in a press conference after being relieved of his position by his colleagues, stated categorically how the "House of Representative is a den of systemic corruption", (Punch, 2016).

To further proof this, Hon. Abdulmumin listed in the first release how they shared Nigeria money. He confessed in the following order starting with him: (1) Hon Abdulmumin Jubrin got N650 million (2) Speaker Yakubu Dogara got N1.5 billion (3) His Deputy Yusuf Lasun got N800 million (4) House Majority Leader Femi Gbajabiamila got N1.2 billion (5) Deputy Majority Leader Buba Jubrin got N1.2 billion (6) House Whip Alhassan Ado Doguwa got N1.2 billion (7) Deputy House Whip got N700 million (8) House Minority Leader Leo Ogor got N1.2 billion (9) Deputy Minority Leader Onyema got N800 million (10) Minority Whip got N700 million (11) Deputy Minority Whip N700 million, and he concluded by saying that he has documents to back up all these.

This neo overt concept of President Buhari's ruling party-APC bigwigs accusations of each other on corruption in recent time and yet no invitation or arrest has been made by the anti-graft agencies, indeed, shows that Buhari's anti-corruption war is one rule for all and another for the privileged few. However, it is apt at this time to note the Ekpeye ethnic nationality's saying of the Niger Delta Region that "if it smells like a fish and looks like a fish, it is possibly a fish". Thus, this brings us to the questions being asked covertly and overtly by Nigerians, if President Buhari is sincere in his fight against corruption or if the fight against corruption is a vendetta, a reality or an illusion?

### **The Achievements of Buhari's Anti- Corruption Policies**

Accordingly, Liman (2017) stated 5 achievements of Buhari's Anti-Corruption Policies:

- i. Perhaps more than any of his predecessors, President Buhari has consistently and repeatedly stated his government's commitment to fighting corruption. In a country where politicians euphemistically promise to 'carry along' their supporters and give 'juicy appointments' to their



supporters if they 'show gratitude', President Buhari's uncompromising rhetoric sets the right tone.

- i i. President Buhari has mandated all government ministries, departments and agencies to use the TSA under the watchful eye of the Accountant General of the Federation, rather than maintain their own corruption-prone bank accounts. Over the decades, such off the-radar accounts had proliferated uncontrollably, allowing corrupt officials to siphon public funds with ease. President Buhari has likewise pushed for tertiary educational institutions to join the Integrated Payroll and Personnel Information System (IPPIS) that other government entities are already required to use. Improved Financial Centralisation.
- i i i. President Buhari has mostly appointed experienced practitioners to lead Nigeria's anticorruption bodies. EFCC chairman Ibrahim Magu is an experienced anti-corruption law enforcement officer. ICPC chairman BolajiOwasanoye is a policy expert and veteran legal scholar. Nigeria Extractive Industries Transparency Initiative (NEITI) head WaziriAdio—a respected journalist—has also performed well. Such appointments are important because the capacity and effectiveness of government agencies often depend on skill and integrity of their senior staff.
- i v. Although caveats apply to this achievement, President Buhari has recorded more corruption convictions during his tenure than any of his predecessors. The EFCC claims to have secured over 2,000 convictions since 2015. It is important to note, however, that in 2019 alone—it won over half of these convictions due to a sharp increase in successful cybercrime prosecutions. In other words, these laudable gains do not translate into a spike in high-profile corruption convictions under President Buhari, a fact which government press releases touting this achievement fail to mention.
- v. President Buhari's direction, anti-corruption agencies have made the recovery of stolen assets one of their top priorities. They have increasingly used these innovative legal tools to seize suspected proceeds of corruption from former officials who would be difficult and time-consuming to convict. As a result of this strategic shift, more stolen assets are being recovered than ever before. Without greater transparency, however, it will continue to be difficult to assess the quantity and type of assets seized, their final forfeiture status and how they are reallocated. In June 2016, for example, the information minister claimed the Buhari government had seized \$9.1 billion during its first year in office: an astronomical sum that has still to be independently verified.

#### **The Shortcomings and the Weaknesses of Buhari's Anti-Corruption Policies**

Moreover, Samuel (2016) mentioned the 5 weaknesses of Buhari's Anti-Corruption Policies Below:

- i. **Questionable Senior Appointments:** Although President Buhari has appointed some capable technocrats to top jobs, he has also appointed many individuals of questionable integrity to key positions.

- ii. **Failure to Make Petroleum Sector Reform:** President Buhari who is dual-hatted as Minister of Petroleum bears personal responsibility of his government's failure to undertake basic, and long overdue, reforms to the Nigerian National Petroleum Corporation (NNPC). Widely seen as one of the most corrupt and mismanaged national oil companies in the world, the NNPC continues to conceal illicit financial outflows from public or legislative scrutiny, inflate internal administrative budgets and withhold oil revenues from the national treasury.
- iii. **Turning a Blind Eye to Political Corruption:** Under President Buhari's leadership, the APC has demonstrated the same toxic behaviours and corrupt norms that have characterised Nigeria's post-1999 electoral politics. Its modus operandi both in governing and while campaigning is indistinguishable from its predecessor.
- iv. **Tolerating Security Sector Corruption:** Despite President Buhari's promises to curtail it, security sector corruption which was rife under the Jonathan administration persists. Defence and security expenditures continue to escape public and legislative scrutiny, and mostly occur under emergency procurement processes that lack basic anti-corruption safeguards.
- v. **Corruption Prone Economic Policies:** Many of President Buhari's statist economic policies have allowed corruption to undermine his government's efforts to develop power and transportation infrastructure, and to boost trade and investment. His administration has done little to reform the country's anemic power sector which, according to a recent study, lost (N) 11 trillion to corruption between 1999 to 2017.

### The Way Forward

- i. The war against corruption should be holistic and transparent. Nigeria requires good and virtuous leaders who are men of proven integrity. Leaders who are disciplined, honest and trustworthy.
- ii. The agencies of the anti-graft should ensure the immediate prosecution of people who are involved in corrupt practices. There should be no sacred cows and prosecution should not be on "one rule for all and another for the privileged few".
- iii. The government should fund the agencies adequately so that they can carry out the processes of prosecuting culprits without hindrances
- iv. The income of every public official should be thoroughly scrutinized by the code of conduct Bureau before and after office to avoid falsification of claims.
- v. There should be a special court for prosecuting people involved in corruption charges. This will reduce the cumbersome and delayed processes of the conventional court.
- vi. Capital punishment should be clearly spelt out for offenders as it is obtained in other developed countries. Possibly death or life imprisonment should be meted as in the case of China and most Asian countries.
- vii. The anti-graft staffs and the Nigerian police officers should be trained and equipped to carry out investigations without compromise
- viii. The public servants should be well remunerated and motivated with improved staff welfare packages to have job satisfaction

- ix. The Federal Government should endeavour to create employment opportunities to reduce the rate of unemployment and crime in the society.
- x. The Federal Government should jail past corrupt leaders to serve as deterrence to others. This will infuse fear in the system and reduce the act and science of corruption in Nigerian government and politics.

### Conclusion

President Buhari's fight against corruption in Nigeria should not be a mere rhetoric as corruption is a cankerworm that has eating deep into the fabrics of the Nigerian society and endemic, ravaging the nation's economy. The causes of corruption are from various institutional and political factors stemming from the flawed structure and monopoly of the economy by the federal government. Its effects on the nation's socio-political and economic development are numerous and devastating. It has damaged the image of the country abroad to the extent that Nigeria is tagged as one of the most corrupt countries in the world and made stunted the democratic growth and development of the country. This has discouraged foreign investors and caused inflation and the depreciation of our currency. On a final note, the fight against corruption in Nigeria by the Buhari administration is being encouraging indeed; but it should be holistic and transparent, not targeting only a section of the country, a particular political party members and or his passive enemies if he wants Nigerians to believe and have faith in his war against corruption.

### REFERENCES

- Abiodun, A. (2015). Diversion of Ebola Fight Fund upto \$1.96 Billion Naira. "N1.9bn Ebola Fund Scan: Ministry Staff Stop Arrest of Officials". Punch.
- Adekunle, F. (1991). Illustrations of Types, Patterns, and Avenues of Corruption in Nigeria: A Typology"
- Kalu A. W. et.al (1991). Perspectives on Corruption and Other Economic Crimes in Nigeria, Lagos. Federal Ministry of Justice.
- Akambi, M. M. A. (2001). "The Effect of Transparency and Accountability on Nigerian Socio-Economic Development" A Paper Presented at the Maiden Lecture of the Polytechnic, Lecture series, Federal Polytechnic, Bauchi. All Progressive Congress (APC) Constitution of 2013, Item No. 4.
- Bagshaw, B. (2004, Nov; 18th). "Causes of Corruption in Nigeria". Daily Independent.
- Buhari, M. (2015, May, 19th). The Inaugural Speech of President Muhammadu Buhari" at Eagle's Square, Abuja.
- Campuswaka. (2005, July, 5th). Massive Scan in Weapons and Defence Procurement Under the Guise of Fighting Boko Haram. Campuswaka.
- Chrisman, F. (2016). The Effects of Macrolevel Government Policies on Rural Development and Poverty Alleviation in Nigeria. Ibadan J. Soc. Sci., 1(1): 85-101
- Daily Sun. (2016, April, 11th). The Invasions of Tax by Oil Prospecting Licenses (OPL) and Oil Mining Licenses (OML). Daily Sun.
- Daily Sun (2016, April, 11th). The Alleged Down Payment of N50 Billion for the N1 Trillion Fine Slammed on MTN by The Nigerian Communications Commission (NCC) for a Breach of The Nations Laws on Subscriber Identification Module (SIM) Registration which was Allegedly Diverted by Government Agencies involved.
- Gboyega A (2013). Democracy and Development: The Imperative of Local Governance. An Inaugural Lecture, University of Ibadan, pp 6-7.
- Federal Republic of Nigeria Constitution of 1999, section 23, 88 & 89.

- Federal Republic of Nigeria Constitution of 1960, section 15(5).  
Federal Republic of Nigeria: Offences and Penalties; the Corrupt Practices and other Related Offences Act 2000 of ICPC and 2002 of EFCC.
- Izeze, I. (2015, June, 18th). NEITI discovered \$11.6 Billion USD was Missing from Nigeria LNG Company Dividend Payments. Siteadmin.
- Izeze, I. (2015, June, 18th). Non-Remittance of \$11.63 Billion USD Paid to NNPC on Crude Swaps Due to Subsidy and Domestic Crude Allocation. Siteadmin.
- Izeze, I. (2015). Diversion of 60% of \$1 billion USD Foreign Loans obtained from the Chinese by the Ministry of Finance. Siteadmin.
- Kohlberg L, & Candee, (1984). The Relationship of Moral Judgment to Moral Action. In W. M. Kurtines & J. L. Gewirtz (Eds), *Morality, Moral Behaviour and Moral Development*. New York, Willey.
- NIMASA Fraud Under Investigation by EFCC, Inclusive of Accusation of Funding PDP and Buying a Small Piece of Land for N13 Billion. ([http://www.punch.com/news/efcc\\_quizzes\\_exnimasa\\_dg\\_fraud/](http://www.punch.com/news/efcc_quizzes_exnimasa_dg_fraud/) Retrieved 3rd July 2016.
- Naomi O (2017). Towards an Integrated View of Human Rights. *Hunger Teach Net*, 6(3): 6-7.
- Oronsaye, A. O. (2016), "From Military to Democracy: The Challenges of Government and Development in Nigeria in the 21st Century: A Prognosis" in *International Journal of Governance and Development*, Vol.2 No.1, September.
- Oyebode, A. (2001). An Overview of Corruption in Nigeria" in Ayua, I. A. and Gwobadia, A. (eds) *Political Reforms and Economic Recovery in Nigeria*, Lagos: NIALS.
- Piaget, J. (1983). "Piaget's Theory". In P. Mussen (Ed.) *Handbook of Child Psychology*.
- Premium Times. (2015, August, 8th). "Multimillion Naira Contract Scan Rocks NDDC". NDDC Scans and Multifarious Scan Including N2.7 Billion Worth of Contracts that Does Not Confirm to The Public Procurement Act. Premium Times.
- Premium Times. (2015). ICPC Indicts Okiro-Led PSC, Orders Body to Refund N145 Million. Police Service Commission Scan Investigated By ICPC that Revealed Misappropriation of Over N150 Million Related to Election Trainings. Premium Times.
- Punch. (2015). Okonjo-Iweala Connected with Fresh \$2.2 Million Trouble". Ministry of Finance led by Okonjo-Iweala Hurried Payment of \$2.2 Million USD to Health Ministry Contractor in Disputed Invoices. Punch.
- Punch. (2016). "There is Corruption in House of Reps". Punch.
- Siteadmin. (2014). Diversion of 2.2 Vaccination Medicine Fund by Ministry of Health. "Nigeria's Ministry of Health, Others Mismanaged \$2.2 Million USD Meant for Vaccination of Children – Auditors"

**EFFECT OF DIFFERENT CARBON SOURCES (CORN FLOUR, SORGHUM AND RICE BRAN) ON THE GROWTH PERFORMANCE AND CONDITION INDICES OF THE AFRICAN CATFISH IN BIOFLOC CULTURE SYSTEM.**

**Muhammad Musa Ahmad**

Department of Science Laboratory Technology  
School of Engineering, Science and Technology  
Federal Polytechnic Daura, Katsina State, Nigeria

**Taofik Babatunde Ademoula Ph.D**

Department of Biology  
Faculty of Natural and Applied Sciences  
Umaru Musa Yar'adua University Katsina

**Hassan Haruna**

Department of Science Laboratory Technology  
School of Engineering, Science and Technology  
Federal Polytechnic Daura, Katsina State, Nigeria

**ABSTRACT**

Three different carbon sources (corn flour, rice bran and sorghum) were evaluated for their suitability in biofloc system. A sixty days (60) rearing trial was conducted where 8 circular plastic tanks (100 L) each were used as experimental units for different treatments and the control all in duplicate. Each tank was stocked with 25 African catfish (*Clarias gariepinus*) fingerlings with average body weight of  $8.90 \pm 0.00$  g and were aerated by air electrical aerators. Length and weight of the fishes were monitored weekly and recorded. The use of corn, rice bran, and sorghum as carbon sources in this experiment supported the growth of African catfish in biofloc. After six weeks rearing period, the survival of fish in all treatments was not significantly different ( $p < 0.005$ ); control group (94%); corn treatment (98%), sorghum (90%) and rice bran (96%) (Table 1). Total weight gain was significantly higher ( $p < 0.005$ ) in corn treatments compared to control. Specific growth rate (SGR), showed significantly higher values among the treatments ( $p < 0.05$ ). Corn is recorded to have significantly higher liver weight than the control at ( $p < 0.05$ ) but there is no significant difference between all the treatments (corn, rice bran and sorghum).

**Keywords:** biofloc, carbon source, growth performance, condition indices

**INTRODUCTION**

Fish is considered to be one of the most important sources of food globally to overcome world hunger and provide a reasonable amount of protein for the world growing population (Godfray *et al.*, 2010). For hunger to be completely eliminated in the future, intensive aquaculture production

most been enhanced (FAO, 2016). Conventional farming requires regular exchange rate of water which contains a lot of aquaculture effluent that causes environment pollution and leading to unsustainable fish farming under condition of water shortage (Tidwell, 2012). In order to minimize disadvantages of conventional aquaculture new techniques were introduced to made great advantages (Crab, 2010).

Need for intensive aquaculture to meet the rising demand for various aquatic products. In traditional intensive aquaculture systems, water quality need to be maintained due to higher stocking densities and feed inputs (Akeem *et al.*, 2017). This can increase operational costs, as well as potentially cause harm to the surrounding environment (Akeem *et al.*, 2017). The deterioration of water quality can be minimized, with little to no water exchanges, by using Biofloc Technology (BFT) (Avnimelech, 1999; Avnimelech, 2009; De Schryver *et al.*, 2008; Crab *et al.*, 2012; Akeem *et al.*, 2017).

The Biofloc Technology (BFT) enables growth of phytoplankton, bacteria, zooplanktons and aggregates of dead organic matter and grazers of the bacteria in ponds (Hargreaves, 2013). Organisms' natural production of these food is increased by the addition of carbon sources or fertilizers (Crab *et al.*, 2007; Uddin *et al.*, 2007). The nitrogenous waste generated by the cultivated species more especially ammonium is converted in to bacterial biomass when carbon and nitrogen are well balanced in the culture solution (Schneider *et al.*, 2005). Production of microbial protein take place by the addition of carbohydrates to the pond, and therefore bacterial growth and nitrogen uptake is stimulated through it (Avnimelech, 1999). This promoted nitrogen uptake by bacterial growth reduces the toxic ammonium within a few hours when compared to nitrification which is conventionally used as biofilters that is slow. (Hargreaves, 2006).

The BFT can be successful using different types of organic carbon. The way to go for the BFT is to use carbohydrates. There are many conditions for the selection of the type of carbon source like cost, biodegradability, local availability and efficient bacterial assimilation. Biofloc technology systems include the activation of heterotrophic bacteria by addition of carbon source in the aquaculture ponds. The bacteria consume nitrogen and increase the bacterial population in presence of carbon nitrogen ratio starting from 10:1 (Avnimelech, 1999). Biofloc system has a great advantage having to be nearly zero water exchange system and has no stress on fish due to water exchange (Crab *et al.*, 2012; De Schryver *et al.*, 2008; Nevejan *et al.*, 2018).

Floccing of feed residuals together with bacteria and zooplankton organisms is considered to a secondary feed source that contains highprotein content. Biofloc also contributes to the overall percentage of protein delivered in the feed which results to lower the cost of the feed formula (Khalil *et al.*, 2016; Zidan *et al.*, 2017; El-Husseiny *et al.*, 2017).

Biofloc technology is considered as one of the cost effective and best way of fish management because of its ability to clean the water pollutant in fish ponds, and reduce the food intake of the fishes because it provides additional protein. Its ability to clean the water reduced the risk of infection because the pathogenic organism cannot survive in biofloc system. This research will reveal the potentiality of our native plants as carbon source in bioflock formation, thereby improving fish farming in our locality.

## MATERIALS AND METHODS

### Fish collection and acclimatization

The study was carried out from January – May 2021 at the Biological Garden and Biology Laboratory Department of Biology Faculty of Natural and Applied Sciences. Umaru Musa Yar'adua University, Katsina (UMYU).

African catfish (*Clarias gariepinus*) fingerlings were obtained from Hatchery Department of National Biotechnology Development Agency (NABDA), Yankatako Katsina State of Nigeria. The fish was carried inside Jericane with a small hole on it for cross ventilation for the fish to breathe healthy and transported to the experimental site. The fish was then acclimatized for 10 days. After acclimatization period, 200 African catfish fingerlings with an average body weight of  $8.46 \pm 0.06$  g were randomly distributed in 8 tanks.

### Experimental design

The experimental design was a completely randomized, where three different carbon sources; corn flour, rice bran and sorghum, were examined for their effect on: growth performance and body indices

The Fish were fed according to their body weight 5% twice daily (9:00am and 5:00pm).

### Biofloc set up

Out dour type of biofloc system was adopted and the experiment was done by the use of plastic tanks. All biofloc systems require constant motion to maintain both high oxygen levels and to keep solids from settling. Areas without movement will rapidly lose oxygen and turn into anaerobic zones which release large amounts of ammonia and methane. To prevent this, every tank was connected to a well-planned layout of aerators. Electrical aerator (SB-2) were used. Biofloc systems require up to 6mg of oxygen per Litre per hour. The aerators were installed strategically so that a current is created in the tank.

The carbon sources (Corn, Rice bran and Sorghum) used were purchased from different markets and processed for use in the experiment. For the corn and sorghum; the grains were purchased from Katsina Central Market. The grains were grinded and sieved into powdered form. For the rice bran, it was obtained from Dawanau market in Kano and grinded into foddered form before use.

### Calculation of carbon-nitrogen ratio

The commercial fish feed utilized in this study was bluecrown<sup>(R)</sup> (Crude protein 45%, fat 8.0% crude fibre 2.0%, calcium 1.5% phosphorus 1.1% and sodium 0.3%. The nitrogen was calculated based on the protein content in the feed. The carbon contents in rice brown, corn, and sorghum used in this study were approximately 45%. (Ravi *et al.*, 2018; Arjmandi *et al.*, 2020; Hou *et al.*, 2020)

- Fish feed of 45 % protein was used
- Ideally protein contains 16 % of nitrogen (Ravi *et al.*, 2018)
- If 1kg feed contains  $(450 \times \frac{16}{100}) = 69.75 \approx 70$ g of nitrogen
- Therefore N = 70g

- The amount of carbon in the fish feed is 50%
- So 1kg of feed contains 500g of carbon
- So carbon: nitrogen ratio (C: N) =  $\frac{500g}{70g} = 7.14 \approx 7:1$  (Ravi *et al.*, 2018)

#### Carbon to be added

- C:N ratio of the feed is 7:1
- Required C:N ratio is 15:1 (Recommended by Lima *et al.*, (2015).
- Carbon to be added in order to get the ratio 15:1 = (15 – 7) x 70g of nitrogen
- 8 x 70 = 560g
- Therefore 560 grams of carbon is required to be added for each 1kg of the feed to attain C:N ratio of 15:1

#### % of carbon in carbon sources

- C:N ratio of the feed is 7:1
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Table 3.1: Estimate of corn flour added weekly to attain 15:1 carbon nitrogen ratio in biofloc

Weeks	Average fish weight (g) 25/tank	Amount of feed required (g) for a tank	Fraction of nitrogen in feed used (g)	Fraction of carbon in feed (g)	Fraction of carbon required 15:1 (C:N) (g)	Corn flour to be added (g)
1	10.16	12.70	0.91	6.35	7.49	16.18
2	13.40	16.75	1.21	8.38	9.55	21.44
3	17.02	21.28	1.53	10.90	12.25	27.23
4	25.68	32.10	2.31	16.05	18.49	41.09
5	33.29	41.61	3.00	20.81	23.97	53.26
6	42.21	52.75	3.80	26.38	30.39	67.64
7	52.12	65.15	4.69	32.58	37.53	83.39
8	64.23	80.29	5.78	40.16	46.25	102.77

Table 3.2: Estimate of rice bran added weekly to attain 15:1 carbon nitrogen ratio in biofloc

Weeks	Average fish weight (g) 25/tank	Amount of feed required (g) for a tank	Fraction of nitrogen in feed used (g)	Fraction of carbon in feed (g)	Carbon required (g) 15:1 (C:N)	Rice bran to be added (g)
1	11.16	13.95	1.00	6.98	8.04	17.86
2	12.29	15.36	1.11	7.68	8.85	19.66



3	15.05	18.81	1.35	9.41	10.84	24.08
4	22.69	28.36	2.04	14.18	16.34	36.30
5	29.07	36.34	2.62	18.17	20.93	46.51
6	37.39	46.74	3.37	23.37	26.92	59.82
7	46.97	58.71	4.23	29.3	33.82	75.15
8	57.63	72.04	4.86	36.0	38.90	86.45

Table 3.3: Estimate of Sorghum flour added weekly to attain 15:1 carbon nitrogen ratio in biofloc

Weeks	Average fish weight (g) 25/tank	Amount of feed required (g) for a tank	Fraction of nitrogen in feed used (g)	Fraction of carbon in feed (g)	Carbon required (g) 15:1 (C:N)	Sorghum to be added (g)
1	11.17	13.96	1.01	6.98	8.04	17.87
2	13.19	16.49	1.19	8.25	9.50	21.10
3	14.40	18.00	1.30	9.00	10.37	23.04
4	18.89	23.61	1.70	11.81	13.60	30.22
5	25.28	31.60	2.28	15.80	18.20	40.45
6	34.15	42.69	3.07	21.35	24.59	54.64
7	43.44	54.30	3.91	27.15	31.28	69.50
8	53.92	67.40	4.85	33.7	38.82	86.27

#### Growth performance

- Survival (%) =  $\frac{\text{Number of harvested fish}}{\text{number of stocked fish}} \times 100$
- weight gain (%) =  $\frac{\text{Mean final weight} - \text{mean initial weight}}{\text{mean initial weight}} \times 100$
- Specific growth rate (%/day) =  $\frac{\ln(\text{Final weight} - \text{initial weight})}{\text{number of days}} \times 100$

(Arjmandi *et al.*, 2020)

#### Statistical Analysis

All data was analyzed using IBM SPSS statistics 21. The data was presented in mean  $\pm$  SD. Repeated-measures ANOVA was used to test for significant difference in growth performance of the fish within the experiment period.

## RESULTS

### Growth performance

The use of corn-flour, rice bran, and sorghum flour as carbon sources in this experiment supported the growth of catfish in biofloc. The survival of fish in all treatments did not deviate from that of a control group (94%); corn treatment (98%), sorghum (90%) and rice bran (96%) (Table 1). Total weight gain was significantly higher ( $p < 0.005$ ) in corn treatments compared to control. Specific

growth rate (SGR), showed significantly higher values among the treatments ( $p < 0.05$ ). compared to those of the control (Table 1)

Table 4.1: Survival, Weight Gain and Specific Growth Rate of African Catfish (*Clarias gariepinus*) in Biofloc System Using Three Different Carbon Sources from UMYUK Biological Garden

Carbon sources				
Parameters	Corn	Rice bran	Sorghum	Control
Weight Gain (g)	302.93	261.37	241.13	216.34
Percentage survival (%)	98	96	90	94
Specific Growth Rate (%)	0.059	0.056	0.055	0.053

### Condition indices

After random sampling of all the treatments and control the experiment did not record any significant difference in respect of the gutted weight of the fish. Corn is recorded to have significantly higher liver weight than the control at ( $p < 0.05$ ) but there is no significant difference between all the treatments (corn, rice bran and sorghum). No significant difference was observed in gonad weight among all the treatments and the control

Table 4.5: Gutted weight, liver weight, and gonad weight of African Catfish (*Clarias gariepinus*) in Biofloc System Using Three Different Carbon Sources from UMYUK Biological Garden

Treatments	Total weight (g)		Liver weight (g)	Gonad weight (g)
	Total weight (g)	Gutted weight (g)	(HIS)	(GSI)
Corn	32.71±8.45 <sup>a</sup>	26.73±6.52 <sup>a</sup>	0.61±0.18 <sup>a</sup>	0.36±0.13 <sup>a</sup>
Rice bran	30.98±6.15 <sup>a</sup>	25.37±4.88 <sup>a</sup>	0.53±0.16 <sup>ab</sup>	0.31±0.11 <sup>a</sup>
Sorghum	30.70±4.65 <sup>a</sup>	25.03±4.57 <sup>a</sup>	0.51±0.11 <sup>ab</sup>	0.29±0.09 <sup>a</sup>
Control	31.00±3.53 <sup>a</sup>	24.82±2.22 <sup>a</sup>	0.42±0.11 <sup>b</sup>	0.24±0.56 <sup>a</sup>

Values with same superscript along the raw have no significant difference at ( $p < 0.05$ )

### DISCUSSION

In this study, three commonly available carbon sources: corn flour, rice bran and sorghum flour were used to evaluate their potential in biofloc formation. The BFT may be considered to be a sustainable method to maintain water quality within an acceptable range for fish or shrimp species (Boyd and Zimmerman, 2000). The accumulation of high level of toxic ammonia and nitrate resulting to the low survival rates or decreased growth can be prevented and therefore, BFT make it possible to increase survival level and growth at zero water exchange or minimal low water replacement rates, and a potential additional natural food resource is provided, more specifically in the form of bioflocs (Mallasenand Valenti, 2006; Asaduzzaman *et al.*, 2008). Present study confirmed these statements with the lower survival rate (94%) in control, because, it did not receive

any addition of carbon and hence, biofloc formation was limited or virtually absent. Increased survival rate in all other biofloc tanks were observed. Among biofloc tanks, corn flour added tank showed 98% survival rate which was highest among all tanks.

Carbon source significantly influence the nutritional composition of the bioflocs, and that could also be observed when looking at survival. The ability to both ingest and digest the biofloc determine the nutritional value of the bioflocs. Feed digestibility is generally less in the larval stages while the survival is measured in the post larval stage (Das *et al.*, 2007). However, the present study confirmed all the carbon sources which were used had higher survival than control and the growth rate was higher in corn flour treatment (98%), so, this indicates that; the digestibility of the corn flour tank biofloc was higher than other carbon sources bioflocs. The rice bran and sorghum bioflocs showed lesser digestibility. So, these biofloc fed animals showed a low survival when compared to corn treatment.

### Conclusion

The result of this research showed that cornflour and sorghum could be used as the carbon source in the biofloc system for *C. gariepinus* with significant effect on the, survival and growth of the fish. The result also shows that the carbon sources used have no significantly effect on the condition indices of the fish. Further research to degrade the lignin in rice bran through fermentation could boost its carbon release for use in biofloc technology.

### REFERENCES

- Akeem, B., Nicholas, R., Mahdi, E., Murni, K., Ikhsan, N., Mohd, S. K., and Julie, E., (2017) Different carbon sources affects biofloc volume, water quality and the survival and physiology of African catfish *Clarias gariepinus* fingerlings reared in an intensive biofloc technology system *Fish Science* (2017) 83:1037–1048
- Arjmandi A., Peyravi M., Arjmandi M., Altaee A. (2020). Exploring the use of cheap natural raw materials to reduce the internal concentration polarization in thin-film composite forward osmosis membranes. *Chemical Engineering Journal*, Volume 398.
- Asaduzzaman, M., M.A. Wahab, M.C.J. Verdegem, S. Huque, M.A. Salam and M.E. Azim, (2008). C/N ratio control and substrate addition for periphyton development jointly enhance freshwater prawn *Macrobrachium rosenbergii* production in ponds. *Aquaculture*, 280: 117-123.
- Avnimelech Y., (1999) Carbon/nitrogen ratio as a control element in aquaculture systems. *Aquaculture* 176(3-4):227-235.
- Avnimelech Y., and Kochba M., (2009). Evaluation of nitrogen uptake and excretion by tilapia in bio floc tanks, using 15N tracing. *Aquaculture* 287(1-2):163-168.
- Boyd, C. and S. Zimmerman, (2000). Grow-Out Systems-Water Quality and Soil Management. In: *Freshwater Prawn Culture-The Farming of Macrobrachium rosenbergii*, New, M.B. and W.C. Valenti (Ed.). Blackwell Science, Oxford, UK., pp: 221-238.
- Crab R, Defoirdt T, Bossier P, Verstraete W (2012). Biofloc technology in aquaculture: beneficial effects and future challenges. *Aquaculture*, 356: 351–356.
- Crab R., 2010 Bioflocs technology: an integrated system for the removal of nutrients and simultaneous production of feed in aquaculture. *Doctoral dissertation*, Faculty of Bioscience Engineering, Ghent University, 178 pp.

- Das, S.K., V.K. Tiwari, G. Venkateshwarlu, A.K. Reddy, J. Parhi, P. Sharma and J.K. Chettri, (2007). Growth, survival and fatty acid composition of *Macrobrachium rosenbergii* (de Man, 1879) post larvae fed HUFA-enriched *Moina micrura*. *Aquaculture*, 269: 464-475
- De Schryver P., Crab R., Defoirdt T., Boon N. and Verstraete W. (2008). The basics of bio-flocs technology: the added value for aquaculture. *Aquaculture*, 277: 125-137.
- El-Husseiny O. M., Wassef E. A., Aboseif A. M., Suloma A., 2017 Manipulating diet composition to develop and maintain the zooplankton for Nile tilapia under biofloc condition. *African Journal of Biological Sciences* 13(1):147-154.
- FAO (2016) Fisheries and Aquaculture Department. Cultured Aquatic Species Information Programme: *Clarias gariepinus*. [http://www.fao.org/fishery/culturedspecies/Claria\\_gariepinus/en](http://www.fao.org/fishery/culturedspecies/Claria_gariepinus/en). Accessed May 2019.
- Godfray H. C., Beddington J. R., Crute I. R., Haddad L., Lawrence D., Muir J. F., Pretty J., Robinson S., Thomas S. M., Toulmin C., 2010 Food security: the challenge of feeding 9 billion people. *Science* 327(5967):812-818
- Hou T., Zhao J., Lei Z., Shimizu K., Zhang Z. (2020). Synergistic effects of rice straw and rice bran on enhanced methane production and process stability of anaerobic digestion of food waste Bioresource Technology, Volume 314,
- Khalil M. T., Mohamed R. A. R., El-Deeb R., Suloma A., Abd-alatty B. S., Henish S. A., (2016). Eco-friendly cultivation of Keeled mullet (*Liza carinata*) in biofloc system. *Egyptian Journal of Aquatic Biology and Fisheries* 20(2):23-35.
- Mallasen, M. and Valenti W.C. (2006). Effect of nitrite on larval development of giant river prawn *Macrobrachium rosenbergii*. *Aquaculture*, 261: 1292-1298.
- Nevejan N., De Schryver P., Wille M., Dierckens K., Baruah K., Van Stappen G., (2018). Bacteria as food in aquaculture: do they make a difference? *Reviews in Aquaculture* 10(1):180-212.
- Schneider, O., V. Sereti, E.H. Eding and J.A.J. Verreth, (2005). Analysis of nutrient flows in integrated intensive aquaculture systems. *Aquaculture Engineering*, 32: 379-401
- Uddin, M.S., A. Farzana, M.K. Fatema, M.E. Azim, M.A. Wahab and M.C.J. Verdegem, 2007. Technical evaluation of tilapia (*Oreochromis niloticus*) monoculture and tilapia-prawn (*Macrobrachium rosenbergii*) polyculture in earthen ponds with or without substrates for periphyton development. *Aquaculture*, 269: 232-240.
- Zidan A. E. N. F. A., Mola H. R. A., El-Husseiny O. M., Suloma A., Mabroke R. S., (2017). Inclusion of biofloc meal in tilapia diets and its effect on the structure of zooplankton community under biofloc system condition. *Journal of Egyptian Academic Society for Environmental Development* 18(1):47-57.

**A REVIEW ON INDUSTRIAL APPLICATIONS OF ZINC OXIDE NANOPARTICLES****Garba Danjumma Sani**Department of Sciences,  
School of Applied Sciences,  
Kebbi State Polytechnic Dakingari**Abubakar Yakubu**Department of Physics,  
Faculty of Physical Sciences,  
Kebbi State University of Science and Technology, Aliero,  
Kebbi State, Nigeria.**Aliyu Saidu**Department of Sciences,  
School of Applied Sciences,  
Kebbi State Polytechnic Dakingari**Rilwanu Aati**Department of Sciences,  
School of Applied Sciences,  
Kebbi State Polytechnic Dakingari**Suleiman Sahabi**Department of Sciences,  
School of Applied Sciences,  
Kebbi State Polytechnic Dakingari**Sirajo Abdullahi**Department of Sciences,  
School of Applied Sciences,  
Kebbi State Polytechnic Dakingari**Abstract**

Nanotechnology research has gained much attention in recent years as it provides innovative solutions in the field of biomedicine, material science, optics and electronics. Nanostructured ZnO materials have received broad attention due to their excellent performance in electronics, optics and photonics, optoelectronics, sensors, transducers and biomedical sciences. It is a wide band-gap compound semiconductor that is suitable for short wavelength optoelectronic applications. ZnO nanoparticles are non-biotoxic materials with photo-catalysis and photo-oxidising properties on biological species. ZnO is costless, environmentally friendly with significant physical and chemical stabilities. It is one of the most important metal oxide nanoparticles and one of the most widely used nanoparticles. ZnO NPs are popularly employed in various fields due to their peculiar physical and chemical properties. In this paper, industrial applications of ZnO NPs are highlighted, focusing on the recent progress in research to realize its feasibility in these applications. However, further intensive research on better understanding of the relationship between size, shape and

structure of zinc oxide nanoparticles, and how one can tune its capability for various industrial applications is highly recommended.

**Keywords:** Zinc Oxide, Semiconductors, Piezoelectric devices, Gas sensors, solar cells

## INTRODUCTION

Nanostructured ZnO materials have received broad attention due to their distinguished performance in electronics, optics and photonics, optoelectronics, sensors, transducers and biomedical sciences. From the 1960s, synthesis of ZnO thin films has been an active field because of their applications as sensors, transducers and catalysts. ZnO is a key technological material. The lack of a centre of symmetry in wurtzite, combined with large electromechanical coupling, results in strong piezoelectric and pyroelectric properties and the consequent use of ZnO in mechanical actuators and piezoelectric sensors. In addition, ZnO is a wide band-gap compound semiconductor that is suitable for short wavelength optoelectronic applications. The high excited binding energy (60meV) in ZnO crystal can ensure efficient excitonic emission at room temperature. ZnO is transparent to visible light and can be made highly conductive by doping. ZnO is a versatile functional material that has a diverse group of growth morphologies, such as nanocombs, nanorings, nanohelices, nanosprings, nanobelts, nanowires and nanocages (Zhong, 2004).

Zhiyong and Jia (2005), noted that, ZnO offers tremendous potential in future applications of electronic, optoelectronic, and magnetoelectronic devices. Agnieszka and Teofil (2014), Confirmed that, Zinc oxide has applications in various branches of industry: rubber, pharmaceutical, cosmetics, textile, electronic and electrotechnology, photocatalysis. Dušan and Petar (2010), noted some advantages of ZnO as low price, good gas sensing properties, photocatalytic activity, antibacterial activity, possibility to prepare structures with interesting optical properties, like photonic crystals, catalytic materials, in small amounts as ZnO is non- toxic. ZnO is odourless and white solid in appearance, with a band gap of 3.3 eV, 1975°C melting point and a density of 5.606 g/cm<sup>3</sup>. The wurtzite structure is the most stable at environmental conditions and thus the most common structure of ZnO as shown in figure 1.

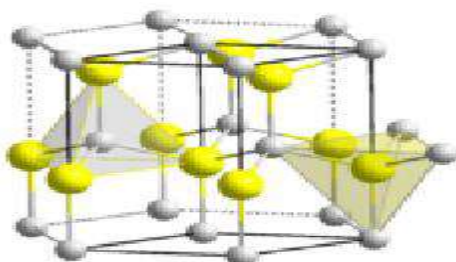


Figure 1: ZnO Wurtzite Structure (Prateek & Kirti, 2016)

## PREPARATION

There are different methods of ZnO nanostructures preparation, like MOVPE, high temperature evaporation, gas spraying, pulsed laser deposition, sputtering, sol-gel, wet chemical,

electrochemical methods (Dusan & Peter, 2010), precipitation method, vapour transport method, hydrothermal process (Sidra, *et al.* 2014), metal-organic, chemical vapour deposition, pulsed laser deposition and chemical vapour transport (Prateek & Kirti, 2016).

### SEMICONDUCTORS

ZnO remains a promising material for electronic and optoelectronic device applications, despite the difficulties in achieving p-type conductivity. The difference between the current surge to turn ZnO into a functional semiconductor and past attempts is the availability of better thin-film growth techniques (Anderson & Chris, 2009). ZnO substrates have higher quality and experience has been gained from research on III-nitrides, which posed similar difficulties with respect to controlling the conductivity (Anderson & Chris, 2009). Bedia *et al.* (2014) reports the experimental and the electrical junction properties analysis of current–voltage characteristics of n-ZnO/p-Si heterostructures and reported that Zinc oxide semiconductor presents n-type conductivity and with lowest resistivity. The measured current–voltage (I–V) of the p–n heterostructure show nonlinear diode like behaviour. It also shows great photoelectric effect under power (160W) lamp illuminate. The solar cell exhibited a short-circuit current density of  $4 \times 10^{-3}$  mA, an open-circuit voltage of 6mV.

A composite containing 10% ZnO with 7% Al displayed a dielectric constant of 18.5 at 100 Hz, twice when compared with the pure ZnO/PVDF (polyvinylidene fluoride) composites. This phenomenon was attributed to ZnO semiconducting properties which can significantly improve the conductive nature of the materials (Ju *et al.*, 2016). Juan *et al.* (2018). reported the successful fabrication of new heterojunction of two 2D hybrid ZnO(SA)/V<sub>2</sub>O<sub>5</sub>(HDA) semiconductors exhibited an improved photocatalytic activity than the pristine zinc oxide in the degradation of methylene blue under visible light.

### LIGHT EMITTING DIODE

LED is an acronym that stands for light emitting diode. It is a semiconductor diode that emits light when voltage is applied to it and that is used especially in electronic devices as an indicator light. White light emitting diodes play an important role in applications, such as in displays, general lighting and automobile headlights (Vivek and Kantisara, 2019). The materials for light-emitting diodes in the visible spectrum (400 - 700 nm) are semiconductors with band gaps between 1.8 and 3.1 eV, with  $E_g$  (eV) =  $hc / \lambda$  (nm) (Srikant & Clarke, 1998) and ZnO with band gap of 3.1 eV at room temperature falls within the range. This is the reason why the most common application of ZnO is in Laser and LED.

Jiangyong *et al.* (2015), designed and fabricated a flexible red-emitting quantum dot light emitting diodes (QLEDs) on indium tin oxide/poly(ethylene-terephthalate (ITO/PET) substrates using ZnO NPs as an electron transfer layer (ETL), which display a low turn on voltage of 1.60 V and high current and power efficiencies of 5.20 cd A<sup>-1</sup> and 1.80 lm W<sup>-1</sup>, respectively. They reported that, the superior performance is as a result of the higher electron mobility of ZnO NPs. Prateek and Kirti (2016) also confirmed that Zinc Oxide (ZnO) nanostructures are perfect photoelectric diode.

Mustapha *et al.* (2018), investigated the optical behaviour of pure and blended conjugated copolymers with added ZnO nanoparticles and confirmed that the addition of ZnO nanoparticles has greatly improved the fluorescence optical properties. Vivek and Kantisara (2019), developed a method to determine the concentration of  $\text{Eu}^{3+}$  ions and  $\text{Tb}^{3+}$  ions (Europium and Terbium) in a thin-film sample of  $\text{SiO}_2$  co-doped with ZnO-np to produce a white light emitting material. An emission of white light was observed which was attributed to the energy transfer from the excited ZnO-np to the rare-earth (RE) ions.

### **GAS SENSORS**

Fan and Lu, (2005) in Umit, (2010) declared that, one of the most important parameters of gas sensors is their selectivity and this selectivity is achieved by applying different voltages to the gate of a nanowire FET or by performing measurements at different temperatures since different gas molecules have different activation energies. Wang *et al.* (2006), observed the high response and good selectivity of ZnO nanorods to low concentrations of  $\text{H}_2\text{S}$  and concluded that, the nanorods are promising candidates for detecting extremely low concentrations of  $\text{H}_2\text{S}$ . Umit (2010), stressed that ZnO nanowires have a potential for detecting  $\text{NO}_2$ ,  $\text{NH}_3$ ,  $\text{NH}_4$ ,  $\text{CO}$ ,  $\text{H}_2$ ,  $\text{H}_2\text{O}$ ,  $\text{O}_3$ ,  $\text{H}_2\text{S}$  and  $\text{C}_2\text{H}_5\text{OH}$  gases. Hassan *et al.* (2015), constructed a novel structures of Nanomaterials gas sensors array using ZnO, and ZnO doped with Al via sol-gel technique with the aim of assessing its gas sensing ability. The highest sensitivity values for both double and quadrature gas sensor devices established for  $\text{H}_2$  gas was observed at Zn:Sb=95:5 weight ratio.

Zhezhe *et al.* (2017), after successfully synthesis and characterization of high crystalline ZnO nanoparticles recommended the nanoparticles a promising gas sensor for n-butanol. Sanaz *et al.* (2017), synthesized Indium doped ZnO and ZnO nanoparticles and subjected it to gas sensing measurement whose result showed indium dopant ions improving the gas sensitivity of ZnO for high acetone concentrations effectively. They therefore, suggested that the IZO tablet can act as reliable and low cost gas sensor for acetone detection. Fatemeh *et al.* (2018), reported that pristine ZnO NPs displayed a high response to hydrogen at a low concentration in air but with poor selectivity

### **BIOSENSORS**

Biosensor development is receiving much attention nowadays as it intersects the biological and engineering sciences. Biosensors are analytical devices that comprise a biological recognition element and a suitable transducer which are usually coupled to an appropriate data processing system (fig. 2) (Inbasekaran, *et al.*, 2014). The potential of ZnO nanostructures as nanosized biosensors for detecting different biological molecules has also been explored and reported though in limited number. As in the case of gas sensors, the principle of operation is that the conductance of ZnO nanorod FETs drastically changes when biomolecules are adsorbed. The key factor in most biological processes is the need for a small change of the pH concentration created by the release of  $\text{H}^+$  ions during biochemical reactions (Umit, 2010).



Ali *et al.* (2016), used modified carbon paste electrode (CPE) with zinc oxide (ZnO) nanoparticles for designing a glucose oxidase enzymatic biosensor for investigation of its electrochemical behavior, and determination of glucose concentration. The designed GOD/ZnO/CPE electrochemical biosensor showed high stability and efficiency for glucose sensing. Yuhong *et al.* (2016), synthesized ZnO nanoparticles via a green biochemical method using *Corymbia citriodora* leaf extract as a reducing and stabilizing agent. The electrochemical sensor showed excellent detection performance towards trace amounts of  $H_2O_2$ , demonstrating that it could potentially be used in clinical applications.

Muhammad *et al.* (2019) investigated the biosensing performances of ZnO nanostructures with different dimensions (0-D, 1-D, 2-D and 3-D ZnO). They confirmed that, 0-D ZnO nanostructures had been used widely due to its ease of fabrication before 1-D, 2-D, and 3-D nanostructures were developed. However, the focus turned towards 1-D ZnO because of the issues with low mobility faced in 0-D nanostructures. The vertical and lateral 1-D ZnO-based FET biosensor nanostructures are also proven to enhance the performance of biosensors. As research in the nanotechnology is receiving great attention, the improvement of 0-D ZnO-based electrochemical biosensor nanostructures is reported to be positive form different researchers. Meanwhile, 2-D ZnO nanostructures were also proven to tune the sensing performance of biosensors.

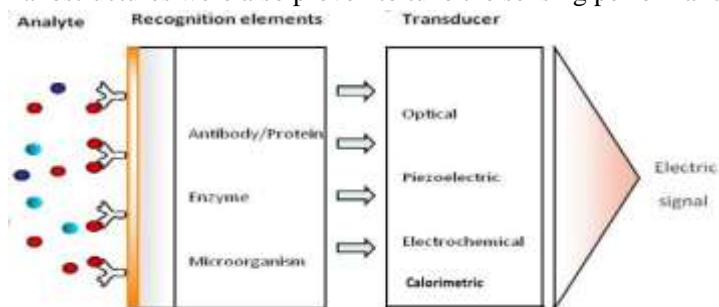


Fig.2. Schematic diagram of a biosensor (Inbasekaran, *et al.*, 2014).

## BIOMEDICINE

Biomedical nanomaterials have received more concerns because of their prominent biological characteristics and biomedical applications (Jinhuan *et al.*, 2018). Nowadays, microbial infection became an overwhelming issue globally as they are significant in causes of morbidity and mortality because of the development of resistant strains of a virus, bacteria, pathogenic fungi, protozoa and they can survive the clinical treatment with the antibiotic, antifungal, antiviral, antiprotozoal drugs (Yah & Simate, 2015). Sperling *et al.* (2008) stated that, in present days as an antibacterial agent Nanoparticles are used because they are found to be highly effective and therefore acquire much attention. These nanoparticles satisfy the requirements where antibiotics fail to prevent the development of Multi-Drug Resistant (MDR) mutants.

ZnO NPs have become one of the most popular metal oxide nanoparticles in biological applications due to their excellent biocompatibility, economic and low toxicity. It has emerged a promising potential in biomedicine, especially in anticancer and antibacterial fields (Jinhuan *et al.*, 2018).

Sumon and Tamalika (2018), noted that, Silver (Ag) and Zinc Oxide (ZnO) are two metallic nanoparticles that can be synthesized with the help of plant extract and have the antibacterial activities which are exploited to cure several diseases, caused by Multi-Drug Resistant (MDR) bacteria. These two particles have excessive potential to inhibit MDR bacteria. Mohammad *et al.* (2010), reported that, application of ZnO nanoparticles in the biological realm requires high quality ZnO nanoparticles in aqueous solution at neutral pH and physiological temperature as biomolecules are very sensitive to changes in the parameters. Omkar (nd), used different sized synthesized zinc oxide nanoparticles to study the antimicrobial activity against *Escherichia coli*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*. The result showed that the antimicrobial activity increased with the decrease of the size of the nanoparticles.

### **PIEZOELECTRIC DEVICES**

Due to its moderately high (very high for a semiconductor) electromechanical coupling coefficients, ZnO has been successfully used in thin film piezoelectric devices such as bulk acoustic wave and surface acoustic wave (SAW) resonators, filters, sensors and microelectromechanical systems (MEMS). The most common application being the SAW filter, which has been an important component in mass consumer items such as TV filters and wireless communications systems (Umit, 2010).

Zhong and Jinhui (2006) successfully converted nanoscale mechanical energy into electrical energy by means of piezoelectric zinc oxide nanowire (NW) arrays. The efficiency of the NW-based piezoelectric power generator was estimated to be 17 to 30%. Li *et al.* (2011) stated that under varying applied elastic loads (ZnO deposition on Si substrates with sputtered Pt film), the decrease of transverse electrical conductivity at higher loads is attributed to the depletion zone formation induced by local piezoelectric effect in ZnO.

Nour *et al.* (2014) successfully grown high-quality single crystalline zinc oxide nanowires on silver and gold coated plastic substrates using the aqueous chemical growth method for the fabrication of a sandwich-like nanogenerator. The harvested electrical output under mechanical deformation demonstrated the applicability of this configuration as a nanogenerator. They concluded that more piezoelectric potential can be harvested by using two arrays of ZnO NWs placed face-to-face than by using a single nanowire configuration.

Denishev (2016), emphasized that, the Lead Zirconate Titanate (PZT) and Zinc oxide (ZnO) based thin film devices can be used as piezoelectric stress sensors, energy harvesters and piezoelectric transformers. Depending on the electrodes configuration, piezoelectric sensor structures, using sputtered PZT layers, operate in different ranges of the applied stress. Using of flexible Polyethyleneterephthalate (PET) substrate provides higher elasticity of the piezostructure, which increases the voltage generation, even at lower mechanical loading and makes the energy harvesting devices more sensitive and effective.

### **MICROWAVE ABSORBERS**

ZnO nanotrees and its paraffin composites have good effect on microwave absorption. The microwave attenuation of ZnO nanotree composite with the volume ratio of 60% is as high as 58

dB at the frequency of 4.2 GHz with a thickness of 4.0 mm as stated by Zhuo *et al.*, (2008). Pre-mixed NiZn ferrite/MWNT, according to the weight ratio 1:1, were incorporated into the thermoplastic natural rubber nanocomposite by melt blending process. It was found that both reflection loss (RL) and shielding effectiveness (SE) depend on the filler content. The effect of fillers mixing ratio were investigated too. Results showed samples with higher MWNT content exhibits better shielding effectiveness, while samples with higher NiZn ferrite achieved better reflection loss (Yu, et al. 2012). The essential properties of polymer-based composites can be modified by varying the amount of Zn/Al-NO<sub>3</sub> layered double hydroxide (LDH) added to polyvinyl chloride (PVC). The results indicate that these composites show great potential for use as microwave absorbers at low microwave frequencies (Ethar *et al.*, 2014).

Xiaodong *et al.* (2018) synthesized Fe<sub>3</sub>O<sub>4</sub>/ZnO core-shell nanocomposites through a chemical method of coating the magnetic core (Fe<sub>3</sub>O<sub>4</sub>) with ZnO by co-precipitation of Fe<sub>3</sub>O<sub>4</sub> with zinc acetate in a basic medium of ammonium hydroxide. The electromagnetic parameters of the Fe<sub>3</sub>O<sub>4</sub>/ZnO core-shell nanocomposites were investigated. It was observed that, Fe<sub>3</sub>O<sub>4</sub>/ZnO nanocomposites exhibited an enhanced absorption capacity in comparison with the naked Fe<sub>3</sub>O<sub>4</sub> nanospheres. It is therefore expected that the Fe<sub>3</sub>O<sub>4</sub>/ZnO core-shell structured nanocomposites could be a promising candidate as high-performance microwave absorbers.

## SOLAR CELLS

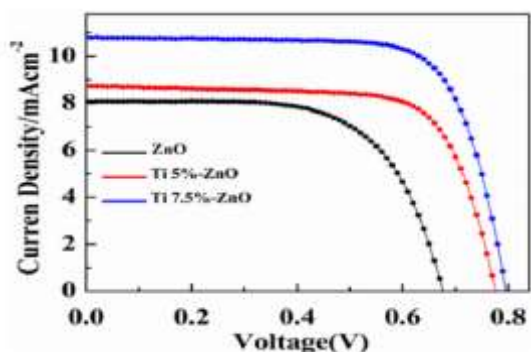
ZnO is an attractive material for applications in electronics, photonics, acoustics and sensing. In optical emitters, its high binding energy (60 meV) gives it an edge over other semiconductors such as GaN if reproducible and reliable p-type doping in ZnO were to be achieved, which currently remains to be the main obstacle for realization of bipolar devices (Umit, 2010).

Lai *et al.* (2011) presents a new structure for nanorod DSSCs. ZnO nanorods and a ZnO film were grown using a one-step chemical-vapor deposition method. The ZnO film functioned as the TCO of the DSSC. The ZnO nanorod/ZnO film structure was sensitized with D149 or N719 dye and assembled into a DSSC. Two notable features in this new DSSC structure are: (1) the junction between the TCO film and the nanorods is completely eliminated; (2) the TCO and the photoelectrode are made of the same material. Testing showed that under AM1.5 illumination, a short current density of 15.7 mA/cm<sup>2</sup> and a power conversion efficiency  $\eta$  of 1.82% can be achieved. The  $\eta$  is more than two times higher than the  $\eta$  reported earlier for ZnO-nanorod DSSCs with the same structure. Zinc Oxide thin films are formed by electrodeposition of Zinc Nitrate. Their structural and optical characteristics were confirmed using UV-VIS absorption and emission. Their photoconductive performance was verified which makes them promising candidates for Solar Cells (Sathya *et al.*, 2012).

Yuancheng (2015) has reviewed the research progress in ZnO Nanowires and their application for solar cells. He found that, a number of methods have been employed to achieve ZnO nanostructured arrays and several attempts have been made to use ZnO in solar cells. In his opinion, the quality and stability of the ZnO nanowires need to be further improved and the techniques used in fabricating these solar cells need to be optimized. Once these milestones are achieved, the ZnO

nanowire arrays have great potential in improving the performance of solar cells. Vanja *et al.* (2018) electrodeposited ZnO thin films to study the effects of different potentials applied during deposition. ZnO photoanodes were synthesized through electrodeposition at the potentials of -1.0 V (film A), -1.2 V (film B) and -1.4 V (film C). DSSCs were assembled and the photovoltaic parameters were obtained through J-V plots. DSSC with 0.031% of efficiency was demonstrated at -1.4 V of deposition potential.

Mati *et al.* (2019) reported on an efficient dye-sensitized mesoporous photoanode of Ti doped zinc oxide (Ti-ZnO) through a facile hydrothermal method. It was observed that Ti-ZnO nanoparticles with a high surface area of  $131.85 \text{ m}^2$  and a controlled band gap, exhibited considerably increased light harvesting efficiency, dye loading capability, and achieved comparable solar cell performance at a typical nanocrystalline ZnO photoanode (figure 3).



**Fig. 3. :** I-V curves of ZnO, Ti(5%)-ZnO and Ti(7.5%)-ZnO nanoparticles based DSSCs, in both the active area is 0.25 and under (AM 1.5,  $100 \text{ mW/cm}^2$ ) illumination.

Babatunde *et al.* (2019) successfully deposited ZnS thin films on the glass substrate using a chemical bath deposition method. The effect of deposition time on optical and morphological characteristics of the films was investigated. The optical result

shows the films have high transmittance, low reflectance in the visible region and also high optical band gap energy from 3.6 eV to 3.8 eV as the time of deposition increases.

## COSMETICS

ZnO nanoparticles also exhibit tremendous UV-blocking properties. Generally, sunlight consists of three types of UV radiation, i.e., UV-A (320–400 nm), UV-B (290–320 nm), and UV-C (250–290 nm). UV-A radiation is the main concern as it contributes ~95% of the total sunlight radiation. UV-B radiation contributes ~5%, and UV-C radiation has no prominent effect, as it is absorbed by ozone at the surface of the Earth (Airhurst & Mitchnick, 1997). UV-A radiation is considered more dangerous than UV-B, because it is ~100 times more intense than UV-B and can penetrate deeper into the dermis area of the skin. In the view of the abovementioned UV radiation values, it is important to block such types of harmful radiation, as exposure causes skin cancer in humans. Generally, to protect the skin, materials having UV-blocking properties are added to cosmetic formulations. For the protection of skin from UV-A radiation, ZnO nanoparticles provided an effective UV-blocking material.  $\text{TiO}_2$  is also used as a UV-blocking material but reported to be less effective than ZnO because ZnO nanoparticles effectively absorb UV-A radiation rather than scatter it, while  $\text{TiO}_2$  usually scatters these wavelengths (Muhammad *et al.*, 2010).

Varsha *et al.* (2013) reported that the ZnO particles can serve as an excellent material for the removal of Cd(II) from effluents. ZnO nanoparticles used in cosmetic applications also require non-photo catalytic activity, which can be hindered by the uniform surface coating of ZnO nanoparticles by silica or other molecules and toxicity to the human skin is also a main concern. According to Lu *et al.* (2015) ZnO and TiO<sub>2</sub> NPs can help to prevent skin irritation as well as disruption of the endocrine system typically induced by chemical UV filter. Therapeutic Goods Administration (2016) declared that neither TiO<sub>2</sub> nor ZnO NPs are likely to cause harm when used as ingredients in sunscreens. The current state of knowledge strongly indicates that the minor risks potentially associated with the NPs in sunscreens are vastly outweighed by the benefits that the NP-containing sunscreens afford against skin damage and, importantly, skin cancer.

### PAINTS

Paint is a substance that is applied as a liquid or paste and dries into a solid coating that protects or adds colour to a surface to which it has been applied. Nano coatings are polymer-nano composite materials made of resin, solvents, pigments and additives, produced by dispersing nano pigments in resin media at the nano scale to form a denser product, which give a solid film on substrate surface after application. Coatings of wood surface with paint, varnish and modification with other chemicals improve the durability of wood surface against UV irradiation and weathering factors (Weichelt *et al.* 2011). The applications of suitable nanoparticles within compatible ratio in paint formulations carry many advantages and opportunities to paint and coating industries. Coating industry is one of the first among all to utilize the potential of nanotechnology (Raymond, 2009). Dispersed TiO<sub>2</sub> and ZnO particles are excellent UV filters, and are sometimes referred to as mineral or physical filters. Both are commonly used as white pigments (titanium white and zinc white). Ultrafine TiO<sub>2</sub> and ZnO particles lose their capability to scatter visible light, but retain the ability to absorb UV light (Kurapati, 2018). ZnO and TiO<sub>2</sub> are used for improving wood surfaces against UV radiation, water, mildew, fungus growth, stains and grease. ZnO NPs has been used for a long time as a UV stabilizer and preservative component in wood coatings (Vlad-Cristea *et al.* 2012). Nanoparticles of ZnO have the ability to offer UV protection to coatings so it was low discoloration than from the use of only nano-ZnO (Ahmet & Husseyin, 2014).

### FERTILIZER

Despite a reasonable number of reports on the endangering nature of some nanoparticles, nanotechnology remains in the frontline as the alternative to revamp the agricultural sector for the better. Its advantages are greater than those of nuclear energy. These advantages are: their manipulative ability that enhances the physicochemical properties; their high carrier system use, bioavailability, and easy processability and engineering; and their low toxicity compared to other compounds (Elias, *et al.*, 2019). As food demand is increasing day by day the yield of staple food crops is much low. So there is need to commercialize metal nanoparticles for sustainable agriculture. Zinc oxide nanoparticles (ZnO NPs) also have remarkable optical, physical, and antimicrobial properties and therefore have great potential to enhance agriculture. Zinc (Zn) is

considered an essential micronutrient and its deficiency in crops as well as in humans is still an overwhelming issue in the health sector worldwide. ZnO NPs play a significant role in agriculture, where its colloidal solution is used in nanofertilizers as they increase the growth and yield of crops (Sidra *et al.*, 2014). Laware and Shilpa (2014) treated onion plants and concluded that, the plants treated with ZnO NPs at the concentration of 20 and 30 $\mu\text{g ml}^{-1}$  showed better growth and flowered 12-14 days earlier than the control. This result indicates that ZnO NPs can reduce flowering period in onion by 12-14 days and even produce healthy seeds.

Archana and Satyavikas (2016), conducted a field experiment at M/s.Rashtriya Chemicals and Fertilizers, Ltd., Mumbai, India, (RCF) experimental farm to evaluate the effect of ZnO Nanoparticles (ZnO NP) in combination with N: P: K (15: 15:15) complex fertilizer “Suphala” of RCF Ltd. on growth attributes of *brinjal* (*Solanum melongena L*) as well as nutrient use efficiency. The experiment was carried out in randomised block design with three replications. The first treatment (T-1), comprised of recommended dose of fertilizer (RDF), N: P: K (50:50:50), applied at the time of transplantation. The second treatment (T-2) was conducted with RDF in combination @ 2kg ZnSO<sub>4</sub> (bulk)/ha. The third treatment (T-3) was added, N: P: K (12.5; 12.5; 12.5) in combination to ZnO NP @ 4500mg/ha. The fourth treatment (T-C) was without any fertilizer. All treatments were given appropriate quantity of nitrogen per hectare as urea at the 30th day of transplantation. The results of field trials reveal that, there was synergistic effect of ZnO NP @ 4500mg per hectare with N: P: K complex fertilizer on growth attributes of *brinjal* as well as nutrient use efficiency.

Pankaj (2017), in his PhD thesis, reported that, seed treatment with ZnO NPs at 1000 ppm resulted in significantly maximum seed germination in maize. Healthy and most vigorous seedling with the largest seedling length was observed under the treatment receiving at 1000 ppm of ZnO NPs. However ZnO NPs at higher concentration *i.e.* 2000 ppm was detrimental to seedling growth in comparison to lower dose. He went further to clarify that, two foliar application of ZnO NPs to maize at 30 and 45 days of sowing was found to be significantly superior in enhancing grain, stover and dry matter yield of maize. Munir *et al.* (2018) reported that, plant growth, photosynthesis, biomass and Zn concentrations in roots, shoot and grains increased linearly with the seed priming (0, 25, 50, 75, 100 ppm) of ZnO NPs than control. Thus, ZnO NPs could be used as a source of Zn to reduce Zn deficiency in cereals. They added that, their results can help the fertilizer industries to decide the production of nanofertilizers especially ZnO NPs for plant nutrition which will help to reduce the Zn deficiency in plants and finally humans. They concluded that, field studies under different nanostructure sizes, shapes, conditions and plants may further enhance the mechanistic understanding of the applicability of NPs in this field. In another report by Josué *et al.* (2019), the application of ZnO NPs affects the development of pepper plants. At a concentration of 1000 mg L<sup>-1</sup>, it promoted plant growth, and increased number and average weight of the fruits, while at 2000 mg L<sup>-1</sup>, it promoted negative effects on growth and development of the crop. Therefore the ZnO NPs effect depends on the concentration applied.

## RUBBER INDUSTRY

Natural polymers are polymers with a variety of chemical formula and exhibit unique characteristics. They have received tremendous interest in understanding the transforming

mechanism to obtain more useful engineered systems. Neudys *et al.* (2017) reported that sonication-assisted mechanical mixing of ZnO and TiO<sub>2</sub> nanoparticles inside the non-vulcanized rubber facilitates the dispersion of solids and the proper incorporation of inorganic particles between polymer chains. It also helps in obtaining a stable emulsion and largely avoiding amorphous phase separation after the vulcanization process. The cross-linking density of the vulcanized rubber was slightly improved due to the better filler dispersion, which in turn improve the mechanical and dielectric properties of films. Few defects due to the presence of solid particles inside the polymer matrix and with a better vulcanization process was achieved.

Wang *et al.* (2017), prepared the samples of 1%, 2%, 3% and 4% Zinc Oxide (ZnO) nano-composite silicone rubber by mechanical method and found that the dielectric constant of the silicone rubber composite increases with the increase of the content of nano-ZnO. They noted that ZnO nano can reduce the hydrophobicity and the breakdown strength of silicone rubber.

## CONCLUSION

There is a lot of different methods of ZnO nanostructures preparation, like MOVPE, high temperature evaporation, gas spraying, pulsed laser deposition, sputtering, sol-gel, wet chemical and electrochemical methods. ZnO is an attractive material for applications in electronics, photonics, acoustics, and sensing. In general, ZnO NPs are found useful in optical emitters, Lasers, biosensors, gas sensors, solar cells, microwave absorbers, LEDs, piezoelectric devices, cosmetics, biomedicine, paint, coating and rubber industry. The zinc oxide nanoparticle (ZnO NP) is one of the most widely used nanoparticles and is being utilized in the production of pigments, semiconductors, UV protection films, chemical sensors, modern sunscreens and hair care products due to its adsorption ability, large surface area, transparency, UV absorption efficiency and chemical stability.

## Conflict of Interest

There was no conflict of interest among authors

## REFERENCE

- Ahmet, C. & Husseyin, S. (2014). Effects of Nano-Zinc Oxide Based Paint on Weathering Performance of Coated Wood. *Proceedings of the 3rd International Conference on Processing Technologies for the Forest and Bio-based Products Industries (PTF BPI 2014) Kuchl/Salzburg, Austria, September 24-26, 2014.* 1-7.
- Ali, S., Fatemeh, S., Asadollah, A. & Saeed, R. (2016). A Glucose Biosensor Based on Glucose Oxidase enzyme and ZnO Nanoparticles Modified Carbon Paste Electrode. *International Journal of Electrochemical Science*, 11(2016), 9891 – 9901, doi: 10.20964/2016.12.33.
- Archana, P. K. & Satyavikas, N. G. (2016). Studies on Nanoparticle Induced Nutrient Use Efficiency of Fertilizer and Crop Productivity. *Green Chemistry & Technology Letters*, 2 (2), 88-92.
- Babatunde, R. A., Bolanle, Y. I. and Adegboyo, O. O. (2019). Effects of Deposition Time of ZnS Thin Film on Optical and Morphological Properties of ZnS Deposited by Chemical Bath Deposition Method for Photovoltaic Application. *Journal of Theoretical & Applied Physics*, 1(2019):38-45.
- Bedia, F. Z., Bedia, A., Benyoucef, B. & Hamzaou, S. (2014). Electrical characterization of n-ZnO/p-Si heterojunction prepared by spray pyrolysis technique. *Physics Procedia*, 55(2014), 61 – 67.

- Denishev, K. (2016). Some metal oxides and their applications for creation of Microsystems (MEMS) and Energy Harvesting Devices (EHD) *Journal of Physics: Conference Series*, 764(2016), 1-11. doi:10.1088/1742-6596/764/1/012003.
- Dušan, N., & Petar, G. (2010). ZnO nanoparticles and their applications – new achievements. *nanocon 2010*, 1-6.
- Elias, E. E., Ifeyinwa, M. U., Damian, C. O. & Olubukola, O. B. (2019). The Role of Nanotechnology in the Fortification of Plant Nutrients and Improvement of Crop Production. *Applied Sciences*, 9(499), 1-32.
- Ethar, Y. S., Zulkifly, A., Samer, Hasan, H. A., & Mohd, Z. H. (2014). Dielectric Behaviour of Zn/Al-NO<sub>3</sub> LDHs Filled with Polyvinyl Chloride Composite at Low Microwave Frequencies, *Advances in Materials Science and Engineering*, 2014, 1-6.
- Fairhurst, D. & Mitchnick, M. (1997). *Sunscreens, Development, Evaluation, and Regulatory Aspects* (2nd Ed.). Marcel Dekker, New York.
- Fan, Z. & Lu, J. G. (2005). Gate-refreshable nanowire chemical sensors, *Appl. Phys. Lett.*, 86, 123510-1–123510-3, 2005.
- Fatemeh, M., Mohammad, E. B., Ramin, K., Ali, M., Salvatore, G. L. & Giovanni, N. (2018). Hydrogen Sensing Properties of Co-Doped ZnO Nanoparticles. *Chemosensors*, 6(61), 1-11.
- Hassan, H. S., Kashyout, A. B., Morsi, I., Nasser, A. A. A., & Raafat, A. (2015). Fabrication and Characterization of Nano-Gas Sensor Arrays. *AIP Conference Proceedings 1653*, 020042-1 - 020042-11.
- Jiangyong, P., Jing, C., Qianqian, H., Qasim, K., Xiang, L., Zhi, T., Wei, L., Feng, X., & Zichen, Z. (2015). Flexible quantum dot light emitting diodes based on ZnO nanoparticles. *RSC Adv.*, 2015(5), 82192 – 82198.
- Jinhuan, J., Jiang, P. & Jiye, C. (2018). The Advancing of Zinc Oxide Nanoparticles for Biomedical Applications. *Bioinorganic Chemistry and Applications*, 2018, 1-19.
- Josué, I. G., Guillermo, N., Emilio, O., Ricardo, H. L., Enrique, D. B., Rigoberto, V., Pablo, A. R. & Francisco, Z. (2019). Foliar Application of Zinc Oxide Nanoparticles and Zinc Sulfate Boosts the Content of Bioactive Compounds in Habanero Peppers. *Plants*, 8(254), 1-20.
- Ju, P., Weng, Li., Liu, L., & Zhang, X., (2016). Preparation and characterisation of Al-doped ZnO and PVDF composites. *The Institution of Engineering and Technology Journals*, 1(4), 166–170.
- Juan, A., Nasla, C., Guillermo, G., Clivia, S. & Eglantina, B. (2018). Enhancement Photocatalytic Activity of the Heterojunction of Two-Dimensional Hybrid Semiconductors ZnO/V<sub>2</sub>O<sub>5</sub>. *Catalysts*, 8(374), 1-13. doi:10.3390/catal8090374.
- Kurapati, S. (2018). Nanotechnology in Paint Industry. *International Journal of TechnoChem Research*. 4(1), 27-39.
- Lai, M. H., Lee, M. W., Gou-Jen, W. & Tai, M. F. (2011). Photovoltaic Performance of New-Structure ZnO-nanorod Dye-Sensitized Solar Cells. *International Journal of Electrochemical Science*, 6, 2122-2130.
- Laware, S. L. & Shilpa, R. (2014). Influence of Zinc Oxide Nanoparticles on Growth, Flowering and Seed Productivity in Onion. *Int. J. Curr. Microbiol. App. Sci.*, 3(7), 874-881.
- Li, M., Su, Y. J., Chu, W. Y., Qiao, L. J., Alex, A. V. & Grygoriy, K. (2011). Local piezoelectric effect on single crystal ZnO microbelt transverse I-V characteristics. *Applied Physics Letters*, 98, 082105-1 - 082105-3.
- Lu, P. J., Cheng, W. L., Huang, S. C., Chen, Y. P., Chou, H. K. & Cheng, H. F. (2015). Characterizing titanium dioxide and zinc oxide nanoparticles in sunscreen spray. *International Journal of Cosmetic Science*, 2015(37), 620–626. doi: 10.1111/ics.12239.
- Mati, U., Mingdeng, W., Fengyan, X. and Matiullah, K., (2019). Efficient Dye-Sensitized Solar Cells Composed of Nanostructural ZnO Doped with Ti. *Catalysts*, 9(273):1-11.
- Mohammad, V., Ahmad, U., & Yoon-Bong, H. (2010). ZnO Nanoparticles: Growth, Properties, and Applications. *American Scientific Publishers*, 5, 34-40.
- Muhammad, L. M. N., Suhana, M. S., Razali, I., Khoo, W. H. & Mohd, K. A. (2019). Electrochemical-Based Biosensors on Different Zinc Oxide Nanostructures: A Review. *Materials*, 12(2985), 1-34.



- Munir, T., Rizwan, M., Kashif, M., Shahzad, A., Ali, S., Amin, N., Zahid, R., Alam, M. F. E. & Imran, M. (2018). Effect of Zinc Oxide Nanoparticles on the Growth and Zn Uptake in Wheat (*Triticumaestivum* L.) by Seed Priming Method. *Digest Journal of Nanomaterials and Biostructures*, 13(1), 315 – 323.
- Mustapha, N., Fekkai, Z. & Idriss, H. (2018). Optical Study of Pure and Doped Conjugated Polymers with ZnO Nanoparticnl
- Neudys, G., Maria, A. C., Daniel, R., Jordi-Roger, R., Elaine, A. (2017). Influence of ZnO and TiO<sub>2</sub> Particle Sizes in the Mechanical and Dielectric Properties of Vulcanized Rubber. *Materials Research*, 20(4), 1082-1091.
- Nour, E. S., Azam, K., Omer, N. & Magnus, W. (2014). A Flexible Sandwich Nanogenerator for Harvesting Piezoelectric Potential from Single Crystalline Zinc Oxide Nanowires. *Nanomaterials and Nanotechnology*, 4(24). doi: 10.5772/59068.
- Omkar, B. (nd). Synthesis and Characterization of ZnO nanoparticles of various sizes and Applications in Biological systems. Thesis submitted to the Department of Biotechnology and Medical Engineering, National Institute of Technology Rourkela, Orissa, India. In partial fulfilment of the requirements for the degree of Bachelor of Technology in Biotechnology. (Unpublished).
- Pankaj, K. T. (2017). Effect of Zinc Oxide Nanoparticles on Germination, Growth and Yield of Maize (*Zea Mays* L.). A Thesis Submitted to the Anand Agricultural University, In Partial Fulfilment of the Requirements for the Award of the Degree of Doctor of Philosophy (Agriculture) In Soil Science & Agricultural Chemistry. (Unpublished).
- Prateek, U., Kirti, V. (2016). Review of Zinc Oxide (Zno) Nanoparticles Applications and Properties. *International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE)*, 21(2), 239-243.
- Raymond, H. F. (2009). Nanocomposite and Nanostructured Coatings: Recent Advancements, in Nanotechnology Applications in Coatings. *American Chemical Society*, 2-21.
- Sanaz, A., Morteza, S. G. & Majid, J. T. (2017). Synthesis, Characterization, and Gas Sensing Properties of In-doped ZnO Nanopowders. *Nanochem Res* 2(2), 198-204.
- Sathya, M., Claude, A., Govindasamy, P. and Sudha, K. (2012). Growth of pure and doped ZnO thin films for solar cell applications. *Advances in Applied Science Research*, 3(5):2591-2598.
- Sidra, S., Muhammad, A. & Sunbal, K. C. (2014). Zinc Oxide Nanoparticles for Revolutionizing Agriculture: Synthesis and Applications. *The Scientific World Journal*, 2014, 1-8.
- Sperling, R. A., Gil, P. R., Zhang, F., Zanella, M. & Parak, W. J. (2008). Biological applications of gold nanoparticles. *Chemical Society Reviews*, 7(9), 1896-1908.
- Srikant, V. & Clarke, D. R. (1998). On the optical band gap of zinc oxide. *JOURNAL OF APPLIED PHYSICS*, 83(10), 5447-5453.
- Sumon, D., Tamalika, C. (2014). A review on green synthesis of silver nanoparticle and zinc oxide nanoparticle from different plants extract and their antibacterial activity against multi-drug resistant bacteria. *Journal of Innovations in Pharmaceutical and Biological Sciences (JIPBS)*, 5(4), 63-73.
- Therapeutic Goods Administration, (2016). Literature Review on the Safety of Titanium Dioxide and Zinc Oxide Nanoparticles in Sunscreen. Scientific Review Report, Department of Health, Australian Government.
- Umit, O. (2010). ZnO Devices and Applications: A Review of Current Status and Future Prospects. *Proceedings of the IEEE*, 98(7):1255-1268.
- Vanja, F. N., Antonio, P. S. S., Francisco, L. and Gessé, O. (2018). Effects of Potential Deposition on the Parameters of ZnO dye-sensitized Solar Cells. *Materials Research*, 21(4):1-8.
- Varsha, S., & Deepakgusain, Y. (2013). Synthesis, characterization and application of zinc oxide nanoparticles (n-zno). *Ceramics international*, 39(2013), 9803–9808.
- Vivek, M. & Kantisara, P. (2019). White Light Emission from Thin-Film Samples of ZnO Nanocrystals, Eu<sup>3+</sup> and Tb<sup>3+</sup> Ions Embedded in SiO<sub>2</sub> Matrix. *Materials* 2019, 12(1997), 1-13. doi:10.3390/ma12121997.
- Vlad-Cristea, M., Riedl, B., Blanchet, P. & Jimenez, P. E. (2012). Nanocharacterization techniques for investigation the durability of wood coatings. *European Polymer Journal*, 48, 441-453.

- Wang, C. H., Chu, X. F. & Wu, M. W. (2006). Detection of H<sub>2</sub>S down to ppb levels at room temperature using sensors based on ZnO nanorods, *Sens. Actuators B, Chem.*, 113, 320–323.
- Wang, F., Yan, D., Su, Y., Lu, Y., Xia, X. & Huang, H. (2017). Research on the Dielectric Properties of Nano-Zno/Silicone Rubber Composites. *IOP Conf. Series: Materials Science And Engineering*, 231, 1-8.
- Weichelt, F. Beyer, M., Emmler, R., Flyunt, R., Beyer, E. & Buchmeiser, M. (2011). Zinc oxide based coatings for the UV-protection of wood for outdoor applications. *Macromol. Symp.*, 301, 23-30.
- Xiaodong, S., Guangyan, M., Xuliang, L., Mingxu, S., Huabing, L., Fan, W. & Jijun, W. (2018). Controllable Fabrication of Fe<sub>3</sub>O<sub>4</sub>/ZnO Core–Shell Nanocomposites and Their Electromagnetic Wave Absorption Performance in the 2–18 GHz Frequency Range. *Materials*, 11(780), 1-12.
- Yah, C. & Simate, G. (2015). Nanoparticles as potential new generation broad spectrum antibacterial agents. *DARU Journal of Pharmaceutical Sciences*, 23(1), 43.
- Yu, L., Sahrim, H. A., Kong, I. & Mouad, A. T. (2012). Microwave Absorbing Properties of Nickel-Zinc Ferrite/ Multiwalled Nanotube Thermoplastic Natural Rubber Composites. *Advanced Materials Research*, 501(2012), 24-28.
- Yuancheng, Q. (2015). ZnO Nanowires and Their Application for Solar Cells. Retrieved from [www.researchgate.net/publication/221913392](http://www.researchgate.net/publication/221913392) on 05/05/2019.
- Yuhong, Z., Zhong, W., Feng, P. & Li, F. (2016). Application of biosynthesized ZnO nanoparticles on an electrochemical H<sub>2</sub>O<sub>2</sub> biosensor. *Brazilian Journal of Pharmaceutical Sciences*, 52(4), 781-786. <http://dx.doi.org/10.1590/S1984-82502016000400023>.
- Zhezhe, W., Hongchao, S., Rongjun, Z., Xinxin, X. & Yude, W. (2017). ZnO Nanoparticles as Sensing Materials with High Gas Response for Detection of n-butanol Gas. *J Nanostruct*, 7(2), 103-110.
- Zhiyong, f., & Jia, G. L. (2005). Zinc oxide nanostructures: synthesis and properties, *Appl. Phys. Lett.*, 86, 19-25.
- Zhong, L. W. & Jinhui, S. (2006). Piezoelectric Nanogenerators Based on Zinc Oxide Nanowire Arrays. *Science*, 312, 241-246.
- Zhong, l. w. (2004). Zinc oxide nanostructures: growth, properties and applications. *Journal of physics: condensed matter*, 6, 830-858.
- Zhuo, R. F., Qiao, L., Feng, H. T., Chen, J. T., Yan, D., Wu, Z. G. & Yan, P. X. (2008). Microwave absorption properties and the isotropic antenna mechanism of ZnO nanotrees. *Journal of Applied Physics*, 104, 1-6.

**THE IMPERATIVENESS OF AGRICULTURAL EXTENSION AND COMMUNITY DEVELOPMENT IN NIGERIA.**

**Ven Egesi Jonathan.C**

Imo State Polytechnic, Omuma  
Imo State, Nigeria.

**Egeonu Eugene**

Imo State Polytechnic, Omuma  
Imo State, Nigeria.

**Amaechi J.N**

Imo State Polytechnic, Omuma  
Imo State, Nigeria.

**Iheanacho Charles.U**

Imo State Polytechnic, Omuma  
Imo State, Nigeria.

**Onuoha Modestus**

Imo State Polytechnic, Omuma  
Imo State, Nigeria.

**Abstract**

Agriculture like many other countries with good, arable and fertile soils have been a well- paying and good source of food supply. One can therefore make bold to say that there is hardly any sort of food eaten anywhere that is not a product of agriculture. In fact no matter how well-packaged, well refined and palatable any kind of food is, it is basically an agricultural produce. One disgusting aspect is that certain people relegate both the farmers and the process to the background as if they are not important. On the other hand, certain other people feel proud enough to under price farm produce simply considering it a cheap venture while parading themselves as people who do not like to farm but love its produce. This is quite shameful. It must be stated and clearly too on the imperativeness of Agriculture and possible ways of improving on various farm and agricultural practises in Nigeria. The above statement form the gamut of this study. Data collection techniques interviews, journals, questionnaire and the internet were used. The knowledge-gap theory and theory of planned behaviour /Reasoned Action were adopted for the study, thereafter, conclusion was drawn.

**KEYWORDS:** Imperativeness, Agricultural Extension, Community Development, Nigeria.

## **INTRODUCTION**

It is necessary to reiterate that Nigeria is the most populace country in Africa. It can equally become the richest country in Africa and leader in development. With a population of close to 200 million people, Nigeria has the internal market to manufacture various consumable goods. Also with the array of natural resources at her disposal, as in petroleum, fertile lands, the country can become self reliant in food and other needs. Infact, it is the goal of the government to return the country to the glorious 1960s when Nigeria was a net exporter of many products. In the early 1960s, Nigeria led the world in producing 42% of groundnut exports: supplied 27% of the world's oil palm ;and 18% of cocoa production. However, the country lost this urge with the gushing of oil in the 1970s. Today, Nigeria imports over 1.3 trillion naira in wheat, rice and sugar every year-653 billion naira annually importing wheat alone –products, which Nigerians can grow at home. Thus the Nigeria Transformation Agenda has been considered a federal policy aimed at returning the country to greatness. Through an agriculture led development approach aimed at achieving a hunger –free Nigeria: creating millions of employment opportunities and making the nation once again a leader in global food markets. It is left to be seen how this lofty dreams and height could be achieved. This is really achievable with meaningful investment in Agriculture.

## **DEFINITION OF TERMS/ CONCEPTUAL FRAMEWORK.**

Various concepts making up the question will require explanation in order to further understanding of the work.

Such words are these:

## **IMPERATIVENESS.**

This can simply be taken for the quality of being insistent. Imperativeness can also be taken for needful. The state of demanding notice or attention.. Something that demands urgent attention.

## **AGRICULTURAL EXTENSION.**

Agricultural extension is another name for agricultural advisory services. In practical terms, extension means giving farmers for us small holders in developing countries – knowledge of agronomic techniques and skills to improve their productivity, food , security and livelihoods.

## **COMMUNITY DEVELOPMENT.**

Community development is a process where community members are supported by agencies to identify and take collective action on issues which are important to them. Community development empowers community members and creates stronger and more connected communities.

The United Nations defines community development as a process where community members come together to take collective action and generate solutions to common problems. It is a broad concept, applied to the practices of civic leaders, activists , involved citizens and professionals to improve various aspects of communities , typically aiming to build stronger and more resilient local communities

Community development is also understood as a professional discipline and is defined by the International Association for Community Development as a practice-based profession and an academic discipline that promotes participative democracy , sustainable development , rights, economic opportunity ,equality and social justice through the organisation, education and empowerment of people within their communities , whether these be of locality, identity or interest in urban and rural settings.

Community development seeks to empower individuals and groups of people with skills they need to effect change within their communities. These skills are often created through the formation of social groups working for a common agenda. Community developers must understand both how to work with individuals and how to affect communities' positions within the context of larger social institutions.

It is also necessary to establish that community development approaches are recognised internationally. These methods and approaches have been acknowledged as significant for local social, economic, cultural, environmental and political development by such organizations as the UN,WHO,OECD, WORLD BANK. There are basically a number of institutions of higher education that offer community development as an area of study and research such as the University of Toronto, Leiden University , SOAS University of London etc

### **BENEFITS OF AGRICULTURAL EXTENSION PROGRAMMES IN NIGERIA.**

There are basically more extension agents involved in agricultural activities than any other part of rural life. Given the importance of agriculture and the need to produce food for the farm family and for the nation as a whole, this emphasis upon agricultural extension is understandable. Some agricultural services are based upon a single crop while others adopt more of a whole farm approach. The choice is very much dependent on the local agricultural system and the national crop requirements. In regions where cash such as cotton, cocoa or sugar grow the single crop extension approach is more common.

An agricultural extension service offers technical advice on agriculture to farmers and also supplies them with the necessary inputs and services to support their agricultural production. It provides information to farmers and passes to the farmers new ideas developed by agricultural research stations. Agricultural extension programmes covers a broad area including improved crop varieties better livestock control , improved water management and the control of weeds , pests or plant diseases. Where appropriate, agricultural extension may also help to build up local farmers' groups and organizations so that they can benefit from extension programmes. Agricultural extension therefore provides the indispensable elements that farmers need to improve their agricultural productivity. Actually, it is not a waste of material and monetary resources asv some schools of thought may say, but it is in fact it is a wise way of investing for the future.

### **THEORETICAL FRAMEWORK**

#### **THE KNOWLEDGE0-GAP THEORY**

The knowledge gap theory was first proposed by Tichenor, Donohue and Olien in 1970 (Severin and Tinankard,2001) The theory expresses the belief that the increase of information in society is

not evenly acquired by every member of society as people with higher socio-economic status tend to have better ability to acquire information than others with lower socio-economic status. This theory assumes that attempt to improve people's life with information through invention of technologies might result in an unwanted outcome such as a further increase in the gap between a group of better-educated people who know more about most things and those with low education who know less. While the knowledge gap theory has its shortcomings among which is the assumption that knowledge automatically translates to behaviour change without much consideration for the role played by individuals attitude, however, it provides the basis for a probe into extension workers knowledge of goals of extension in this study. This is anticipated to reveal whether access to and use of modern information and communication technologies for extension services delivery in Nigeria has any link with the extension workers background characteristics and their awareness of public affairs issues

### **THEORY OF PLANNED BEHAVIOUR/REASONED ACTION**

Ajzen and Fishbein formulated in 1980.the theory of reasoned action (TRA) (Vallerend et al , 1992) The theory suggests that behavioural outcome of individuals is a function of his /her intention to perform the behaviour and that this intention is , in turn determined by his/her attitude toward the behaviour and subjective evaluation of the risks and benefits of that outcome The assumption of TRA that behavioural achievement depends on both motivation (intention) and ability (behavioural control) informed the inclusion of variables such as job satisfaction of extension workers competencies in using ICT and effectiveness of several aspects of extension in this study

### **CONCLUSION AND RECOMMENDATIONS**

This study observed and therefore concludes that extension workers in Nigeria have poor capacity in the use of development and communication tools which are central to their work and the attainment of the national agricultural transformation agenda. An effective transformative agricultural agenda will thus require making equally transformative changes in the extension system which should begin with training of extension workers on innovative extension approach described by the world Bank and the Food and Agriculture Organization of the United Nations(2007) as Communication for Development (C4D) . Also, these changes will include reviewing and reforming the extension curricula at college , University and field levels: and restructuring extension programmes at the state and federal levels to more effectively serve all clients at minimum cost. For example we found that virtually all ministries have similar communication needs. Therefore, setting up regional multi media and print production Centres is a cost effective way of meeting these needs and ensuring that these media centres operate in a cost recovery way/ manner. The study also showed that effective extension practice must be backed by sound science. Therefore social science approaches to extension must be reviewed and adopted including assessing extension impact.

Equally, the fund disbursement must be audited and ensured it is used according to purpose.. It has been discovered over time that the fund meant for agricultural extension programmes are diverted away with impunity with little or nothing to show for it.

The knowledge base of the agricultural extension staff or officers needs to be upgraded over time. Since this is considered as a continuous process, the idea of sending the officers abroad to acquire and update if not to upgrade their techniques will also be welcomed idea ( the emphasis is mine)

## REFERENCES

- Amabile T and S Kramer(2011) The Progress principle: Using Small Wins to Ignite Joy, Engagement and Creativity at work.
- Ammani A.A , S. I Anta and J.A Aliyu (2010) Challenges to Sustainability : applying the problem tree analysis methodology to the ADP system in Nigeria. Journal of Agricultural Extension,14(2)35-45.
- Chukwuemeka E and H.P Nzewi (2011) An Empirical study of World Bank Agricultural Development programme in Nigeria.American Journal of Social and management Sciences 2(1) 176-187
- Hiire G.B(2011) Staff Development and job satisfaction of academic Staff in Mubende National Teachers' College . M.sc.diss, Makerere University, Uganda.
- Lopez K.J (2013) Why is Government involved with marriage anyway [www.nationalreview.com/corner](http://www.nationalreview.com/corner) June 18,2015:10-40.
- Obiora C.I and A.I Emodi (2013) Restructuring the Agricultural Extension service for Effective Agricultural Transformation ager Da in Nigeria. Greener. J Agric sci 3(6)516-522.[www.gjournals.org](http://www.gjournals.org).
- <http://aif/gov.au> practice-guides.
- <http://en.m.wikipedia.org>.
- The Oxford Advanced Learner's Dictionary 10<sup>th</sup> Edition.

## حركة الجمع والترجمة في الكوفة والبصرة

## TRANSLATION AND COMPILATION OF ARABIC LANGUAGE IN KUFA AND BASRAH

Muhammad Bello Idris

School of Education.

A.D.R College of Education, Legal and General Studies, Misau,  
Bauchi State, Nigeria.**Abstract**

This paper is an attempt to study and explore the historical development of the art of translation in Arabic language and the language compilation in the areas known as Kufa and Basra in the present day Iraqi land. The paper further dig into to the geneses of Arabic grammar, its origin and the main factors that motivated its emergence in the early days of its development.

**Keywords:** Translation, Compilation, Arabic, Kufa and Basrah.

**المقدمة:**

اللغة ظاهرة بشرية ووسيلة اتصال وتبادل المشاعر والأفكار، وهي مجموعة رموز صوتية منطوقة ومسمومة متفق عليها -بعدها كانت محاكاة- لأداء هذه المشاعر والأفكار، وهذه الرموز تجتمع فيما بينها فتكون مقاطع ومفردات وجملا تؤدي عاني شتى حسب ما يريد الباحث للرسالة اللغوية، وفهم المتلقي يعني إدراك العلاقات التي تقوم بين الأصوات ومدلولاتها، وبين الكلمات بعضها ببعض. وهذه المواضع هي "الأمر الأساسي الذي تستمد منه الكلمة مقومات دلالتها، يضاف إليها بعد ذلك سياق الكلام والمقام الذي يقال فيه.

اللغة العربية من اللغات السامية، لم تولد كاملة، فقد مرت كغيرها من اللغات لأطوار لم يدركها عصر التدوين، والمهم أنها نمت نموًا طبيعيًا بعد زمن طويل، والشواهد ترجع وجود كتابتها إلى القرن الثاني الميلادي، وقد ظهرت فيها نهضات نوعية بسبب احتكاك الأفكار بالاختلاط الذي كان يتم أثناء مواسم الحج، أضف إلى هذا أثر الهجرة التي اقتضتها عوامل الطبيعة وبذلك تعرضت لكثير من الطوارئ قبل أن تدون وتضبط وجدت مجموعة كبيرة من اللغات التي تعرف آنذاك بالللهجات<sup>(61)</sup>. ومهما يكن فإن كثيرا من المصادر تشير إلى أن العربية مثلها مثل اللغات الأخرى، عرفت طفولة، فقد مرت بعدة أطوار قبل أن ينزل بها القرآن الكريم، وهذه الأطوار هي:

**أطور اللغة العربية:**

- **الطور الأول:** كانت فيها مزيجا من اللهجات، والبدائية تعود إلى لهجتين: لهجة قبائل بني عدنان في شمال الجزيرة العربية، ولهجة قحطان الحميرية، وقد أفادت العدنانية من الحميرية وصارها حتى تغلبت عليها.
- **الطور الثاني:** بدأت عند اجتماع القبائل، واختلاط بعضها ببعض في الحروب والحج والأسواق، وهنا كان لقريش السيادة الدينية، حيث كانت تأخذ من لغات الشام واليمن وفارس والحبشة، ما تدخله في لغتها بعد تهذيب متقن، وزادت ثروتها اللغوية.
- **الطور الثالث:** بدأت بنزل القرآن الكريم، فأتم لهذه اللغة سيادتها وشرافها، فكانت شيئا مهما، وكان للحديث النبوي الشريف أثر واضح في تهذيبها، وهنا اتسعت أغراض هذه اللغة بتأثير الدين، ودخلتها الألفاظ الجديدة، وتغيرت معاني بعض الألفاظ حسب طبيعة تطور المجتمع المدني آنذاك<sup>(62)</sup>.

61 . موقع شبكة سيدات مصر، ص1.

62 . كلود كاهن، تاريخ العرب والشعوب الإسلامية، ترجمة بدر الدين القاسم، دار الطليعة بيروت 1977م، ص105.



### جمع اللغة والأسباب الباعثة على ذلك:

لم يكن المجتمع الجاهلي في حاجة إلى دراسة أو روايتها، حيث كانت على لسان العربي فطرة، وكان صدره وعاء لها، وكانت الوسيلة التي بها كان يفاخر بأجداد قبيلته ويحیی عصبته. ولما جاءت الدعوة المحمدية، التف الناس حولها لفهم رالة الإسلام التي نالت باللسان العربي المبین، وكان عجزهم وتحدي القرآن لهم مدعاة إلى البحث فيه لفهم أسراره، والعمل على نشره، كما كانت الدوافع لجمع اللغة لا تخرج عن ثلاثة عوامل، وهي كالاتي:

- 1- الخوف من اللحن في القرآن الكريم
- 2- الرغبة في ضبط اللسان العربي وحفظه من اللحن
- 3- التفاخر في التراث<sup>(63)</sup>.

### نشأة الرواية اللغوية:

لقد كان المجتمع الجاهلي مجتمعا أميا لا يأخذ اللغة إلا بالحس "وكانت القبائل كأنها سجل زمني في إحصاء الأخبار والآثار" ومع ظهور الدين الإسلامي، كانت اللغة ذات أوجه ومستويات كثيرة، وكان ذلك دافعا لنشاط لغوي وافر بسبب إعجازه<sup>(64)</sup>.

لقد شافه أهل الكوفة والبصرة أعراب البادية للأخذ عنهم، وتعد لغة البادية أوثق نص لغوي وصل العرب، وهي مثال جيد لتدوين اللغة وجمعها، وذلك لبعدهم عن بلاد العجم من جميع جهاتهم ونقلوا عنهم كثيرا من الشاذ والدخيل والمتروك، هذا يعني أنهم كانوا يدونون اللغة انطلاقا من المجموعة اللغوية الناطقة بها، وفي محيطها الطبيعي، وهذا يستلزم بالضرورة أن المدونة كانت أمينة وصادقة في تحديدها للحيز المكاني، وتحديد البيئة أمر جدير بالتقدير، وكان الرواة يجمعون ما يسمعون من القبائل المختلفة اللهجات، فكان من الضروري أن يوجد في اللغة الترايف والمشارك والأضداد. وإن جمع اللغة من "عوامل نمو اللغة وإثراء ألفاظها نظرا لما كان في لهجات القبائل من اختلاف في اللفظ ومدلولاتها، فجمع الرواة ما جمعا من هذه اللهجات، وبهذا ظهر واضحا أن اختلاف لهجات القبائل على أنواعها أدى إلى وجود ألفاظ ومعان مغايرة مستعملة عند قبيلة أخرى" ومع ذلك فاللغة لا تؤخذ إلا من الرواة الثقات ذوي الصدق والأمانة ويتقى المظنون. وقد بقيت لغة البادية على صفائها إلى آخر القرن الرابع الهجري<sup>(65)</sup>.

### الرحلة إلى البادية لجمع اللغة:

لقد كان أهل البصرة والكوفة عربا كلهم في القرن الأول، إلا الموالى منهم، وكان أولئك العرب من قبائل مختلفة، وكلهم باق على فطرته، فلم يكن الرواة في حاجة إلى البادية لأنهم لم يكونوا قد بلغوا الغاية في تحليل النحو وتفريعه، ومن أقدم الذين رحلوا إلى البادية: الخليل بن أحمد (ت170هـ/786م)، وخلف الآخر (ت180هـ/796م)، يونس بن حبيب الضبيبي (ت182هـ/798م). ولا شك أن ذهاب المجموعة إلى البادية كان سببه نقشي اللحن في الحضر والالتجاء إلى الأعراب الذين لم يظهر على ألسنتهم أثر الاحتكاك بالأعاجم فأخذوا عن قيس، تميم، وأسد، وهؤلاء هم الذين أخذ عنهم الكثير، وعليهم اعتمد في الغريب وفي الإعراب والتصريف، وتأتي بعد هذه القبائل هذيل، وبعض كنانة، وبعض الطائيين، ولم يؤخذ عن غيرهم. وفي الحق أن هذا التحديد المكاني والزمني كان من الضرورة أن يكون من الجاهلية إلى نهاية القرن الرابع لتكون المدونة واسعة، إلا أن هذا التحديد يحتاج إلى دقة أكثر، وتنبغي دراسة مستويات اللهجات على حدة لكل قبيلة لكي لا يقع الخلط بين القبائل الستة، ولكي لا يؤدي ذلك إلى الفوضى اللغوية، ومجافاة روح البحث العلمي، وبعد هذه الطبقة، وهي الطبقة الثالثة من النحاة تأتي الطبقة الرابعة، ومن أقدمهم النضر بن شميل (ت818هـ)، وقد أخذ عن الخليل وعن بعض الأعراب الذين أخذت عنهم الطبقة الثالثة، وأقام في البادية أربعين سنة، ثم الكسائي (ت189هـ)، وقد خرج إلى بوادي الحجاز ونجد وتهامة، وقد أخذ أيضا عن الخليل واستمرت الرحلة إلى البادية حتى نهاية القرن الرابع، ثم فسدت سليقة العرب، وانقطعت المادة اللغوية اكتفاءً بالتوارث عن كتب الأسلاف<sup>(66)</sup>.

63 . عبد الحسين المبارك (د.)، دور البصرة في نشأة الدراسات اللغوية، المعجم العربي، ص52.

64 . عبد الحسين المبارك (د.)، المرجع السابق، ص55.

65 . المرجع السابق.

66 . شبكة سيدات مصر، ص5.

**بعض وجوه نشاط الرواية:**

كانت المواضيع التي كتب فيها الرواة القدماء مما يقع تحت بصر العربي، وهم في كتاباتهم هذه لا يخرجون عن نطاق جمع اللغة، ولقد كانت موضوعاتهم في التوبيخ والتصنيف شاملة، حيث أنها تتناول ما يوجد في الطبيعة من حشرات ونبات وإنسان، وهناك كتب الصيغ التي كانت كتب تصنيف وبحث، وإلى جانب كتب لجمع اللغة. فكتبوا في المؤنث والمذكر، وفي المقصور والممدود وغير ذلك<sup>(67)</sup>.

**نشاط الرواية في البصرة:**

لقد كان علماء البصرة يأخذون اللغة عن الأعراب، وقد كانوا يضعون لهم أسئلة بطريقة خاصة ليمتحنوا سليقتهم، وقد كان جلهم ينتسب في اختيار ما يصدر عن الشعراء مخافة ظاهرة اللحن، فلقد حدد عبد الله بن أبي إسحاق الحضرمي (ت117هـ)، الفصاحة بانتقاء اللغة التي يدرسونها، والقبائل التي يأخذون عنها هذه اللغة، وبحكم نشأته غير بعيد عن السليقة العربية، دفعه للرحلة إلى البادية فسن هذه السنة، ومن تلاميذه يونس بن حبيب، وعيسى بن عمر (ت149هـ)، وقد رحل هذا الأخير لمشاهدة الأعراب الفصحاء، فلقد كانت حلقة البصرة يحضرها الأعراب، وطلاب العلم أمثال سيبويه، وهكذا تشدد البصريون في تحديد رقعة الفصاحة، والقبائل الفصيحة على خلاف الكوفيين الذي يعتدون بلغات عربية كثيرة<sup>(68)</sup>.

**نشأة الرواية في الكوفة:**

لقد كانت الرواية فيها مقصورة على الشعر، لإشباع نزوع العنصر العربي من الشعر، فرحل علماءها إلى البادية للسمع عن الشعراء، والرواة، ومن أقدم رواةهم: الخثمي أبو البلاد الكوفي، ثم حماد الراوية، والمفضل الضبي 170هـ/786م، والكسائي، وأبو عمر الشيباني (ت206هـ/821م).<sup>(69)</sup>

ورأى كثير من اللغويين أن الشعر بالكوفة أكثر وأجمع منه بالبصرة، إلا أن أكثره مصنوع ومنسوب إلى من لم يقله. وإن أكثر آثار الرواة تحاول جمع الثروة الأدبية في صميم المجتمع الكوفي، فيقال في حماد الراوية أنه جمع السبع الطوال، واختار المفضل مجموعة كبيرة من الشعر عرفت باسم المفضليات، كما وضع كتابا في الأمثال، وعمل الأصمعي كتابا على شاكلة المفضليات سماه الأصمعيات، وهي سبع وسبعون قصيدة. ومهما يكن من أمر، فإن الكوفيين أكثر توسعا في الرواية، ومن آثار الرواية عندهم: النوادر، ومعاني القرآن.

ويمكن أن نجمل ما قلناه في مسألة جمع اللغة أنها مرت بهذه المراحل:

- 1- مرحلة جمع أوائل العلماء الشواهد كيفما كانت ونظموها على شكل رسائل صغيرة في موضوع صغير.
  - 2- مرحلة تأليف الكتب في الموضوع كفعل سيبويه في النحو.
  - 3- مرحلة تأليف الكتب الضخمة الشاملة الجامعة للموضوع أو شرح الكتب السابقة<sup>(70)</sup>.
- إن، اختصت المرحلة الأولى بجمع الكلمات، تدوين كل شيء، والمرحلة الثانية جمع الكلمات المتعلقة بموضوع ما، والمرحلة الثالثة كانت على شكل معجم شامل، يشمل الكلمات على نمط خاص.

وفي الحقيقة أنه نشأت الرواية اللغوية من العلوم العربية الأخرى، وكانت مرتبطة بعلوم الدين، حيث كان الالتفات إلى فهم القرآن الكريم الداعي الأول للبحث اللغوي، ثم استقل بعد ذلك، ونضج على يد البصريين والكوفيين، رغم الاختلافات في طريقة رواية اللغة، حيث نجد أن مدونة الكوفة أكثر توسعا من البصرية، ولكن البصرية أكثر منطقية وتحكما في الأسلوب العلمي الدقيق. غير أن هذا النشاط يمكن اعتباره جهدا قيما في مرحلة معينة، وفي إطار تاريخي واجتماعي وسياسي خاص، كان من الأخرى أن يتطور هذا الجهد، لتترقى به اللغة<sup>(71)</sup>.

**جمع مفردات اللغة العربية:**

- شرع علماء اللغة في جمعها في العصر العباسي الأول ووضع أصول قواعدها.

67 . محمد عبد الرحمن مرجح، الجامع في تاريخ العلوم عند العرب، ط2، بيروت 1988م، ص196.

68 . أحمد محمد عوف، صناع الحضارة العلمية الإسلامية، ج2، القاهرة، 1997م، ص51.

69 . أحمد محمد عوف، المرجع السابق، ص53.

70 . المرجع السابق، ص57.

71 . المرجع السابق، ص60.

- كان في العالم الإسلامي لغتان، الأولى فصحي (لغة الكتابة والأدب)، الثانية لغة عامية (لغة المولدين).
- ارتحل العلماء الذين وقع على عاتقهم جمع مفردات اللغة إلى البادية وأخذوا عن سكانها أصولها على أساس أن لسانهم لم يفسد كما فسد لسان أهل الحضرة نتيجة الاختلاط بغيرهم من غير العرب.
- بذل العلماء جهداً في محاولة تصحيح اللغة وإظهار الفصح منها وما هو موضوع وضعيف<sup>(72)</sup>.

#### مراحل جمع اللغة:

- المرحلة الأولى: شملت تدوين مفردات اللغة بدون ترتيب وحسبما اتفقت وكما تيسر للعلماء سماعها.
- المرحلة الثانية: شملت جمع الكلمات الخاصة بموضوع واحد كما جاء في كتب الأصمعي.
- المرحلة الثالثة: وضع المعاجم وأول من وضع هذه المعاجم الخليل بن أحمد صاحب معجم العين<sup>(73)</sup>.

#### حركة الترجمة:

كانت حركة الترجمة للكتب الأجنبية من أكثر العوامل التي أثرت على العقيدة الإسلامية، فأدخلت على هذه العقيدة موروثة فلسفية، وإن كانت هذه الحركة في بداياتها ليس لها علاقة بالعقيدة؛ لكنها ما لبثت أن دخلت في العقائد فأفسدت على بعض المسلمين عقائدهم.

ولقد كان السلف يحذرون من هذا، وبدأت بعض بذوره -وربما لم تكن مقصودة- في عصر الصحابة، ومعلوم قصة صبيغ بن عسل وخوضه في المتشابهات، حيث قيل فيه إنه (كانت عنده كتب)<sup>(74)</sup>. وهذا لا يدل على نوعية هذه الكتب، وليس فيه إلا أن صبيغاً ربما كانت عنده تيارات غير إسلامية أخذها من هذه الكتب.

#### أولاً: الترجمة في عصر الدولة الأموية:

لم تكن عملية الترجمة والنقل في ظل الدول الأموية علامة ظاهرة، ولم يكن لهم شغل بالعلوم الفلسفية، إلا ما ذكر عن خالد بن يزيد بن معاوية، فقد ذكر ابن النديم أن "خالد بن يزيد بن معاوية يسمى حكيم آل مروان، وكان فاضلاً في نفسه، وله همة ومحبّة للعلوم، خطر بباله الصنعة فأمر بإحضار جماعة من الفلاسفة ممن كان ينزل مدينة مصر، وقد تصفح بالعربية، وأمرهم بنقل الكتب في الصنعة من اللسان اليوناني والقبطي إلى العربي، وهذا أول نقل كان في الإسلام من لغة إلى لغة، ثم نقل الديوان وكان باللغة الفارسية..."<sup>(75)</sup>.

ويتبين من هذا أن حركة الترجمة لم تتعدّ كتب الصنعة، والذي حمل خالداً على ذلك دوافع نفسية ورغبات شخصية، وربما يكون السبب في ذلك أن خالداً رأى جده معاوية قد اتخذ من ابن أثال النصراني طبيباً، فأراد أن يتصل مثله برجال الطب والفلسفة والكيمياء...<sup>(76)</sup>.

وأما عمر بن عبد العزيز فقد ترجم في عهده كتب الطب، وقرب إليه من الفلاسفة عبد الملك بن أجزر الكناشي، وكان طبيباً ماهراً أسلم على يد عمر بن عبد العزيز<sup>(77)</sup>.

فمما سبق يتبين لنا أن الترجمة في هذا العصر الأموي تناولت جانبيين في هذه المرحلة:

**الأول:** ترجمة العلوم الطبيعية، كالطب والكيمياء، دون أن تتجاوزها إلى العلوم العقلية، كالمنطق وما وراء الطبيعة، وذلك لحاجتهم لهذه العلوم مع عدم معارضتها للإسلام في الجملة.

**الثاني:** حركة التعريب للدواوين<sup>(78)</sup>.

72 . حسين ناصر (د.)، المعجم العربي، ص15، وينظر أصول في فقه اللغة العربية، ص234.

73 . المرجع السابق، ص18.

74 . الإبانة لابن بطّة 609/2، وانظر دراسات في الأهواء والفرق والبدع للعقل، ص378.

75 . الفهرست ص338، وانظر كشف الظنون 681/1، أجد العلوم 252/2، والتفكير الفلسفي في الإسلام لعبد الحليم محمود، ص277.

76 . عبد المتعال الصعيدي، الوسيط في تاريخ الفلسفة، ص9.

77 . المرجع السابق، ص12، في الفلسفة الإسلامية، محمد السيد نعيم، ص122.

78 . أثر حركة الترجمة في ردة الحضارة العربية الإسلامية، د. فاضل الحسيني، مجلة تاريخ العرب والعالم، عدد180، وانظر الإسلام في مواجهة الفلسفات القديمة للجندبي، ص49.

ومما ينبه إليه في هذه المرحلة أن الاهتمام فيها لم يكن اهتماما بالفلسفة كعلم، وما نقل عن أطباء وغيرهم وإنما هو معمول به كصناعة من الصناعات، وهذا لا يطعن فيما نقول من أن العلم الشائع في هذا العصر هو العلم الشرعي الديني<sup>(79)</sup>.

### ثانيا: الترجمة في عصر الدولة العباسية

شهدت الترجمة في العصر العباسي الأول تغيرا كبيرا، إذ كانت سياستها تختلف عن السياسة في الدولة الأموية، فالثانية تميزت بالعصبية القبلية، فكان خلفاؤها ووزراؤها من العرب. أما الدولة العباسية فقامت على أكتاف الفرس من أهل خراسان الذين لهم ثقافات قديمة قد تمسكوا بها، زد على هذا أن كثيرا من خلفاء بني العباس كانت نشأتهم غير عربية، مما جعل عندهم مرونة في الانفتاح على غيرهم؛ لذا أخذ خلفاء بني العباس يطلبون العلم بجميع أنواعه، ويكلفون النقلة والمترجمين بنقل العلوم الحكيمية -طب وهندسة وفلك- ويغدقون عليهم الأموال<sup>(80)</sup>.

وكان أبو جعفر المنصور -ثاني خلفاء بني العباس- قد عني بنشر هذه العلوم الفلسفية، ولكن ليس جميع العلوم، "... فبعث أبو جعفر إلى ملك الروم يبعث إليه بكتب التعاليم مترجمة، فبعث إليه بكتاب أوقليدس وبعض كتب الطبيعيات، وقرأها المسلمون واطلعوا على ما فيها"<sup>(81)</sup>.

ولم تترجم في هذه المرحلة جميع علوم اليونان، بل كانت بعض العلوم لم تترجم؛ لما فيها من الضرر، والذي تُرجم في عهد المنصور هي كتب الطب والمنطق، فأما الطب فقد بدأت الترجمة فيه في عهد بني أمية، فالمعروف أن أبا جعفر هو أول من ترجمه.

وأما المنطق فأول من اشتهر بترجمته عبد الله بن المقفع كاتب أبي جعفر المنصور. كما كان أيضا من أشهر المترجمين من الفارسية إلى العربية، إذ ترجم العديد من الكتب الفارسية مثل "خدينامة" في السير وكتاب "التاج" في سيرة نوشروان وكتاب "الأدب الكبير" وكتاب "الأدب الصغير" وكتاب "اليتيمة" في الرسائل، وما غير ذلك.

يقول ابن النديم: "وقد كانت الفرس نقلت في القديم شيئا من كتب المنطق والطب إلى اللغة الفارسية، فنقل ذلك إلى العربية عبد الله بن المقفع وغيره"<sup>(82)</sup>.

وما ينبغي التنبيه إليه أن الترجمة في عصر المنصور لم تقتصر على العلوم اليونانية، بل شملت غيرها من العلوم.

### أسباب ترجمة المنطق:

- 1- يرى بعض الكتاب أن هناك أسبابا دعت أبا جعفر إلى ترجمة المنطق، منها:
  - كثرة المناظرات والجدل الديني بين المسلمين مع بعضهم، وبينهم وبين أصحاب الديانات الأخرى، فالمسلمون اختلطوا بكثير من أرباب الديانات القديمة، وكان المسلمون يجادلونهم، وكان المجادلون من غير المسلمين لهم دراية وعلم بالمنطق اليوناني، فاضطر المسلمون إلى استعمال هذا المنطق الأرسطي لمقابلة حجج الخصوم الذي كان سلاحهم في المناظرة هو المنطق اليوناني.
  - 2- دخول كثير من عقائد الفرس الدينية في الجماعة الإسلامية، وقد سلك الفرس في تأييد عقائدهم مسلك الأقبسية المؤسسة على المنطق اليوناني، فحمل علماء الإسلام على أن يسلكوا نفس طريقته بعد إتقانها، ولكي يتمكنوا من إجادتها عمدوا إلى المنطق اليوناني يستمدون حاجتهم منه.
  - 3- ضعف الإيمان وقلة الوثوق بكتاب الله وسنة نبيه محمد صلى الله عليه وسلم.
  - 4- ميل بعض العلماء والوزراء إلى علوم الفلسفة والمنطق<sup>(83)</sup>.

79 . مبادئ الفلسفة، أ.س. رابورث، ترجمة أحمد أمين، ص142.

80 . في الفلسفة الإسلامية، محمد السيد نعيم، ص124.

81 . كشف الظنون لحاجي خليفة، 679/1.

82 . الفهرست ص337، وانظر: كشف الظنون 681/1، أجد العلوم 252/2.

83 . محمد البهي، الجانب الإلهي من التفكير الإسلامي، ص167-168، في الفلسفة الإسلامية، ص129.

ثم جاء عصر يحيى بن خالد البرمكي وأكمل وزاد في ترجمة الكتب، حيث إنه بعث إلى ملك الروم بالهدايا الكثيرة، حتى طلب منه كتب اليونان التي قد بنى عليها النصارى ولم يخرجوها إلى شعوبهم، فوافق ملك الروم على ذلك وبعث بها إليه، فلما وصلت جمع عليها كل زنديق وفيلسوف<sup>(84)</sup>.

إن عصر المأمون من أزهى عصور الترجمة عند المسلمين خلال العصور الوسطى، إذ أنه أقبل طلب العلم بهمة فكان أول من فحص كتب الحكمة والفلسفة وأمر بنقلها إلى العربية، وفتح الباب للترجمة على مصراعيه، وعمل ما لم يعمله سابقوه بأن قام بترجمة الفلسفة الإلهية فلسفة أرسطو وغيره، واستمر عصره بأخذ الثقافة من مواردها الأصلية والبحث عنها في منابئها القاصية، وشجع على ترجمة أمهات الكتب الأجنبية في مختلف اللغات في الفلسفة والطب والطبيعة والفلك والرياضة... ولم يدخر المأمون وسعاً في ذلك، فقد وثق علاقاته بملوك الروم وأتحفهم بالهدايا الثمينة، وسألهم صلته بما حضرهم من كتب أفلاطون وأرسطو... وكان من شروط عقد الصلح بينه وبين الإمبراطور البيزنطي ميخائيل الثالث أن يعطيه مكتبة من مكنتات الأستانة... وازدهرت مكتبة بيت الحكمة التي أنشأها الرشيد وتطورها المأمون<sup>(85)</sup> تطويراً كبيراً عما كانت عليه، وعمل فيها كثير من النقلة عن اللغة اليونانية والسريانية والفارسية والقبطية....

هذا، ولم يكن التشجيع على النقل في هذا العصر مقصوراً على الدولة، بل كان لبعض الأفراد من أهل اليسار مشاركات قوية احتنوا فيها ما احتذاه المأمون، ومن هؤلاء بنو موسى المنجم<sup>(86)</sup>.

يقول ابن القيم: "وولي على الناس عبد الله بن المأمون، وكان يحب أنواع العلوم... فأمر بتعريب كتب اليونان، وأقدم لها المترجمين من البلاد، فعربت واشتغل بها الناس..."<sup>(87)</sup>.

أما في الموجة الأخيرة في عصر المأمون ترجمت هذه الألوان من العقائد والأدب والفنون من الفلسفة اليونانية، وترجمت عقائد الفرس أيضاً وأفكار الصوفية الهندية<sup>(88)</sup>.

#### آثار هذه الترجمة على العقيدة:

كان من أكبر الآثار على العقيدة الإسلامية ترجمة كتب الإلهيات التي تضاد بالدرجة الأولى صفاء العقيدة الإسلامية، فكان ترجمة علم المنطق والفلسفة الإلهية خاصة من أهم أسباب دخول الفلسفة في العقائد الإسلامية بدلاً من النصوص الشرعية، فحينما تتصفح كتاباً من كتب المعتزلة أو الأشاعرة -خاصة المتأخرين منهم- فإنك تجد أنها تتميز بالمقدمات المنطقية الطويلة والصعبة، ثم تجد الصفحات الطويلة في الاستدلال على العقائد بالعقل، مع إغفال النصوص الشرعية، ناهيك عن الفلاسفة المنتسبين إلى الإسلام وما أحدثوه على العقائد الإسلامية من ويلات.

قال شيخ الإسلام ابن تيمية: "والفلاسفة المتظاهرون بالإسلام يقولون: إنهم متبعون للرسول، لكن إذا كشفت عن حقيقة ما يقولونه في الله وملائكته وكتبه ورسله واليوم الآخر تبين لمن يعرف ما جاء به الرسول وما يقولونه في نفي الأمرس أن قولهم ليس هو قول المؤمنين"<sup>(89)</sup>.

وهناك بعض الأمور التي تلفت الانتباه في هذه الترجمة:

- 1- التضاد التام بين العقيدة الإسلامية والديانات التي ترجمت كتبها خاصة اليونانية<sup>(90)</sup>.
- 2- الخلل في هذه الترجمات ودقتها، مما ينتج عنه عدم الدقة في المعلومات المنقولة والشك في مصداقيتها إن كان فيها حق<sup>(91)</sup>.

84 . صون المنطق والكلام للسيوطي، ص 7. وانظر: موقف المتكلمين للغصن، 51/1.

85 . يخطئ بعض المؤرخين في نسبة بيت الحكمة إلى المأمون، والحق ما ذكرنا من أن المأمون هو الذي طره.

86 . محمد عبد الرحمن مرجبا، من الفلسفة اليونانية إلى الفلسفة الإسلامية، 303/1-305، وانظر مبادئ الفلسفة، أس رابورت، ص 145.

87 . الصواعق المرسله، 1072/3.

88 . الإسلام في مواجهة الفلسفات القديمة لأنور الجندي، ص 53.

89 . الصفدية، 326/2.

90 . انظر الإسلام في مواجهة الفلسفات القديمة، ص 79.

91 . انظر: تمهيد لتاريخ الفلسفة الإسلامية، مصطفى عبد الرزاق ص 42.

3- أن معظم هؤلاء النقلة كانوا نصارى، وبعضهم يهود، ومن كان منهم مسلماً فهو فاسد العقيدة في الغالب<sup>(92)</sup>. من أمثال: يعقوب الزهاوي النصراني، يوحنا بن ماسويه النصراني، حنين بن إسحاق وابنه إسحاق وهم نصارى، وقسطا بن لوقا، وأبو بشر متى بن يون، وابن المقفع، وغيرهم كثير.

#### الخلاصة:

إن العرب المسلمين كانوا مبتكرين ومبدعين في العلوم التي نقلوها عن اللغات الأخرى ولم يكونوا مجرد مترجمين ونقل، إذ إنهم فسروها وأضافوا إليها شروحا وتعليقات قيمة. وإن حركة الجمع والترجمة للكتب الأجنبية إلى اللغة العربية من أكبر العوامل التي اهتم بها العرب القدامى، وكانت مرتبطة بالعلوم الدينية، وقد أثرت على العقيدة الإسلامية، حين كانت الالتفات على فهم القرآن الكريم، الداعي الأول للبحث اللغوي. بدأت حركة الجمع تستقل بعد ذلك، ونضج على يد البصريين والكوفيين رغم الاختلافات في طريقة رواية اللغة حين نجد أن الكوفة أكثر توسعا من البصرة، ولكن البصرة أكثر منطقية وتحكما في الأسلوب العلمي الدقيق. أما حركة الترجمة فقد بدأت في أوائل عصر الدولة الأموية على يد خالد يزيد بن معاوية، أنه أول من اهتم بالترجمة في هذا العصر، ثم عمر بن عبد العزيز، واستمرت هذه الحركة في عصر الدولة العباسية على يد أبي جعفر المنصور، ثم أكملت وزادت في عصر يحيى بن خالد البرمكي، ثم تطورت وافتحت الباب على مصراعية في عصر المأمون، حيث ازدهرت مكتبة بيت الحكمة التي أنشأها الرشيد وتطورها المأمون تطورا كبيرا.

#### المصادر والمراجع

- شبة سيدات مصر.
- كلود كاهن، تاريخ العرب والشعوب الإسلامية، ترجمة بدر الدين القاسم، دار الطليعة بيروت، 1977م.
- عبد الحسين المبارك (د.)، دور البصرة في نشأة الدراسات اللغوية، المعجم العربي.
- محمد عبد الرحمن مرحبا، الجامع في تاريخ العلوم عند العرب، ط2، بيروت، 1988م.
- أحمد محمد عوف، صناعات الحضارة العلمية الإسلامية، ج2، القاهرة، 1997م.
- حسين ناصر (د.)، المعجم العربي، وينظر: أصول في فقه اللغة العربية.
- ابن بطّة، الإبانة، ت/رضا نعيان، الراية، الرياض، ط1، 1415.
- أنور الجندي، الإسلام في مواجهة الفلسفات القديمة
- محمد البهي، الجانب الإلهي من التفكير الإسلامي، مكتبة وهبة.
- ابن تيمية، ت/محمد رشاد سالم، الصفدية، ط2، 1406.
- ابن القيم، ت/علي الدخيل الله، الصواعق المرسلّة، دار العصامة-الرياض، ط3، 1418م.
- السيوطي، صون المنطق والكلام عن فني المنطق والكلام، تحقيق: علي النشار، مكتبة السعادة، الطبعة الأولى.
- عمر كحالة، الفلسفة الإسلامية، مطبعة الحجاز، بدون تاريخ ولا طبعة.
- عرفان عبد الحميد، الفلسفة الإسلامية دراسة ونقد، مؤسسة الرسالة، بيروت، الطبعة الثانية.
- محمد بن النديم، الفهرست، دار المعرفة، بيروت، 1398-1978م.
- ترجمة أحمد أمين، مبادئ الفلسفة، مطبعة لجنة التأليف، ط4، 1938م.
- حاجي خليفة، كشف الظنون، دار الكتب العلمية، بيروت، 1413/1992م.
- عبد المتعال الصعيدي، الوسيط في تاريخ الفلسفة الإسلامية، مكتبة الجامعة الأزهرية، الطبعة الخامسة.

92 . انظر أسماء جملة منهم وأخبارهم في: الفهرست لابن النديم ص340-342، طبقات الأمم لصاعد الأندلسي، ص68.

**PEOPLE'S AWARENESS OF ENVIRONMENTAL LAWS AND POLICIES ON SOLID WASTE MANAGEMENT IN SABON GARI LOCAL GOVERNMENT AREA, KADUNA STATE.**

**Idris, Rakiya Kabir,**

Department of Geography  
Federal College of Education, Zaria,  
Kaduna State, Nigeria.

**Akilu Suleiman**

Department of Geography  
Federal College of Education, Zaria,  
Kaduna State, Nigeria.

**Ali Ibrahim Maccido.**

Department of Geography  
Federal College of Education, Zaria,  
Kaduna State, Nigeria.

**ABSTRACT**

Environmental law is a collective term encompassing aspects of law that provide protection to the surrounding. The sample size for this research was two hundred (200) respondents from the selected individuals in the community; the instruments used for data collection are questionnaire and interview methods. The method used in analyzing the data was the simple mean and percentage which involves the use of presenting data in a tabular format and then calculated in percentage form. The Likert Scale of ranking order using a 4-point of Strongly Agreed (SA), Agreed (A), Strongly Disagreed (SD) and Disagreed (D) was employed. The mean for every item was computed as  $(4,3,2,1)/4 = 2.50$ . Hence, the items with mean exceeding 2.50 are accepted while those below 2.50 were rejected. The result shows that majority of the respondents are literate in which 42% of them have attained tertiary education only 8% of the sampled population have no formal education. The result further indicates 42% of the respondents disagreed that authorities have established guidelines on waste disposal and collection in Sabon Gari while 12.5% strongly agreed. It is recommended that police and judiciary should take their roles seriously on environmental management and government should mount strategic environmental campaigns to raise public awareness through the various existing media.

**Keywords:** Awareness, Laws, Policies, Waste, Environment.

**BACKGROUND TO THE STUDY**

The first large-scale, modern environmental laws came in the form of the British Alkali Acts, passed in 1863, to regulate the deleterious air pollution (gaseous hydrochloric acid) given off by the Leblanc process, used to produce soda ash. In Europe, the Industrial Revolution gave rise to

modern environmental pollution as it is generally understood today. The emergence of great factories and consumption of immense quantities of coal and other fossil fuels gave rise to unprecedented air pollution and the large volume of industrial chemical discharges added to the growing load of untreated human waste (Fleming, 2006). Environmentalism grew out of the amenity movement, which was a reaction to industrialization, the growth of cities, and worsening air and water pollution. In 1962, *Silent Spring* written by American Biologist Rachel Carson was published. The book cataloged the environmental impacts of the indiscriminate spraying of well-known synthetic pesticide Dichlorophenyl trichloroethane (DDT) in the US and questioned the logic of releasing large amounts of chemicals into the environment without fully understanding their effects on ecology or human health. The researcher suggested that DDT and other pesticides may cause cancer and that their agricultural use was a threat to wildlife, particularly birds (Carson, 1962).

In Nigeria, the administrative framework for Solid waste management is three tiered, thus consisting of national, state agencies as well as local government bodies. The Federal Ministry of Environment is the body charged with overseeing the protection of the environment as well as natural resource preservation to the end of achieving sustainable development. The NESREA (National Environmental Standards Regulations and Enforcement Agency) is the major federal body responsible for protecting Nigeria's environment; it is responsible for enforcing all environmental laws, regulations, guidelines and standards. NESREA act 2007 was created under the 1999 constitution of the federal republic of Nigeria (Section 20) it replaced the Federal Environment Properties. Act 1988 (Ejide 2017). The Environmental Protection and Awareness division promotes the protection of our natural environment, the health and well-being of our citizens, increasing awareness in environmental issues. It also facilitates the participation of Non-Governmental Organizations and civil society. In this light, the acceptance of pro-environmental behavior by general public to adopt sustainable life style is an urgent issue in protecting the environment. In order to ensure protection of the environment is better managed, all states in Nigeria (and their local government) have been given the capacity to create related environmental establishments, the sovereignty of which is limited to the state or local government area it has been established (Ogwueleka, 2009).

Consequently, the responsibility for solid waste management in Nigeria lies with local governments at state level as specified in Section 5(2) of Federal Environmental Protection Agency Act No. 1 of 1994; As inter alia stated:| " It shall be the duty of each Local Government Authority in the State to locate, construct, and maintain public refuse receptacles in strategic places, where residents in its area may deposit their household waste" (FEPA, 2005). FEPA (2005) notes that, amidst weak institutional structures, little has been achieved in ensuring people's compliance with the range of environmental management policies and laws in Nigeria.

Like any other state in Nigeria, the problem of solid waste management is a major environmental issue in Kaduna Metropolis. Waste generation is on the increase and only little effort is made by the community and government to address this problem. Ugwa (2006) in his work titled; *Municipal Waste Management* identified that waste generation in Kaduna state is on the increase and only



little effort is made by the government and community to tackle the problem. Aondoakaa and Ishaya (2009) carried out a research on people's perception on the impact of urban generated Solid Waste in the environment of Gboko in Benue State; the study revealed that knowledge on the impact of solid waste on the environment is high among the educated inhabitant. However, it remains unclear what can cause the participation of people in environmental actions. In this research paper, hypothesis is established that more environmental awareness means more environmental behavior. The aim of the study is to investigate people's awareness of laws and policies on solid waste management in Sabon Gari Local Government Area, Zaria Kaduna state.

### **METHODOLOGY**

For the purpose of this research the descriptive research design will be employed, this is because it is simple and direct to understand. The sample size for this research was two hundred (200) respondents from the selected individuals in the community; the instruments used for data collection include questionnaire and interview methods. The responses were analyzed so as to bring out a valid inference. Also interview was conducted on those who cannot speak English fluently. The method used in analyzing the data was the simple mean and percentage. This method involves the use of presenting data in a tabular format and then calculated in percentage form. The Likert Scale of ranking order using a 4-point of Strongly Agreed (SA), Agreed(A), Strongly Disagreed (SD) and Disagreed (D) was employed. The mean for every item was computed as  $(4,3,2,1)/4 = 2.50$ . hence, the items with mean exceeding 2.50 is accepted while those below 2.50 were rejected.

### **DATA PRESENTATION AND ANALYSIS**

**Table 1; Qualification of the Respondent**

<b>Certificate</b>	<b>Frequency</b>	<b>Percentage (%)</b>
No formal education	16	8%
Primary Certificate	28	14%
SSCE	72	36%
Tertiary Education	84	42%
<b>Total</b>	<b>200</b>	<b>100%</b>

**Source: Field Survey, 2021**

From table 1 presented, it shows that 8% of the sampled population have no formal education, 14% of the respondents are Primary certificate holders, 36% are SSCE holders while 42% of the respondents have attained tertiary education. This indicates that, most members of the community are literate and have attained the level of tertiary education. The high percentage of those with tertiary educational attainments indicates that respondents are educated and can easily co-operate in healthy solid waste management practices. Pacey (1990) emphasises on the importance of education to solid waste management, he reported that formal education is a prerequisite for

positive change in sanitation behaviour, in a similar study by Onyema (2006) who stated that the people that are mostly involved in this laws and policies breaking are not educated and are mostly ignorant of their behavior.

Table 3 shows that the research statement 2,3,5,6 and 7 were all accepted. This is because the calculated arithmetic mean ( $\bar{X}$ ) of all the items exceeded the theoretical mean (2.5) which is taken as cut-off point for rejection or acceptance, as the case may be.

S/N	Research Statement	Reponses				$\Sigma F$ %	$\Sigma Fx$	$\bar{x}$	Remark
		SA	A	D	SD				
1.	-Authorities have established guidelines on waste disposal and collection in Sabon Gari.	25 12.5	29 14.5	84 42	62 32	200 100	415	2.1	Rejected
2	-Dumping of hazardous substances in the environment is prohibited by the authorities concerned.	75 37.5	85 42.5	25 12.5	15 7.5	200 100	620	3.1	Accepted
3	-Indiscriminate dumping of refuse is discouraged.	79 39.5	90 45	20 10	11 5.5	200 100	637	3.2	Accepted
4	-There are penalty charges for those who dispose wastes indiscriminately in the community.	24 12	47 23.5	71 35.5	58 29	200 100	437	2.2	Rejected
5	-Authorities do inspect premises, facilities and seize items that are harmful to the environment.	87 43.5	77 38.5	15 7.5	21 10.5	200 100	630	3.2	Accepted
6	-Private sectors are involved in waste collection and disposal.	78 39	59 24.5	30 15	33 16.5	200 100	582	2.9	Accepted
7	-There are environmental volunteers amongst the citizenry (waste pickers, itinerant buyers etc)	10 5	57 28.5	28 14	14 7	200 100	641	3.2	Accepted
8	-Sensitisation Programmes are carried on to educate people on environmental Laws and problems	22 11	31 15.5	55 27.5	92 46	200 100	383	1.9	Rejected

Source: Field Survey, 2021

**Table 3i; Awareness of People on the Laws and Policies on Solid Waste Management.**

However, it is deduced from item two that dumping of hazardous substances in the environment is prohibited by the authorities this statement was strongly agreed by 37.5% respondents and strongly disagreed by 7.5% respondents with mean score of 3.1. While item three shows that indiscriminate dumping of refuse is discouraged, the statement was strongly agreed by 39.5% respondents and disagreed by 5.5% respondent with a means score of 3.2. While item Five shows that authorities

do inspect premises, facilities and seize items that are harmful to the environment the notion was strongly agreed by 43.5% and disagreed by 7.5% respondents with a mean score 3.5. While items six and seven shows that Private sectors are involved in waste management and there are environmental sanitation volunteers amongst the citizenry with a mean of 3.2 and 2.9 respectively. According to (Ahmed and Ali, 2004) the environmental volunteers are groups of waste management stakeholders that are usually not regulated or controlled by government agencies, they usually move from house to house and or street to street in search of wastes and or other recyclable waste materials, they are called scavengers and waste pickers. As Klijin and Teisman (2003) opined that because there is little appreciation for voluntary measures to protect the environment among the people, irresponsible methods of waste disposal have not been uncommon in the country and waste management has not been an exception.

Furthermore, the research statement 1, 4 and 8 were rejected, this is because the calculated arithmetic mean ( $\bar{X}$ ) of all the items was less than the theoretical mean (2.5) which is taken as cut-off point for rejection or acceptance. Item one indicates 42% of respondents disagreed that authorities have established guidelines on waste disposal and collection in Sabon Gari while 12.5% strongly agreed. Item four implies that 35.5% of respondents disagreed that there are penalty charges for those who dispose wastes indiscriminately in the community while 12.5% agreed that charges are impose on offenders. Item eight indicates that 46% of the respondents disagreed that Sensitisation Programmes are carried on to educate people on environmental Laws and problems while 11% are of the opinion that sensitisation programmes are carried out.

S/N	Research Statement	Reponses				$\Sigma F$ %	$\Sigma Fx$	$\bar{x}$	Decision
		SA	A	D	SD				
9.	The environmental laws and policies in the community have made great impact in terms of waste control in the environment.	21 10.5	13 6.5	75 37.5	91 45.5	200 100	351	1.8	rejected
10.	Environmental protection court has been established to enforce laws and policies in the community.	18 9	31 15.5	66 33	85 42.5	200 100	382	1.9	rejected
11.	Community Based Organizations also help in curtailing the solid wastes management problems that has overwhelmed the authorities.	85 42.5	78 39	26 13	11 5.5	200 100	637	3.2	Accepted

12.	In order to curtail the indiscriminate dumping of refuse, waste management authorities have been effective in waste collection.	25 12.5	30 15	90 45	55 27.5	200 100	425	2.1	rejected
13.	There is cooperation between the people and the environmental health officials in charge of solid waste management.	77 38.5	81 40.5	28 14	14 7	200 100	621	3.1	Accepted

Source: Field Survey, 2021

**Table 3ii: Awareness of People on the Laws and Policies of Solid Waste Management.**

The above table shows that the research statements 9, 10 and 12 were all rejected, this is because the calculated Arithmetic mean ( $\bar{x}$ ) of all the items is less than the theoretical mean (2.5) which is taken as cut-off point for rejection or acceptance, as the case may be. Item eleven shows that the environmental laws and policies in the community have made great impact in terms of waste control in the environment this was strongly disagreed by 45.5% of respondents while those that strongly agree are 10.5% with an Arithmetic Mean of 1.8 which is rejected because is less than the theoretical mean (2.5). On Item ten 42.5% of the respondents strongly disagree that environmental protection court has been established to enforce laws and policies regarding solid waste management in the community while 9% agreed that the court has been established. Item twelve has a theoretic mean of 2.1, 45% of respondents disagree that waste management authorities have been effective in waste collection while 12.5% out of the respondents strongly agree.

Items eleven and thirteen are accepted because the calculated Arithmetic mean ( $\bar{x}$ ) of the items exceeds the theoretical mean (2.5) which is taken as cut-off point for rejection or acceptance, the items both have the mean of 3.2 and 3.1 respectively. 42.5% respondents strongly agree that Community Based Organizations also help in curtailing the solid wastes management problems that has overwhelmed the authorities, according to (Wilson et al. 2009) some communities which cannot access enough facilities to maintain their environments clean due to large amount of solid waste accumulations tend to form CBOs for their safety. Generally, these people mainly undertake primary collection and street cleaning. Also about 40.5% of the respondents agree that there is cooperation between the people and the environmental health officials in charge of solid waste management while 7% responded disagreed. Kayode and Omole, (2011) in a similar study in Ibadan metropolis noted that lack of cooperation between the people and the environmental health officials in charge of solid waste in Ibadan metropolis makes the enforcement of environmental law and order to be ineffective in the core area.

## SUMMARY

The high percentage of those with tertiary educational attainments indicates that respondents are educated and can easily co-operate in healthy solid waste management practices. Most of the respondents agreed that dumping of hazardous substances in the environment is prohibited by the

authorities this statement was strongly agreed with a mean of 3.1 and respondents are much aware that indiscriminate dumping of refuse is discouraged, authorities also inspect premises, facilities and seize items that are harmful to the environment with a mean score 3.2 and 3.2 respectively. While items six and seven shows that Private sectors are involved in waste collection and disposal and there are environmental sanitation volunteers amongst the citizenry with a mean of 3.2 and 2.9 respectively. Where as the research statement 1, 4 and 8 were rejected, this is because the calculated arithmetic mean ( $\bar{X}$ ) of all the items was less than the theoretical mean (2.5). Most of the respondents have disagreed on the notion that authorities have established guidelines on waste disposal and collection in Sabon Gari , most respondents are also unaware of penalty charges for those who dispose wastes indiscriminately in the community only a few are aware. This implies that people in the community are not fully aware of the dos and don'ts regarding waste management, it also implies that there is no penalty for dumping waste indiscriminately in the environment. From the research it is deduced that there are no sensitisation programmes carried-out to educate people on environmental Laws only 11% are aware that there are sensitisation programmes carried out.

Table 3ii shows that the research statements 9, 10 and 12 were all rejected, this is because the calculated Arithmetic mean ( $\bar{x}$ ) of all the items is less than the theoretical mean (2.5). the statement that environmental laws and policies in the community have made great impact in terms of waste control in the environment was strongly disagreed upon with a mean of 1.8. Item ten most of the respondents strongly disagree that environmental protection court has been established to enforce laws and policies regarding solid waste management in the community while few agreed that the court has been established. Item twelve has a theoretic mean of 2.1 most respondents disagree that waste management authorities have been effective in waste collection. Items eleven and thirteen are accepted because the calculated Arithmetic mean ( $\bar{x}$ ) of the items exceeds the theoretical mean (2.5) which is taken as cut-off point for rejection or acceptance, the items both have the mean of 3.2 and 3.1 respectively. 85 respondents strongly agree that Community Based Organizations also help in curtailing the solid wastes management problems that has overwhelmed the authorities and 40.5% of the respondents agree that there is cooperation between the people and the environmental health officials in charge of solid waste management.

## CONCLUSION

Conclusively, the review of literature was done in order to grasp the public concern and its involvement in environmental policies. there are relatively limited number of study on environmental awareness in developing countries and those exited lack a policy oriented view. Therefore, it is quite urgent that empirical study on environmental awareness to be carried out in developing countries in order to: first, to collect basic information, second, to justify the validity of method and third, to incorporate the outcome into the environmental policy making process.

## RECOMMENDATIONS

The following recommendations were made to guide the study

1. There is no doubt the low level of environmental awareness in Sabon Gari Local Government Area could affect individual's behavior and environmental habit towards his environment. Therefore, government should mount strategic environmental campaigns to raise public awareness through the various existing media in Gari Local Gouvernement Area.
2. There is the need for government to formulate a solid waste management national policy to facilitate the development of appropriate laws to govern the management of solid waste, but not much has been done to that effect, although the local government may have the power to come up with by-laws on any issue in their areas of jurisdiction, it may still be difficult for them to come up with such when there is no guiding policy at national level.
3. The police and judiciary should take their roles seriously in environmental management, particularly in the enforcement of environmental laws, hoping that this will change the way Nigerians interact with the environment.
4. Government should ensure that resources released for environmental management programs are judiciously utilized for the purpose for which it was released.

## REFERENCES

- Ahmed, S.A. and Ali, M.(2004). Partnerships for solid waste management in developing countries: linking theories to realities. *Habitat International* 28,467–479.
- Aondoakaa, S.C and Ishaya, S (2009). Assessment of People's Perception on the Impact of Urban Generated Solid Waste on the Environment in Gboko, Benue State; *Confluence Journal of Environmental Studies*, 4: 17-20.
- Carson, A. (1962): "The polls-poll trends: environmental problems and protection", *Public Opinion Quarterly*, vol. 55.
- Ejide, R. (2017): "Managing scarce environmental resources", D. Stokolos and I. Altman (eds.), *Handbook of environmental psychology*, vol. 2, New York, Wiley Press.
- Federal Environmental Protection Agency/Federal Ministry of Environment (FEPA/FMENV) (2005).
- Fleming A. (2006): "The effect of respondent characteristics on general environmental attitude-behaviour correspondence", *Environment and Behaviour*, vol. 29, No. 5.
- Kayode.A.M and Omole F.K(2011). Some Socio-Economic Factors affecting Solid Waste generation and disposal in Ibadan Metropolis, Nigeria. *Journal of Environmental issues and Agriculture in Developing Countries*, 3, (1)
- Klijin, E.H. and Teisman, G.R (2003): Institutional and Strategic Barriers to Public-Private Partnership: An Analysis of Dutch Cases, *Public Money & Management*, 23:3, 137-146.
- Ogwueleka I. C (2003) Analysis of Carbon Solid Waste in Nsukka, Nigeria.*Journal of Solid Waste Technology and Management* 29(4) 239-246
- Onyema, A.I. (2004). Solid waste management of achara layout area of Enugu city, being along essay submitted to the department of geography, (pgd) degree in environmental management, Nnamdi Aszikwe university.
- Pacey, A. (1990). Hygiene and Literacy, in Kerr, C (ed), *Community Health and Sanitation*.Intermediate Technology Publications, Nigeria.
- Ugwa, J. (2006), *Solid Waste disposal Problems in Zaria Metropolis*. An Unpublished B.ScProject.Department of Geography.Ahmadu Bello University Zaria.
- Wilson D.C, Araba A, ChinwahK.m and Cheeseman C.R. (2009). Building recycling rates through the Informal sector. *Journal of Waste Management* 29, 629-635.

**LEGAL ISSUES IN JOURNALISM AND ENVIRONMENT AS A CRIMINAL ACT IN  
COMMUNITIES OF LAKE CHAD BORNO STATE NORTH EAST NIGERIA**

**Dogo A. Ngare<sup>1</sup>,**

Department of Geography  
School of Social Sciences,  
College of Education Science and Technology,  
PMB 16 Bama,  
Borno State Nigeria

**Z. Bayero. Aliyu<sup>2</sup>**

High Court Borno State Judiciary,  
Borno State, Nigeria  
[Department of Mass Communication,  
Faculty of Social and Management Sciences,  
BOSU PMB 1122 Njimitilo,  
Kano Road Maiduguri,  
Borno State Nigeria]

**A. Ali. Modu<sup>3</sup>**

High Court Borno State Judiciary,  
Borno State, Nigeria.

**And F. A. Ahmad**

Department of Sociology  
Centre for Human Resources and Development  
College of Education Science and Technology,  
PMB 16 Bama,  
Borno State Nigeria

**ABSTRACT**

This study was to assess the legal issues in journalism and environment as a criminal act in communities of Lake Chad Borno State, north east Nigeria. The objectives were to: examine legal issues as a profession, identify the nature of environment where this profession is been practiced, document the nature of criminal acts committed by journalist in the study area Lake Chad communities; Data for the study were obtained from secondary source, secondary data include research projects, dissertation, thesis written by previous scholars, books, articles, journal, Judicial briefs and proceedings and data from media houses and individual practitioners, the generated were analysed using simple tables and percentages to assess the evidence of those acts in the study area. Few Possible recommendations were also made for the future.

## Introduction

As every profession would have its guiding principles governing its activities, so also the Journalism profession being the fourth realm of the estate for its explicit capacity of advocacy and implicit ability to frame political issues (<https://en.m.wikipedia.org>) has its guiding principles referred to as the Journalistic legal issues or Legal issues in Journalism.

Journalism being the watchdog of the society and doubling with the surveillance function coupled with the agenda setting function owes the community certain responsibilities beyond mere Educating, Entertaining and informing the public. As the public look up to journalists to quench their thirst for information, journalists strive to do these with all fairness, credibility, objectivity, accurate and timely reports of facts.

Rather than treating journalists, artists, creators, and startups as silos, let's recognize the common legal issues faced across all of these groups, and find ways to address the growing demand for legal services by building key legal infrastructure.

## Aim and Objectives of the study

The aim of this study is to look at legal issues in journalism and environment as a criminal act in communities of Lake Chad Borno state north-east Nigeria. Specific objectives are to:

- i. Examine legal issues in journalism as a profession.
- ii. Identify the nature of environment where this profession is been practiced.
- iii. Document the nature of criminal acts committed by journalist in the study area Lake Chad communities.

## Study Area

Borno state lays in the north eastern corner of Nigeria between latitudes 11.00 and 13.45 east. It occupies an area of 69.435 Sq km sharing border with three states, Adamawa to the South, Gombe to the South Westland Yobe to the West as well as three countries, namely, Republic of Niger, Chad and Cameroon to the North, North-East and East respectively. (Waziri, 2009).

According to National Population Commission Borno state has a total population of 4, 151, 103 people, with annual growth rate of 2.8% per annum (NPC, 2006). Maiduguri Metropolis is situated in a semi-arid climate zone. It has basically two seasons: dry and wet seasons. These are further distinguished by the local population into: Binəm (cool dry season), harmattan season from December to February; Bey, (hot dry season), from March to late May: Nəngəli, raining season from June to September and Biila, humid dry transitional period between September and November (Waziri, 2009). According to (Wakil *et al* 2009) empirical findings have shown that rainfall is dwindling in Maiduguri both in volume and number of rainy days since the 1970s. The raining season never exceeds four months in the area, with an annual rainfall mean of 577mm. The rainfall type is usually convectional which is mostly in the afternoon hours (Iloeje, 2009). Rain fall is usually heavy and within a short duration with some variations within a small distance. Temperatures generally range between 29.4°C and 35°C. There is a sudden rise in temperature during the day around April, May and June, occasionally exceeding 40°C, and high terrestrial radiation in the night. With these weather conditions coupled with the low humidity (40% to 60% relative humidity), evaporation is always high and the environment can only support the growth of a scanty vegetation.

The economy of the state is anchored on natural resources such as clay, salt, nitron, limestone and kaolin. Iron ore and uranium and micas petroleum is prospected intensively on the shore of the



Lake Chad in the state. There are only few industries in the state. These are flour mills, shoe factory, ginnery, dairy products, and corn milling just to mention a few (Waziri, 2009). Different kinds of land uses can be identified: such as settlements, agricultural, road, forestry, but the dominant type is the agricultural land use. Majority of the people in the area are peasant farmers although they may be engaged in other activities.

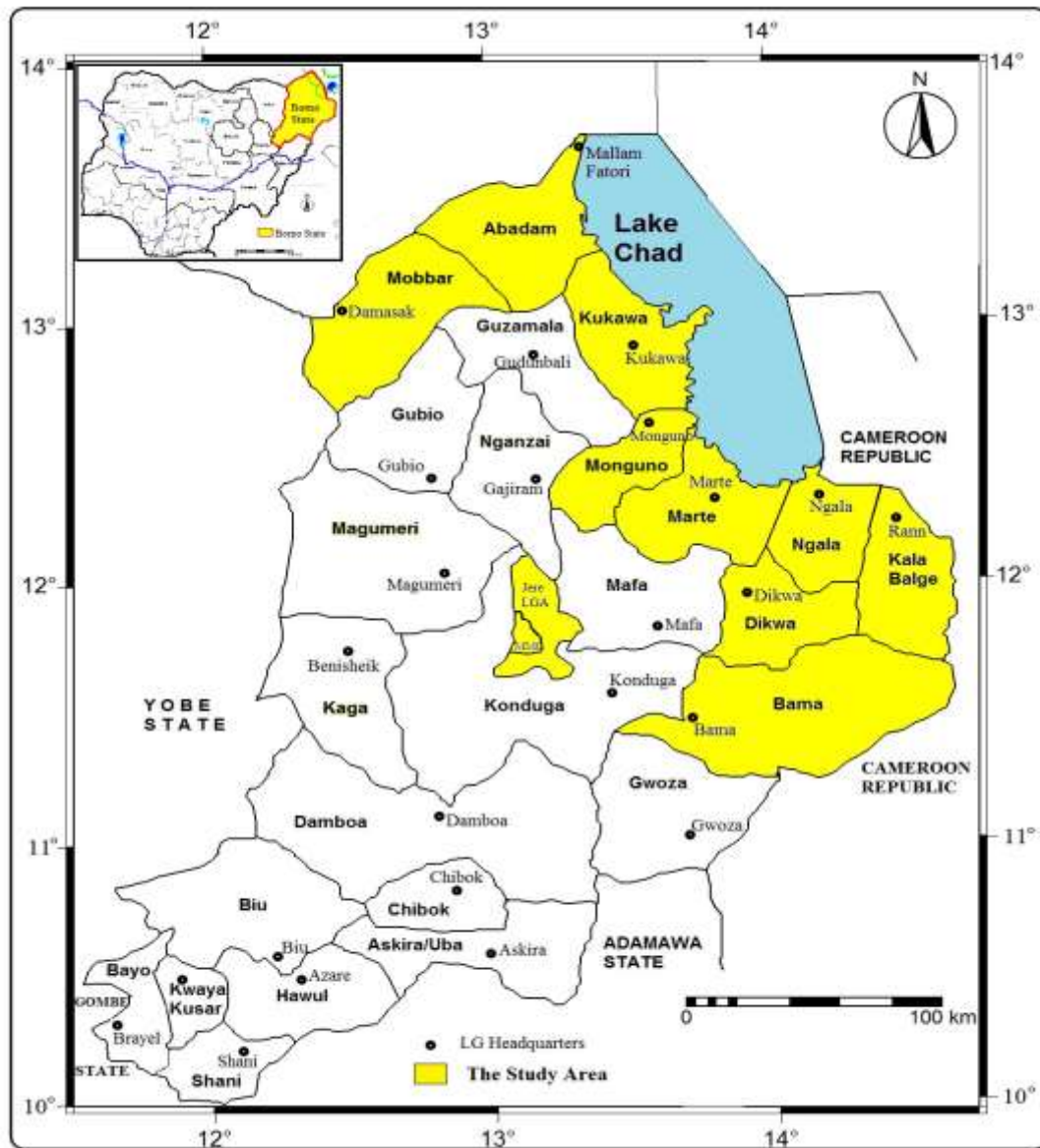


Fig: 1 BORNO STATE SHOWING SAMPLE SETTLEMENTS AND STUDY AREA THAT CONSTITUTED THE FORMER (MEGA LAKE CHAD)

Source: GEONETCast Unit, Department of Geography, University of Maiduguri, 2018

### **Methodology**

The data used in this study were generated from secondary source only; the secondary data sourced from journal articles, conference proceedings, papers, books, photographs and other relevant sources were all consulted to have relevant information on legal issues in journalism and environment as a criminal act in communities of Lake Chad Borno state northeast Nigeria.

### **Results and Discussions of Findings**

**Defamation-** This is the most troublesome area to handle for journalists because a defamatory statement may not have been so intended. But at times, the journalist might knowingly publish a defamatory statement with the belief that it is in the interest of the public. Legal authorities and scholars define defamatory statement as; A statement which is calculated to injure the reputation of a person to whom it refers and intended to lower him in the estimation of righthinking members of the society. These words which are capable of leaving a stain on the reputation of another should not in the absence of lawful excuse be published. Expatiating defamation, Eweluka (2004) notes four highlights of a defamatory statement which are, in the opinion of the victim calculated to: I. Lower him in the estimation of the right-thinking men or ii. Cause him to be shunned or avoided or iii. Expose him to hatred, contempt or ridicule or IV. Convey an imputation on him disparaging or injurious to him in his office, profession, calling, trade or business.

**Children and minor-** In no account should a journalist disclose the identity of children below the age of sixteen. Victims of rape, theft, and other social vices below age sixteen should be anonymous as revealing their identity might cause damage and discrimination to their personalities.

**Non-disclosure of source-** It is a known fact that every information must have a source, it is therefore a duty of journalist to keep their source(s) of information confidential especially sensitive information that might put the originator in danger.

**Access to public records-** It's clear that journalists need access to public records, but one may not realize that documentary filmmakers, researchers, historians, archivists, and a variety of entrepreneurs and nonprofits trying to take raw data and turn it into actionable information need it, too. Accessing this information requires untangling a complex web of state and federal law. Navigating this web be a bit easier with the help of attorneys. And in the case where a lawful request is denied; an attorney can bring formal litigation to ensure that the records are released.

**Censorship:** Censorship is the suppression of speech or other public communication which may be considered objectionable, harmful, sensitive, or inconvenient as determined by a government, media outlet, or other controlling body (Berger and Luckman, 2011). It is also defined by Lavender et al (2003) as the supervision and control of the information and ideas that are circulated among the people in a society. In modern times, censorship refers to the examination of books, periodicals, plays, films, television and radio programs, news reports and other communication media for the purpose of altering and suppressing parts thought to

be objectionable or offensive (Hans, 2009). The objectionable material may be considered immoral or obscene, heretical or blasphemous, seditious or treasonable, or injurious to national security. Censorship can also be defined as the official prohibition or restriction of any type of expression believed to threaten the political, social, or moral order (Dave, 2007). It may be imposed by governmental authority, local or national, by a religious body, or occasionally by a powerful private group. It may be applied to the mails, speech, the press, the theatre, dance, art, literature, photography, the cinema, radio, television, or computer networks. Censorship may be either preventive or punitive. It can be done by governments and private organizations or by individuals who engage in self-censorship. It occurs in a variety of different contexts including speech, books, music, films, and other arts, the press, radio, television, and the Internet for a variety of reasons including national security, to control obscenity, child pornography, and hate speech, to protect children, to promote or restrict political or religious views, and to prevent slander and libel. Many countries provide strong protections against censorship by law, but none of these protections are absolute and it is frequently necessary to balance conflicting rights in order to determine what can and cannot be censored. The rationale for censorship is different for various types of information censored (Hijams, 2006): a. Moral censorship is the removal of materials that are obscene or otherwise considered morally questionable. Pornography, for example, is often censored under this rationale, especially child pornography, which is illegal and censored in most jurisdictions in the world.

1. Military censorship is the process of keeping military intelligence and tactics confidential and away from the enemy. This is used to counter espionage, which is the process of gleaning military information.
2. Political censorship occurs when governments hold back information from their citizens. This is often done to exert control over the populace and prevent free expression that might foment rebellion.
3. Religious censorship is the means by which any material considered objectionable by a certain faith is removed. This often involves a dominant religion forcing limitations on less prevalent ones. Alternatively, one religion may shun the works of another when they believe the content is not appropriate for their faith. For example, when Catholics in Kenya protested that the condom advert be banned as it was against their beliefs and objectionable to their faith.
4. Corporate censorship is the process by which editors in corporate media outlets intervene to disrupt the publishing of information that portrays their business or business partners in a negative light, or intervene to prevent alternate offers from reaching public exposure.

Thus, the rationale for censorship is that it is necessary for the protection of the family, church and the state. Therefore, publishers and other media practitioners should ensure that the information they circulate to the public is free from hate speech, they should reject information that is tasteless or promote illegal obscene, immoral or harmful products.

**Invasion of Privacy-** Section 37 of the 1999 Constitution of Federal Republic of Nigeria guarantees and protects " The privacy of citizens, their homes, correspondence, telephone conversation and telegraphic communications". Therefore, in gathering and writing news stories, journalists must always bear in mind, this requires maturity and Professionalism. However, if the privacy of an individual endangers the public interest, it becomes quite difficult to totally avoid the invasion of privacy of such an individual.

**Responding to illegitimate takedowns-** We rely on a private intermediary service to share content with each other such as websites, apps, and webhosts. Unfortunately, bogus content takedowns often falsely rely on copyright, trademark, and a variety of abusive terms of use violation claims. Many intermediary services will quickly remove content to avoid liability. Navigating each service's appeals process, and making the legal arguments to get your otherwise legal content restored is not always easy. Negotiating with service providers and claimants to restore legitimate content often takes an experienced attorney explaining the user's legal position. Without that assistance, in addition to content removal and the risk of related lawsuits, a key consequence of takedowns is that a user can have their account permanently terminated, silencing their voice.

**Intellectual Property and Licensing-** where a journalist reproduces a work, be it in print, broadcast, artwork or design, proper acknowledgement should be accorded of the author, a journalist should abide by all rules of copyright, established by national and international laws. Copyright relates to artistic creations, such as books, music, paintings and sculptures, films and technology-based works such as computer programs and electronic database. It is also known as author's right (Andrew et al, 2010). Copyright is an 'intellectual property right' protecting things that are created by a person's skill, labour and investment in time and money (Hansen et al, 2008). You will find that most published works will state (usually in the first few pages) that no part of the publication can be reproduced in any material form without the written permission of the copyright holder. It is a legal concept, enacted by most governments, giving the creator of original work exclusive rights to it, usually for a limited time. Generally, it is "the right to copy", but also gives the copyright holder the right to be credited for the work, to determine who may adapt the work to other forms, who may perform the work, who may financially benefit from it, and other related rights. It is a form of intellectual property (like the patent, the trademark, and the trade secret) applicable to any expressible form of an idea or information that is substantive and discrete.

**Forming an entity-** The proliferation of smaller entities and individual journalism and creative projects leads those projects to ask the same questions startup entrepreneurs must ask. Setting up your entity sets the tone for the entire organization, and mistakes at this stage are costly.

While some DIY services for business formation exist, we've seen many businesses that made critical mistakes using DIY services at this critical early stage. Correcting these errors can be more expensive than getting proper legal counseling the first time.

**Fair Use-** Andy Warhol said “good artists borrow, great artists steal.” It may not be as catchy of a quote, but many great journalists, creators, and startups understand their rights to reuse content without permission. Understanding and exercising fair use allows us to engage in social, cultural, and political dialogue. It’s a critical safety valve to the broad protection and extremely long duration of copyright law. But as far as laws go, it’s on the complicated side. When journalists, artists, filmmakers, and startups want to share new perspectives and worldchanging ideas, a quality fair use analysis can make that happen. Moreover, many filmmakers and journalists need a fair use opinion from an attorney to obtain insurance and be picked up by distributors. But the reality is that only a small number of attorneys in the country are experts in fair use law, and when you narrow that list to folks willing to work on a reduced fee basis that number shrinks considerably and clients never find the legal services they need.

### **Conclusion**

Effects of poor communication strategies by some media personnel will continue to have negative impacts on the environment and the general society at large, there are serious issues happening day by day looking at the vulnerability of those communities located along the shores of Lake Chad Basin Borno state. The area had suffered series of challenges from different angle by different perpetrators. Journalism in a hostile environment like Lake Chad requires a lot of techniques and professionalism to ensure credibility in reports to be passed across. People living along the shores of the lake should learnt to listen to credible reporters from different media houses and their likes. Poor access to information could bring severe impacts on communities in such a way as to improvise on human wellbeing. There is a serious need to improve the understanding of communities on the importance, risks and hazards associated to poor communication so as for communities to own their radio houses and to be managed by them. Credible information by journalist alone may not be sufficient to meet the challenges of the current environmental and other associated factors triggered by poor journalism as a criminal act in the environment of Lake Chad Borno State North East Nigeria as in addition to the aforementioned other legal issues in journalism practice includes: Credibility, Accuracy, Fairness and Objectivity.

### **References**

- Andrew, S. R., Rothman, S., & Lichter, L. S. (2010). *The Media Elite: America’s New Powerbrokers*. Bethesda, Maryland: Adler & Adler
- Berger, P., & Luckmann, T. (2011). *The social construction of reality*. New York: Doubleday Anchor.
- Bukar, Y (1990) the Relationship between Cultivation and Pastoralist in Nguro Soye of Bama  
L.G.A: Unpublished Final Year Project Submitted to the Department of Geography University of Maiduguri
- Burkett, V. J.O. Codignotto, D.L. Forbes, N. Mimura, R.J. Beamish, and V. Ittekkot 2001. Coastal Zones and Marine Ecosystems in IPCC. 2001. *Climate Change 2001: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change McCarthy, J.J., O.F. Canziani, N.A. Leary, D.J. Dokken, and K.S. White (eds.), accessed August 31/ 2009

- Dogo. A.N (2012) An Assessment of Community Level Adaptation Strategies to Environmental Degradation in Bama L.G.A Unpublished M. Sc Dissertation Submitted to the Department of Geography University of Maiduguri November 2012
- Eweluka, B.N. (2004). Introduction to Nigerian Press Law. Onitcha: Maranathan Press
- GEONETCast Unit, Department of Geography, University of Maiduguri, 2016
- Hansen, A., Cottle, S., Negrine, R., & Newbold, C. (2008). Mass communication research methods. London: Macmillan
- Hans 2009, Self-Censorship in Contexts of Conflict
- Hijams 2006, US Department of State Country Report on Human Right Practices 2006 <https://en.m.wikipedia.org>
- Hayward and Oguntoyinbo, (1987) Climatology for West Africa. London: Longman Publishers
- Intergovernmental Panel on Climate Change (IPCC, 2001) Intergovernmental Panel on Climate Change (IPCC, 2005) Energy Research and Development Panel of the President's Committee of Advisors on Science and Technology, Federal Energy Research and Development for the Twenty-First Century, and U.N IPCC
- Intergovernmental Panel on Climate Change (IPCC, 2002)
- International Union for the Conservation of Nature (IUCN, 2003)
- J, Allman 2015 [https://en.wikipedia.org/wiki/LakeChad\\_Basin\\_Commission](https://en.wikipedia.org/wiki/LakeChad_Basin_Commission)
- Lavender, M. J., Flanagan, A. J., Eyal, K., Lemus, D. R., & McCann, R. M. (2003). Credibility for the 21st century: Integrating perspectives on source, message, and media credibility in the contemporary media environment. Communication Yearbook 27
- National Population Commission (NPC, 2006)
- Patrick Burnett 2014: United Nation Development Programme (Human Development Index 2007/2008)
- Shehu M. B (1998) Phonological events guiding farm operation among Kanuri's, Unpublished Final year Project Submitted to the Department of Geography University of Maiduguri
- Thiemeyer, H. (1991/92), (2000): A new 14C-record from the Bama Ridge near Konduga, Borno State, NE-Nigeria. -Annals of Borno, 8/9: 239 - 242; Maiduguri.
- United Nation Framework Convention on Climate Change (UNFCCC)
- United Nation Development Programme (UNDP, 2004)
- USGCRP (2000) U.S. Global Change Research Program, Climate Change Impacts on the United States; the Potential Consequences of Climate Variability and Change, "Overview: Great Plains". Washington DC.
- Waziri M, Kagu A, Monguno A.K, Issues in the Geography of Borno Vol. 1 Pp 21-23 (The Bama Ridge: A Significant Landmark in Borno by Abba Kagu and Sadik A. Yelwa)

## EXPLORING THE USE OF TEACHING METHODS AMONG SOCIAL STUDIES TEACHERS

**Mofoluwawo Esther Omoniyi, Ph.D**

Department of Social Studies  
School of Arts and Social Sciences  
Emmanuel Alayande College of Education, Oyo,  
Oyo State, Nigeria.

**Ajibade Ismail Oyebanji**

Department of Social Studies  
School of Arts and Social Sciences  
Emmanuel Alayande College of Education, Oyo,  
Oyo State, Nigeria.

**Ogunniyi Omolayo Ayodele**

Department of Social Studies  
School of Arts and Social Sciences  
Emmanuel Alayande College of Education, Oyo,  
Oyo State, Nigeria.

### **Abstract**

This paper title exploring the use of teaching methods among social studies teachers. The paper disclose many teaching methods with advantages as well as disadvantage available to Social Studies teachers. It however note that no single method of teaching Social Studies can adequately fit all learning situations. The paper recommended that the combination of the methods would definitely help in achieving the desired instructional objectives.

**Keywords:** Teaching, Social Studies, Methods, Teaching Method, Teachers, Exploring.

### **Introduction**

A teacher has to make use of various kinds of methods, devices and techniques of teaching and suitable method for making his teaching meaningful, purposeful, interesting and effective. A good method of teaching can bring out good results even from a weak curriculum. On the other hand a bad method of teaching can make a mess of a good curriculum. Therefore, it can rightly be said that success or failure of teaching depends on its methods. The methods of teaching should be according to the needs and interest of learners. This paper examines the different types of teaching methods employed by social studies teachers to teach the subject, how effective they are, and there advantages and disadvantages. The paper uses relevant information from primary and secondary sources. The paper adopts descriptive approach and content analysis as its methodology. The paper

answers the question, what methods can be used to disseminate information to students in social studies and what are the nuances of each of these methods?

### **What is Teaching?**

Teaching is a process by which one interacts with another person with the intention of influencing the learning of that person. It is the interplay between the teacher and the students. Teaching as a useful and practical art calls for intuition, creativity, improvisation and expressiveness. Teaching method is the general principles, pedagogy and management strategies used for classroom instruction. Teaching method is a systematic way in which a teacher uses to transfer or receive or share information. Teaching method is the process of imparting knowledge and skills which is used by a teacher in the classroom. Effective teaching of Social Studies involves the incorporation of a variety of techniques in the instructions given to students. The ultimate goal of teaching Social Studies is to ensure all students are successful without hindrances brought forth by their learning capacities.

### **Characteristics of a Good Teaching Method**

- (i) It should provide a group of related experiences and activities, arranged on an individual as well as group basis.
- (ii) It should give scope for the creative expression of the child's individuality.
- (iii) It should arouse a large range of interest in the minds of the students.
- (iv) It should shift emphasis from verbalism and memorization to learning through powerful, concrete and relativistic situations.
- (v) It should train the students in the techniques of self-study and the methods of acquiring knowledge through personal effort or in tuition.
- (vi) It should stimulate the desire for further study and explorations.
- (vii) It should awaken an interest in the materials and techniques used by Social Studies teachers.

### **Factors that Determine the Selection of a Teaching Method**

- (i) The nature of the student
- (ii) The objectives of instruction
- (iii) The nature of the subject matter
- (iv) The classroom environment
- (v) The expertise of the teacher who adopts a method.

### **Different Methods of Teaching Social Studies**

#### **(1) Lecture Method**

This simply means teaching through lecture. The teacher explains the matter in simple and understandable manner. The method is particularly used in the secondary classes and above. This method can be used to motivate students, to clarify, to review and to expand contents. Lecture method is for imparting authentic, systematic and effective information about some events and



trends. It gives the students training in listening; develops good audience habits, provides opportunities of correlating events and subjects and enables the linkage of previous knowledge with the new one.

### **Advantages of Lecture Method**

- (i) A well prepared and well delivered lecture can make Social Studies interesting.
- (ii) Lecture method gives the teacher an opportunity to come into immediate contact with the students.
- (iii) Lecture method gives the students training in listening and taking rapid notes.
- (iv) Lecture method saves time and energy
- (v) Good lectures stimulate brighter students
- (vi) It facilitates rapport between the teacher and the students.
- (vii) It helps the implementation of others
- (viii) It is good for a large class size
- (ix) It can be used in the absence of instructional materials.
- (x) It can be used in the case of shortage of manpower.
- (xi) It is less expensive to use
- (xii) It is used to cover a large scope of the syllabus within a short period of time.

### **Disadvantages of Lecture Method**

- (i) It makes students inactive
- (ii) There is a very little scope for student activity
- (iii) It may include irrelevant material
- (iv) It discourages self-effort by the students.
- (v) Every teacher is not expert enough to deliver lecture
- (vi) Students lose opportunity to make self-study.
- (vii) Lecturing is against the principle of “learning by doing”.
- (viii) An average student may not be able to fix up their attention to a lecture of 40-45 minutes.

### **(2) Problem-Solving Method**

In this method, the student is required to solve a problem, making use of his previous knowledge. According to Dewey, the problem fixes the end of thought and the end controls the process of thinking. It involves the use of scientific approach to teaching-learning process. It enables the student to become aware of the fact that there is an orderly procedure or stage in thinking and doing things. Possible problem areas in Social Studies that can be considered by the teacher include family problems, academic problem, socio-cultural problem sex problems, religious problem etc.

### **Procedure for Problem Solving**

- (i) Identify a problem
- (ii) State the problem clearly in simple language

- (iii) Suggest possible solutions to the problems
- (iv) Discuss the suggested possible solutions
- (v) Accept reasonably suggestions.
- (vi) Determine the solution to the problem through reasonable suggestions.
- (vii) Re-state the original problem and solution.

#### **Criteria for Problem Solving**

- (i) The problem should be intellectually challenging to students
- (ii) The problem should not be entirely unfamiliar to the students. It should be related to their previous experience.
- (iii) The problem should be related to a basic human activity
- (iv) The problem should have practical relevance
- (v) The problem should have the potential to create interest among in the specific problem in particular and problem solving in general
- (vi) The problem should be capable of several interpretation or solutions
- (vii) The problem should be stated in a language that is clearly understandable.

#### **Advantages of Problem Solving Method**

- (i) It serves a preparation for adult life
- (ii) It develops the power for critical thinking
- (iii) It makes students active recipient of knowledge
- (iv) It develops values of tolerance and open mindedness
- (v) It helps for the easy assimilation of knowledge
- (vi) It helps to establish harmonious relations between teacher and students.

#### **Disadvantages of Problem Solving Method**

- (i) This method will become monotonous if used too frequently
- (ii) The problem solving method can easily lead to the selection of trivial and untimely topics.
- (iii) This is appropriate for developing cognitive competencies, but not for bringing about affective changes.

#### **(3) Role Playing Method**

Role playing can be defined as an attempt to make a situation clear or to solve a problem by uncharged dramatization. Role playing is the dramatization of an event or a situation or a process. Role playing is dealing with problem through actions. The role is a patterned sequence of feeling, words and actions.

#### **Purpose of Role Playing**

- (i) To motivate or launch units
- (ii) To culminate units

- (iii) To change attitudes
- (iv) To teach values
- (v) To teach content having to do with human relationship
- (vi) To develop citizenship skill by showing both the successful and unsuccessful methods.

**(a) Conducting Role Playing**

- i. Preparing for role playing
- ii. Selecting the players
- iii. Preparing the audience
- iv. Preparing the players.

**(b) Playing of the Roles**

- i. Keep the role playing short
- ii. Let the students play it out
- iii. Do not evaluate the acting language
- iv. Do not allow evidence to interrupt

**(c) Following up the enactment**

- i. Discussion
- ii. Re-enactment

**Advantages of Role Playing Method**

- i. Develops deep understanding
- ii. It develops problem solving skills and attitudes
- iii. It explores subject matter in varied ways
- iv. It develops interpersonal communication
- v. It gives students the opportunity to express their thoughts and feelings
- vi. It helps to develop in the students' cooperative attitude and the desirable social behaviour.

**Disadvantages of Role Playing Method**

- i. Students who are not well prepared for role playing may not take it serious
- ii. Role playing will not work unless the atmosphere in the classroom is supportive
- iii. Students find it difficult to enter the roles properly especially if they are not well briefed on the assignments.
- iv. Role playing does not always take the direction one hopes
- v. Role playing is time consuming
- vi. For role playing to work well, one needs a group of sensitive, imaginative, open minded students who know each other well enough to be at ease with each other.

**(4) Information and Communications Technology (ICT)**

**Enabled Learning Method**

Information Communication Technology (ICT) is a generic name used to describe a range of technologies for gathering, storing, retrieving, processing, analyzing and transmitting information.

### **Benefits for Students**

- (i) Higher quality lessons through greater collaboration between teachers in planning and preparing resources.
- (ii) Gains in understanding and analytical skills, including improvements in learning.
- (iii) Encouragement of independent and active learning and self-responsibility for learning.
- (iv) Flexibility of anytime, anywhere access.
- (v) Increased self-confidence and self-esteem
- (vi) Students found learning in a technology-enhanced setting more stimulating and student-centred than in a traditional classroom.
- (vii) Opportunities to address their work to an external audience.
- (viii) Opportunities to collaborate on assignments with people outside or inside school.

### **The Use of ICTs in Improving the Quality of Education**

ICTs can enhance the quality of education in several ways:

- (i) **Motivating to learn:** ICTs such as videos, television and multimedia computer software that combine text, sound and colourful, moving images can be used to provide challenging and authentic content that will engage the student in the learning process.
- (ii) **Facilitating the acquisition of basic skills:** The transmission of basic skills and concepts that are the foundation of higher order thinking skills and creativity can be facilitated by ICTs through drill and practice.
- (iii) **Enhancing teacher training:** ICTs have also been used to improve access to and the quality of teacher training.

### **Problems of ICT**

One of the major barriers for the cause of ICT not reaching its full potential, in the foundation stage is teacher's attitude. In early year education, attitudes towards ICT can vary considerably. Some see it as a potential tool to aid learning whereas others seem to disagree with the use of technology in early year settings. Another important drawback to using ICT in schools is the fact that computers are expensive.

### **(5) Concept Mapping Method:**

It is an act of constructing maps or diagrams including interrelationships among concepts to represent meaning or ideas on a domain of knowledge. The concepts are arranged hierarchically from general to specific.

### **Procedure for Concept Mapping**

- i. Selection of item for mapping a text, passage, lesson note etc.
- ii. Underline keywords or phrases, objects and events.
- iii. Arrangement of rank and list of concepts from abstract to specific or concrete.
- iv. Drawing circles around the concepts.

- v. Connection of the concept using lines or arrows for easy reading and interpretation.
- vi. Provision of examples at each branch terminus.

#### **Advantages of Concept Mapping Method**

- (i) It encourages deductive reasoning in students.
- (ii) It simplifies the topics.
- (iii) It enhances critical thinking in students
- (iv) It broadens the horizon of the students in terms of the scope covered in the topic.

#### **Disadvantages of Concept Mapping Method**

- (i) It may become boring if not well organized
- (ii) It is time consuming
- (iii) It may be complex or abstract for the student to comprehend easily.

#### **(6) Filmstrip and Slides Method**

A filmstrip is a roll of transparent film containing images designed to be viewed from a filmstrip projector. A filmstrip may contain from 20 to 60 frames depending on the number of visuals required in the concept being taught. Film strip can be commercially made or locally produced. Most filmstrips are not accompanied with audio recording. Slide projection entails the projection of slide films with the slide projector. Slide refers to a frame of photographic transparencies bound by card. Mounts and designed for use with slide projector or slide viewer.

#### **Advantages of Filmstrip Method**

- (i) Filmstrip is compact, easy to handle and can be teacher-made.
- (ii) Filmstrips represent information in sequential order and there is no fear of it being disorganized as with slide.
- (iii) The pace of viewing filmstrips can be controlled compared with audio and motion media.

#### **Disadvantages of Filmstrip Method**

- (i) The frames are permanently fixed in a certain order, it is not possible to alter the sequence of pictures without destroying the filmstrips.
- (ii) They can be used only where there is electricity.
- (iii) It projects only still images.
- (iv) The sprocket holes can easily be damaged if not carefully handled.

#### **Advantages of Slides Method**

- (i) Slide can be arranged and re-arranged to suit the audience and purpose for which they are being used.
- (ii) Slides are used to present information in sequence
- (iii) Slides are preferable when only a picture or few pictures are to be projected.

- (iv) Framing of slides protect them from damage during handling.
- (v) Slides are generally available and easy to handle.
- (vi) It is easy to build up permanent and collections of slides for instructional purpose.

#### **Disadvantages of Slides Method**

- (i) Slides can easily become disorganized since they are single pictures.
- (ii) Slides can easily accumulate dust and fingerprints and get damaged if not carefully stored or handled.
- (iii) Slides are likely to be more expensive compared with filmstrips.
- (iv) Slides show only still pictures and therefore are not good for teaching Social Studies concepts that require motion.
- (v) Electricity supply is a requirement.

#### **(7) Brainstorming Method**

Brainstorming is a large or small group activity that encourages students to focus on a topic and contribute to the free flow of ideas. Social Studies teacher may begin a brainstorming session by posing a question or a problem or by introducing a topic. Students then express possible answers, relevant works or ideas. Contributions are accepted without criticism. These ideas are then examined, usually in an open class discussion format. Brainstorming is the random generation of ideas based around a topic. There is no editing or ordering of these ideas. Brainstorming can encourage students to think more freely and innovatively than if they are doing a more restricted and routine classroom situation. It allows students to remember what they know and to teach each other. It is a dynamic and stimulating way to lead students into a topic. Brainstorming is a tool that uses a relaxed, informal atmosphere combined with lateral thinking to solve problems. Brainstorming contributes to the generation of creative solutions to a problem. Brainstorming is a very useful activity that can be easily introduced into Social Studies classes.

#### **Advantages of Brainstorming Method**

- (i) It creates a greater number of alternative responses since the groups information and knowledge tend to be more comprehensive and reliable.
- (ii) The group decision making is democratic in nature
- (iii) Implementation of a brainstorming based decision is more effective as the entire group participate.
- (iv) Brainstorming brings new ideas on how to tackle a particular problem – the free thinking atmosphere encourages creativity.
- (v) Problems are defined better as questions arise and novel approaches to an issue can arise during the process.

#### **Disadvantages of Brainstorming Method**

- (i) The importance of the moderator is often under-estimated

(ii) Sometimes the ideas produced are unworkable: opponents may refuse to consider each other's ideas.

### **(8) Dramatization Method**

Dramatization method refers to a collection of teaching tools that include traditional drama techniques, such as improvisation, storytelling, role playing and games. Social Studies as a subject is about the learning of certain skills and values necessary for successful living in a modern dynamic society. How valuable will it be for students to act in and see dramatized the various interactions of human being with other human being with his environment. There are many ways to use dramatization method in the classroom. Teachers can use it to help students gain deeper insights into lessons, build on concepts and themes or as a means to test student knowledge. These creative techniques often bring a bit of chaos into the learning process, and teachers guide their students through this creative chaos while staying with the framework of the curriculum.

Teachers may choose to use dramatic teaching methods, such as teacher in role, storytelling or still images. In the teacher in role method, the teacher assumes a character role to guide discussion on a topic. The teacher may use costuming or props to give the role more depth and the teacher answers questions from students while in character. With the story-telling method, the teacher brings the subject matter to life through the use of stories. The stories incorporate key information from the course and turn it into a compelling story that is told in the teacher's own words. With the still images method, the teacher instructs students to form a circle and each student takes a turn at recreating a still image with their bodies that represents a specific topic idea.

### **Advantages of Dramatization Method**

1. Through dramatization, we can develop the creative instincts of the students.
2. It helps in proper utilization of knowledge and activities of the students.
3. It can be used to teach team-work and to help new classmates to bond.
4. It provides a change to the students from the formal and rigid atmosphere of classroom and reading of books.

### **Disadvantages of Dramatization Method**

1. Students can get disorderly and over-excited.
2. Some students may feel inadequate or self-conscious compared to those who are naturally good at drama.
3. Some students may see it as an opportunity to avoid "real" work.
4. Not everybody likes drama.
5. Not all students will be kinesthetic learners.

### **(9) Questions and Answers Method**

Question and answer teaching strategy is an old method known a "Socratic method of teaching". It was developed by the famous philosopher Socrates. Question is the key to all educative activities,

question and answer is the method that focused on how to achieve the cognitive objectives and bringing knowledge to the conscious level.

### **Principles of Question and Answer Method**

1. Theory of unfoldment, all knowledge is within the child, teacher cannot teach anything from outside.
2. The knowledge can be emitted by linking the questions with his answers.

### **Steps of Question and Answer Method of Teaching**

1. To prepare questions and arrange them in a logical sequence.
2. To present the questions in such a way that curiosity arises among the learners.
3. To ask new questions by linking with the learners response.

### **Advantages of Question and Answer Method of Teaching**

1. While asking questions, the teacher keeps in mind the abilities, needs and interest of the learner.
2. It involves the learners' participation towards the subject matter and in teaching acts.
3. It helps in achieving cognitive objectives and bringing knowledge at conscious level.
4. Classroom verbal interaction is encouraged.
5. It is a useful method at all levels of education.

### **Disadvantages of Question and Answers Method**

1. It is difficult to prepare good questions and arrange them logically.
2. The whole content-matter cannot be taught by this method.
3. The teacher wants the structured answers from the learners. There is no freedom for imaginative answers.
4. It is time consuming.
5. It may sometime mar the atmosphere of the class.

### **(10) Field Trip Method**

Field trip is an educational procedure by which the learners obtain first hand information by observing places, objects, phenomena and processes in their natural setting. Field trips involve journey with the students to observe and investigate situations outside the classroom as they occur in actual situations.

### **Advantages of Field Trips Method**

1. Going on field trips offers students a unique cultural learning experience.
2. It allows students to be involved in new environments
3. Field trips are keys to encouraging curiosity about a given subjects.
4. Field trips is also valuable as an exercise in broadening students understand of the world and their place in it.



5. It develops students' skills in the application of theories to real world situation.
6. It affords the students the opportunity of exploring the achievements of the community.
7. It develops in learners' the skills of observation and recording.
8. Through field trips, data gathered could be used for further studies.

#### **Disadvantages of Field Trips Method**

1. Planning and preparation are often the biggest hurdles in setting up an educational trip
2. It may be a waste of time and resources if not well planned.
3. It is externally difficult to carry out especially when it requires long distance.
4. Accident may occur in the course of trip.
5. It results in extra financial expenses on the part of the school, parents and even the students.
6. On field trips, students normally get a sense of freedom which may lead to misbehaviour.
7. It can be challenging to control an entire classroom in a new surroundings.

#### **(11) Discussion Method**

Discussion method of teaching is a group of activity involving both the teacher and the students to define the problem and seek its solution. Discussion method is also described as a constructive process involving listening, thinking as well as the speaking ability of the student. Discussion method is an important component for any teaching or learning situation which allows students to share their ideas. It can also be used at the beginning of a topic to ascertain students' preconceived notion of the subject matter or towards the end of a subtopic by presenting students with a new situation and asking them to explain in it terms of what they have just learned. Discussion method entails a teaching and learning strategy through students share and exchange ideas, experience and opinion takes place, accompanied by active learning with all members of the group participating in it.

#### **Advantages of Discussion Method**

1. It increases the depth of understanding and grasp of the subject matter.
2. Discussion method enhances motivation and generates greater involvement of the learners.
3. It promotes leadership role in students.
4. It develops skills of organizing and presenting ideas to others in a logical form.
5. Discussion method develops a spirit of cooperation among learners.
6. It gives the students training in prospecting other's views.

#### **Disadvantages of Discussion Method**

1. Discussion method is time consuming.
2. If not well handled. Some extrovert students may dominate the discussion.
3. It is not ideal for a large class.
4. It is not appropriate for all the topics.
5. Easy to deviate from the topic.

6. It requires presence of a teacher at all times.

### **(12) Project Method**

Project method is a teacher-facilitated collaborative approach in which, students acquire and apply knowledge and skills to define and solve realistic problems using a process of extended inquiry. Project methods are student-centered, following standards, parameters, and milestones clearly identified by the instructor. The mentor of the project method is an American educationist –John Dewey. He believed that individual activity was not enough in education and classroom instruction. Being a strong believer in educational value of the environment, he stressed the need for pupils to interact freely with their surrounding environment to glean the rich education that abounds in groups or individually under the guidance of the teacher to achieve set objective. The project method is a learning process or a study carried out by learners in real life situation. Students working under the project method have more freedom and autonomy to decide on what they deem best. The students decide on the topic they want to work on.

They also decide on how to collect their data and how to analyze the data collected. The teacher's main role is not to teach but to guide and advice, counsel and discuss with the student. The major characteristic of the project method is that students produce a thesis, a model, a written or oral report or some other piece of work. The project method features prominently in the student-centred curricular.

The process of doing a project obviously varies but it has four overlapping phases each with many parts. Some authors like NTI (1990) called these phases as planning stage, organization stage, implementation stage and assessment stage. In the first stage (planning stage) the students gradually selects a problem, theme or issue to investigate. At first the student may have an interest in a general subject area but as he finds available sources of information, he needs to narrow down his field of enquiry after selecting his problem, the student may decide his procedure to solve it. The second phase may continue beyond the third and it may include field work, experiences, surveys and other methods of collecting data, interpretation of that data and formulation of arguments based upon it. Only when the solution has been selected and developed in the student's mind that the students can plan the organization and presentation of his production.

### **Advantages of Project Method**

1. It provides a learning environment that encourages the child to be motivated intrinsically. Students are responsible for their own learning.
2. It permits each child to progress at his own pace.
3. It helps each child to learn according to his interest, abilities and mode of learning.
4. Students gain committed and satisfaction for producing their piece work because they may have permanent value. It increases experiences for investigation of each child.
5. It provides considerable enjoyment, it trains student not only for independent work but for tact and diplomacy leadership and decision making.
6. Most of all, student learn the techniques of research through project method.

### **Disadvantages of Project Method**

1. It requires a small class.
2. It needs increased time for the students to prepare and collect materials.
3. If project method is not clearly defined, students may be relatively difficult to control.

### **(13) Simulation Method**

Simulations are instructional scenarios where the learner is placed in a “world” defined by the teacher. They represent a reality within which students interact. The teacher controls the parameters of this “world” and uses it to achieve the desired instructional result. Simulation can be taught by allowing students to learn through instructional simulations, when they are actively engaged. Students should predict and explain the outcome they expect the simulation to generate. Every effort should be made to make it difficult for students to become passive during the simulation.

### **How Can We Use Simulation in the Classroom**

Classroom simulation motivate students by keeping them actively engaged in the learning process through requiring that problem solving and decision making skills be used to make the simulation run. As simulation runs, it is modeling a dynamic system in which the learner is involved (play a role). Among some of the most interesting and rewarding teaching techniques developed some time ago are simulation methods. These methods are dynamic and lively ways of presenting very thought provoking ideas, problems, issues and realities in our past and present, social life. They are relevant and important to the teaching of History, Religion, Social Studies as well as Economics. Simulation is derived from Latin word “similis” meaning like i.e. to act like to resemble, to pretend to be. Thus, simulation methods are activities or materials that present real-life situations, past events, incidents or organization in such a way that students will learn and understand more about them. One thing that is common to all kinds of simulations is that they all represent something that has happened or is happening in real life. Such thing as, the turbaning of Emir, crowning of an Oba, raising of the Nigerian flag on the first independence morning are being made into a simulation for the classroom.

### **Organization of Simulation Method**

Most of the activities in Social Studies simulation have to be prepared by the teacher. There should be a leader from the students. Such leader will prepare the student in dramatization forming small groups to pre-costumes, collect objects etc. The teacher should set down the actions to be performed at every simulation exercise. He should also provide a period of discussion where the class can review the model or pattern the simulation intend to teach. Through this discussion, the deeper messages or ideas of simulation can be studied. NTI (1990) spelt out some of the advantages and disadvantages of simulation methods as follows:

### **Advantages of Simulation Method**

1. They are highly self-motivating
2. They are effective techniques of teaching

3. The realities of life are presented in concrete and simple forms.
4. The mental ability of the pupil are fully put into use.
5. They give the pupils increase in personal sense of the environmental control
6. Historic simulation are also enjoyable in through its dramatic presentations.

#### **Disadvantages of Simulation Method**

1. Like dramatizations, historical simulations require a great deal of class time. The preparations, performance and review discussion will take several periods to carry out.
2. They are expensive and in many cases not available.
3. Historical simulation may tend to exaggerate one aspect over the others.
4. Because of the competitive nature of the games there are tendencies for disorderly behaviour in class.

#### **(14) Inquiry Method**

Inquiry method of teaching is a process of asking and answering key Social Studies questions. It is a method of teaching that involves a process of exploring the natural or material world that leads to asking questions and making discoveries in the search for new understandings. Inquiry method like discussion method are particularly appropriate for use in Social Studies classes the reason is because the methods allow student to deepen their understanding of ideas, issues and wants by having to examine and interpret them in a formal way. The inquiry methods require the teacher to involve the students in activities of investigation, collection and the understanding of information. The information is used to answer questions, discuss issues or to solve problems that have been identified in the class. The pupils seek outside the classroom for opinions, facts, and data that will help them to understand as the question or problem that has been presented.

The teacher should assist the students to know where to get the necessary information, how to collect the data and also what to do with the gathered information so that it can help in solving the problem. The teacher is to help the students to identify the problem, issue or question that is to be discussed and to assist in gathering information for the study. The name “inquiry” given to this method is as a result of the collection, classification and analysis of the information gathered. The method can promote skills of observation, information gathering and analysis of the information. The methods also encourage students to be objection and to see varied dimensions and aspects of ideas or problems. The inquiry methods give a foundation for students to understand what is involved in making a decision or arriving at a conclusion about a body of facts that have been collected. Students gain necessary experience in understanding the operations of events, people and society.

Some of the many kinds of inquiry methods that are most appropriate for secondary school classes are opinion polls, interview questionnaire and field trips. Students can practice simplified forms of these methods each of which can be conducted in a sophisticated way as it is done in adult society.

Such activity will prepare them for more complicated forms of inquiry methods in future and lay a foundation of understanding for the scientific approach to information.

### **Advantages of Inquiry Method**

1. The students are actively involved in the assignment
2. The students remember longer because they discover the facts on their own.
3. The students are rewarded by being motivated
4. Inquiry method allows students to be curious, to wonder and ask questions.
5. Inquiry allow students to pursue questions they have and topics they find personally relevant or interesting.

### **Disadvantages of Inquiry Method**

1. It is time consuming
2. They are expensive in the sense that many resource materials are needed
3. They are not suitable for all lessons.

### **Conclusion**

There are many teaching methods available to Social Studies teachers. It should however, be noted that no single method of teaching Social Studies can adequately fit all learning situations. The combination of other methods would definitely help in achieving the desired instructional objectives. Teaching method is a subset of an instructional approach. It deals with the summation of what a teacher does from the beginning to the end of the lesson.

### **References**

- Ajidagba, U.A. & Yusuf, H.T. (2009). Some methods of teaching Social Studies and religious studies. In A.A. Jekayinga and J.A. Olawepo(Ed.) *Fundamentals of Subject Methodologies* OAENoch, Ilorin.
- Ayanwale, O., Wahab, E. I. and Wojuade, J. I. (2012). *Practicum for National Curriculum in Social Studies for Undergraduates*. Ibadan: Adex Sea, Printing & Publishing.
- Ayodele, S. O. (2002). *Teaching strategies for Nigerian secondary schools*. Ibadan: Power House Press.
- Corbin High (Ed.) (1982). *Social Studies methods for teachers*. Lagos, Nigeria Educational Research Council.
- Johnson, D., Johnson, R. & Holubec, E. (1998). *Cooperative in the classroom*, Boston: Allyn and Bacon.
- Kimweri, P. (2010). Factors related to elementary teachers' effective utilization of field trips to informal science resources. *Australian Science Teacher's Journal*, 44, 4: 430.
- Kochhar, S.K. (2000). *Teaching Social Studies*. New Delhi: Sterling Publishers Put. Ltd.
- National Teachers' Institute (1990). *NCE/DLS Courses Book on Primary Education Studies Cycle 1, Modules 8 & 9*, Kaduna National Teachers' Institute Publishers.

- Ogundare, S.F. (2010). *Invitation to fundamentals of teaching Social Studies*. Ibadan: Franco-Ola Publishers.
- Ogunsanya, M. (1996). *Basic process in education*. Oyo: Andrian Publication Series.
- Pathak, R. P. (2003). *Teaching of Social Studies*. New Delhi: Dorling Kindersley (India) Put. Ltd.
- Siahu, H. S. (1998). *The teaching of Social Studies*. Ludhiyana: Tondon Publication.
- Sudheeshkumar, P. K. and Noushad, P. P. (2008). *Social Studies in the classroom trends and methods*. Calicut: Scorpio Publishers and Distributors.

## **MEDIATING EFFECT OF STRATEGIC COMMUNICATION ON THE RELATIONSHIP BETWEEN LANGUAGE PLANNING AND NATIONAL SECURITY**

**Adebayo Tawakalit Oyenike,**

School of Vocational and Technical Education,  
Osun State Polytechnic, Iree,  
Osun State, Nigeria

**J. C. Unachukwu,**

Department of Insurance,  
Federal Polytechnic, Offa,  
Kwara State, Nigeria

**Ajayi Olayemi Olusola,**

School of Vocational and Technical Education,  
Osun State Polytechnic, Iree,  
Osun State, Nigeria

**Olakunle Modupe,**

School of Vocational and Technical Education,  
Osun State Polytechnic, Iree,  
Osun State, Nigeria

### **Abstract**

This study examines the mediating effect of strategic communication on the relationship between language planning and national security. The study incorporated data from 200 participants, including lawyers, politicians, academics, and journalists, and Pearson Correlation and Structure Equation Modelling were used to analyze the data. Results show that language planning has important relevance for strategic communication and national security. It was also shown that strategic communications are positively related to national security. This study confirms previous research claims that language planning and strategic communication are powerful tools to bring complete peace to a nation. Evidence also shows that strategic communication partially mediates between language programs and national security. This connotes that strategic communications pave the way for language planning to influence national security. Therefore, the Nigerian government should develop and implement policies and programs that can address the root causes of Nigeria's unrest through languages understood by all citizens.

**Keywords:** Language planning, Strategic communication, National security, Politicians, Lawyers.

## Introduction

National security is threatened worldwide and this scenario is making global citizens unrest. The Bureau of Statistics and Surveys (2022) revealed that more than 29,389 people were killed by terrorists worldwide in 2020, while sub-Saharan Africa accounts for 48% of the world's terrorist deaths. Due to the impact of global insecurity, the total number of undernourished people has increased to 768 million in 2020, of which more than 282 million live in Africa, 418 million in Asia and 60 million live in Latin America and the Caribbean (UN, 2020). Insecurity has become the norm in Nigeria, turning the country into an unstable homeland. More recently, conflicts between farmers and Fulani nomads have paralyzed economic activity in the north, south, and west, threatening the country's unity. In Nigeria, the abduction of innocent citizens due to a lack of moral self-determination among young people has left some lives unprotected. In the 2020 Global Peace Index, Nigeria ranks among 163 independent countries, and No wonder it was ranked 143rd on Nigeria as one of Africa's top 10 failed states and 14th in the world due to its precarious situation and prevalence of violence (Egwalusor, 2020). Recognizing this fact, the federal government passed the Counter-Terrorism Act in 2011 to install computerized closed-circuit television (CCTV) cameras in parts of the country to enhance surveillance and investigations of crime-related crimes. Strengthen physical security measures nationwide aimed at deterring or thwarting potential attacks, strengthen security agencies through the provision of security facilities, and develop and distribute security advisories in the mass media (Egwalusor, 2020). Despite these commendable efforts, security in the country continues to deteriorate. Apparently, the Cable Index, the data and research arm of Cable (2022), reports that about 1,743 Nigerians were killed due to insecurity in the first quarter of 2022 (Ajibola, 2022). This means that Nigeria has become a lion's den for citizens and foreigners alike.

Our attempt to find a solution to the scourge of anxiety from a linguistic perspective is based on the view that strategic communication and language planning play an important role in all human societies. , beyond traditional security forces to prevent and contain hostility and promote peace and tranquility in society so that all nations are truly safe in this 21st century, often called the Information Age or Jet Age is the fundamental driving force of the social interactions that are possible (Ogu & Oyerinde, 2014). Similarly, Malam Siraho Mukhtar Zubair, President of the Nigerian Institute of Public Relations (NIPR), said that strategic communication is an important tool to contain the rampant terrorism, riots, and other security challenges facing Nigeria(Ojie, Nnaa, Gbenegbara, & Kia, 2017). According to Otto and Ukpere (2012), strategic communication helps to understand and address the complex psychosocial structures and dynamics that underlie problems.

In addition to strategic communication, language planning is considered incontrovertible and its influence is unending when it comes to addressing societal interests. Language planning is considered the key to people's minds (Sapir, 1963). It activates human social functions as the most fundamental medium of communication in all social semiotic settings (Onifade, Imhonopi, & Urim, 2013). Language planning plays an important role in people's lives and societies, not only as mankind's most important asset, not only as a means of empowering societies seeking national



growth but also as a tool that empowers people to cope with the challenges that surround them (Uhunmwuango, & Aluforo, 2011). Similarly, scholars, social researchers, scholars, security experts, and consultants have also identified language planning as an antidote to constant anxiety (Otto & Ukpere, 2012). Former President Obasanjo has repeatedly said that all nations must renew the cultural and moral underpinnings of all their actions in order to maintain free and prosperous societies. In the study of languages, mass communicators have found that language planning has a profound effect on people in all societies because it helps them adapt to society and increases their chances of survival. This means that strategic communication is the platform through which language planning can influence peace and tranquility.

Previous studies have attempted to examine the impact of strategic communication and language planning on national security in both developed and emerging economies (Olawajaju, 2018). However, none of the available empirical studies has established the mediating effect of strategic communication on the relationship between language planning and national security. This current study intends to bridge the identified gap in literature by examining the mediating effect of strategic communication on the relationship between language planning and national security.

### **Concept of National Security**

The concept of national security remains ambiguous as it evolved from a simple definition that emphasized freedom from military threat and political coercion. According to Babangida (2011), national security is the physical protection and defense of citizens, territorial integrity, and the promotion of economic well-being and prosperity of citizens in a secure environment conducive to the realization of national interests. National security objectively means no threat to acquired values and subjectively means no fear of attack on those values. Prabhakaran (2008) states that national security is the measurable measure of a state's ability to consistently meet multifaceted threats to the apparent well-being of its people and its survival as a nation-state by balancing all means of the state assumed to be the state Extensible to policy through governance and global security through external variables. Otto and Ukpere (2012) argued that security means protection from hidden harmful obstacles in the pattern of daily life in the home, office, or community...of physical resources or of personal injury. **National security, therefore, is defined as the lasting protection and continued enhancement of a nation's overriding values and beliefs, its way of life, its governmental institutions, its unity as a nation and as a people, and its well-being and well-being. The state or state of being. In other words, national security is the security of the nation-state, including people, economies and institutions, and is seen as the responsibility of government** (Umaru, Pate & Haruna, 2015).

**Insecurity, therefore, is a state of fear or anxiety resulting from a lack of real or perceived protection. It refers to the lack or inadequacy of freedom from danger. This definition reflects physical anxiety, which is the most visible form of anxiety, and influences many other forms of anxiety, such as Economic and Social Security. According to Umana (2019), anxiety is defined as being unprotected from crime (being anxious) and not being free from psychological harm (being accepted and having opportunities and choices to satisfy oneself),**

**unprotected from emotional distress caused by lack of certainty). Goals have the potential to include freedom from fear.** Insecurity in Nigeria is characterized by a lack of institutional capacity, pervasive material inequality and injustice, ethno-religious conflicts, conflicts of perception between the people and the government, weak security systems, and loss of socio-cultural and community values (Ewetan & Ese, 2014). Umana (2019) explores elite manipulation of ethnic and religious differences, “die or die” politics, pervasive systemic and political corruption, struggles for resources, pervasive material inequality, unemployment and poverty, fragility weak security system, porous borders, and terrorism were key factors affecting unrest in Nigeria (CBN, 2012).

### **Theoretical Framework**

The securitization theory is the underlying theory of this current study, the theory was developed by the Copenhagen School of Barry Buzan in 1990s, with the aim to checkmate insecurity by the policymakers, Politicians and community leaders through strategic communication, language planning and set standard moral values (Bamiduro & Aremu, 2012). According to *Watson (2008)*, securitization theory is the security is a (illocutionary) speech act, that solely by uttering ‘security’ something is being done. ‘It is by labelling something a security issue that it becomes one’ (Adebakin, 2012). By determining that the existence of a particular reference object is threatened, the securitization actor asserts its right to special measures to ensure the continued existence of the reference object. This theory states that leaders must be informed and able to recognize existential threats to prevent “everything” from becoming a security issue (Olawajaju, 2018). This theory explains Nigeria's security challenges. It suggests that security depends heavily on the availability of timely information, language planning, and the value placed on culture (Ogunsiji, 2013). According to Odebunmi (2016), strategic communication helps to understand and address the complex psychosocial structures and dynamics that underlie problems. Similarly, Eggins (2004) argues that language planning is important in people's lives and societies, not only as mankind's most important asset, but also as a tool to strengthen societies aimed at national growth. It empowers people to face the challenges that surround them. Similarly, Ozoigbo (2019)'s research confirms that culture has a significant impact on people in all societies, as it helps them adapt to society and increases their chances of survival. Eroukhanoff (2018) also confirms that securitization theory encourages free agencies to carry out their duties with integrity. Similarly, Soludo (2018) argues that national security cannot be reduced to the navy without effective communication, and language planning. The theory argues that there is a linkage between strategic communication, language planning, and national security.

### **Language Planning**

Language planning is a preliminary concept for planning conscious changes in language form or use. Both planning and language use are social practices, and language planning is usually considered a subfield of sociolinguistics. However, there are strong links between language plans and other types of plans (Odebunmi, 2016). For example, in business and cultural areas, it gives

language planning a strong interdisciplinary flavor. The language or policy gap is never far away (Olawaju, 2018), and the complexity of language planning research in language planning is arguably inseparable. Language planning refers to political attempts to change the status of a language in some way or to develop new uses for it. This often involves states, governments, or other elite groups drafting laws to promote or ban languages, and implemented in a variety of ways. Alternatively, scholars and politicians create guides on how to use the language such as official dictionaries or grammar books (Ewetan & Ese, 2014). In sociolinguistics, language plans are divided into at least two types: status plans and corpus plans. The former involves changing the political perception of language. For example, making the language the official language of the country or banning it entirely. Different degrees of perception are possible, reflecting how language is used in society. While official languages are most likely to be protected by law, the linguistic rights of minority communities (groups of people who share a common speaking style) are likely to be more restricted. Corpus planning, on the other hand, involves changing the way we use language (Ewetan & Ese, 2014). Perhaps through the development of written forms of language or the development of literature.

Existing research establishes a relationship between language planning and national security. According to Egwalusor (2020), language programs play an important role in achieving sustainable national security around the world. Okeke (2012) argues that no country can acquire the knowledge, awareness, and intelligence necessary to strengthen its strategic security without language planning. It helps show how effective language can be used to enhance the management and resolution of already threatening situations that affect interpersonal relationships. From the same perspective, Liddicoat (2008) affirms that language planning sustains social relationships known as interpersonal functions. This allows social groups to be demarcated, individuals to identify and interact with others, and to develop their own personalities. Language is therefore very important as it makes life easier and more meaningful. Language, when used properly, can do much more. Without language, human life would be chaotic (Olawaju, 2018). According to Obadare (2020), there is a significant relationship between language planning and national security and development. The goal of all nations is a positive development, and in order to achieve it, there is a need to ensure maximum security, not only through military force but through something more sophisticated and powerful. This is an effective and proper use of language planning. In other words, the correct choice of words that do not evoke threats, fears, or dangers to human existence (Afe & Olusa, 2012). Akanbi and Fakeye (2019) also confirm that effective and appropriate use of language planning enhances national security. Hence, the following hypothesis is formulated:

**H<sub>1</sub>:** Language planning is significantly associated with national security

### **Strategic Communication as a Mediator**

Strategic communication is the deliberate use of communication by a society or country to ensure national security, identifies key concepts such as audience analysis, goal setting, and messaging strategy (Odebumi, 2016). The term strategy has been most frequently used in the context of management and decision-making authority. Strategic communications play an important role

when it comes to national security issues around the world. This means that strategic communication is essential to solving an already tainted security challenge. Without the ability to communicate with each other, the cop doesn't know how to tactically respond to serious security her alerts (Akanbi & Fakeye, 2019). Obadare (2015) shows that strategic communication is a key factor in facilitating social relationships between people, especially those with different interests. The use of strategic communications by governments to protect their interests and citizens is therefore becoming a primary weapon of defense, and states, therefore, have a strategic focus on enhancing the security and resilience of their citizens. A communication framework needs to be developed. Olarewayu (2018) notes that strategic communication is the processing of national or societal information to influence citizens and positively change their behavior in order to influence citizens and ensure unity, cohesion and development, and dissemination. Previous research has linked strategic communication to language planning and national security. For example, Tasiu (2017) states that strategic communication is the platform that connects language planning and national security. In the same way, Williams (2017) found strategic communications to be a strong predictor of national security. A study by Thomas (2007) argues that strategic communication paves the way for language planning to influence national security. Similarly, Imran et al. (2012) repeatedly found strategic communication to be positively associated with language planning and national security. In another study, James (2007) argues that strategic communication is a powerful tool to influence US national security. Frandsen and Johansen (2017) also confirm the importance of strategic communication in social settings. Because it stimulates and promotes love, understanding and development. According to Ayoola (2016), the importance of strategic communication in conflict situations is for parties to meet, interact, and discuss problems with each other in order to find viable solutions to their problems. In addition, Uwaezuoke (2016) found that strategic communications enable security agencies to plan operations before they arrive at the scene of violent incidents such as armed robbery, hostage-taking, bombings, and other forms of armed robbery. Ogbuleke and Eramah (2020) also show that strategic communication is a platform where language planning can help prevent violent conflict and promote peace and reconciliation and the Nigerian Armed Forces. This connotes that strategic communication has a positive association between language planning and national security. Based on the above empirical evidence, the following hypotheses are proposed

**H<sub>2</sub>:** Strategic communication is positively associated with language planning

**H<sub>3</sub>:** Strategic communication is positively associated with national security

**H<sub>4</sub>:** Strategic communication mediates between language planning and national security

### **Conceptual Model**

A thorough examination of theory and empirical research has revealed that language planning is directly related to national security, while strategic communication has direct relationship between language planning and national security, as shown in the conceptual model formulated (see figure 1).

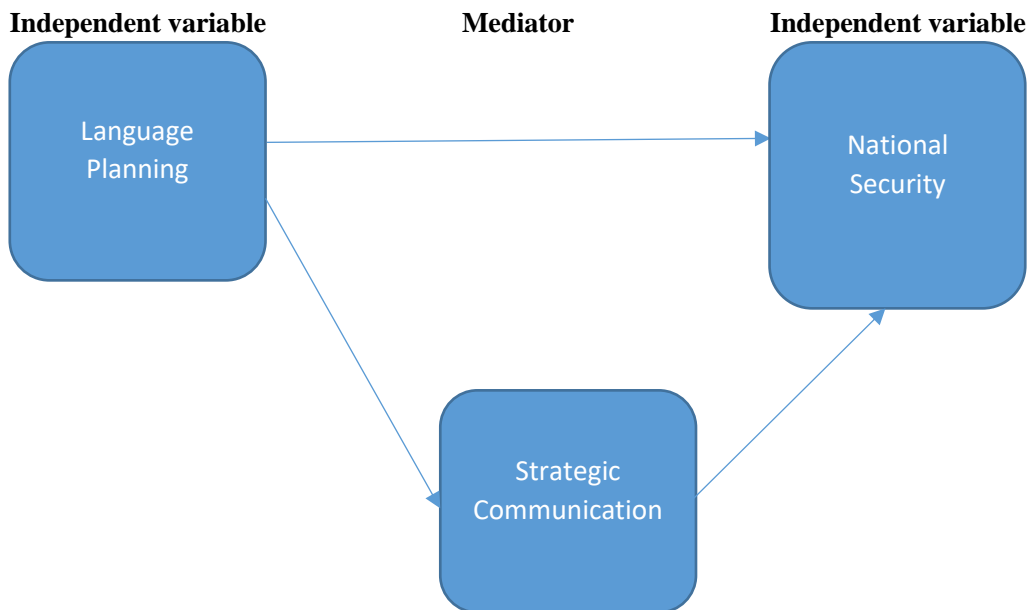


Figure 1: Conceptual Model

### Methodology

For this study, survey research was used because it gives us concrete figures about people's opinions and behaviours that we can use to make important decisions. A purposive sampling technique was used to select one 50 Lawyers, 50 Politicians, 50 Journalists, and 50 Lecturers totalling 200 participants in Osun State. Data were collected from respondents using a structured questionnaire. Pearson Product Moment Correlation Coefficient (PPMCC) and Structural Equation Modeling (SEM) were used to perform data analysis using STATA version 15.

### Survey Instrument

The instruments used for the study consists of language planning scale, strategic communication scale, and national security scale.

**Language Planning Scale:** This scale was derived from a study by Egwalusor (2020),.

The survey consists of 4 items. The scale was fixed on a 5-point Likert scale (1=strongly disagree to 5=strongly agree) for all study instruments. The internal consistency factor  $\alpha$  of the scale was 0.891.

**Strategic communication Scale:** This scale was developed and validated by Ogbuleke and Eramah (2020). The survey consists of 4 items. The scale was fixed on a 5-point Likert scale (1=strongly disagree to 5=strongly agree) for all study instruments. The scale's internal consistency factor  $\alpha$  was 0.862.

**National Security Scale:** This scale is based on the work of Obadare (2020). The survey consists of 4 items. The scale was fixed on a 5-point Likert scale (1=strongly disagree to 5=strongly agree) for all study instruments. The scale's internal consistency factor  $\alpha$  was 0.875.

**Table 1: Summary of Results of the Measurement Instruments Validation**

Language Planning	1	2	3	4
LPQ1	.882			
LPQ2	.853			
LPQ3	.888			
LPQ4	.878			
LPQ5	.848			
LPQ6				
Strategic Communication				
SCQ1		.823		
SCQ2		.779		
SCQ3		.757		
SCQ4		.819		
SCQ5		.823		
National Security				
NSQ1			.708	
NSQ2			.821	
NSQ3			.764	
NSQ4			.818	
NSQ5				
KMO = 0.822				
Bartlett's Test of Sphericity ( $X^2$ ) = 1213.087, 0.000.				
Total Variance Explained = 75.7%				

## Results and Discussion

**Table 2: Relationship between variables**

Variable	1	2	3
1. National Security	1.0000		
2. Language Planning	0.6408	1.0000	
3. Strategic Communication	0.6713	0.6460	1.0000

Table 2 depicts the relationship between the language planning, strategic communication and national security. The results reveal that language planning ( $r = 0.6408$ ;  $P < 0.05$ ), strategic communication ( $r = 0.6408$ ;  $P < 0.05$ ) have a positive association with national security, while strategic communication ( $r = 0.6713$ ;  $P < 0.05$ ) also has a positive relationship with language

planning. This connotes that effective language planning and strategic communication are the strong predictors of national security. This result aligns with Tasiu (2017) that strategic communication is the platform that connects language planning and national security. In the same way, Williams (2017) found strategic communications to be a strong predictor of national security. A study by Thomas (2007) argues that strategic communication paves the way for language planning to influence national security. Furthermore, Olarevayu (2018) demonstrates that language is very important as it makes life easier and more meaningful. Language, when used properly, can do much more. Without language, human life would be chaotic. According to Obadare (2020), there is a significant relationship between language planning and national security and development. The implication of this finding is that language planning and strategic communication are the tools that enhance national security and sustainable development.

**Table 3: Structure Equation Modelling (Without Mediator)**

Path	Coef.	Std. Err.	t-value	P-value	[95% Conf. Interval]		Hypothesis
Direct effects							
SC <- LP	.641	.060	10.57	0.000	.5223025	.7600673	<b>H<sub>1</sub>:</b> Confirmed
NS <- SC	.497	.081	6.10	0.000	.3378809	.657421	<b>H<sub>2</sub>:</b> Confirmed
NS <- LP	.397	.080	4.91	0.000	.2390413	.5561845	<b>H<sub>3</sub>:</b> Confirmed
_cons	.699	.552	1.27	0.205	-.3831014	1.781981	

Table 3 depicts the results of the Structural Equation Modelling of the independent variable (message planning), and National security (dependent variable). The results show that the coefficients of the model are .699, .397, and .497, for constant, strategic communication, (SC), language planning (LP), and national security (NS), respectively. The coefficients obtained from the structural equation model were substituted in the hypothesized model to get:  $NS = .699 + .397SC + .497LP$  (i)

Equation 1 shows that a change in units of strategic communication (SC) resulted in a positive change of 39.7% in national security, and a unit change in language planning (LP), will lead to a 49.7% change in national security (see fig.2). This indicates that of the two explanatory variables, strategic communication and language planning are the more influential predictors of national security. The computed t- values and p-values are 1.270 ( $p = .205$ ), 10.57 ( $p = .000$ ), 6.10 ( $p = 0.000$ ), and 4.91 ( $p = 0.000$ ) for constant, language planning, strategic communication, and national security respectively. This indicates that language has a positive and significant association with strategic communication, while strategic communication and language planning are independently influence national security. This implies that strategic communication (SC) and language planning (LP) help the societies to face the challenges that surround them. The study is

in agreement with previous studies that language planning and strategic communication have a significant impact on people in all societies, as it helps them adapt to society and increases their chances of survival. For example, Eggins (2004) argues that language planning and strategic communication are important in people's lives and societies, not only as mankind's most important asset, but also as a tool to strengthen societies aimed at national growth. Similarly, Ozoigbo (2019)'s research confirms that language planning and strategic communication have a significant impact on national security. Similarly, Soludo (2018) argues that national security cannot be reduced to the navy without effective communication, and language planning. The theory argues that there is a linkage between strategic communication, language planning, and national security. Therefore, **H<sub>1</sub>**, **H<sub>2</sub>** and **H<sub>3</sub>** are supported.

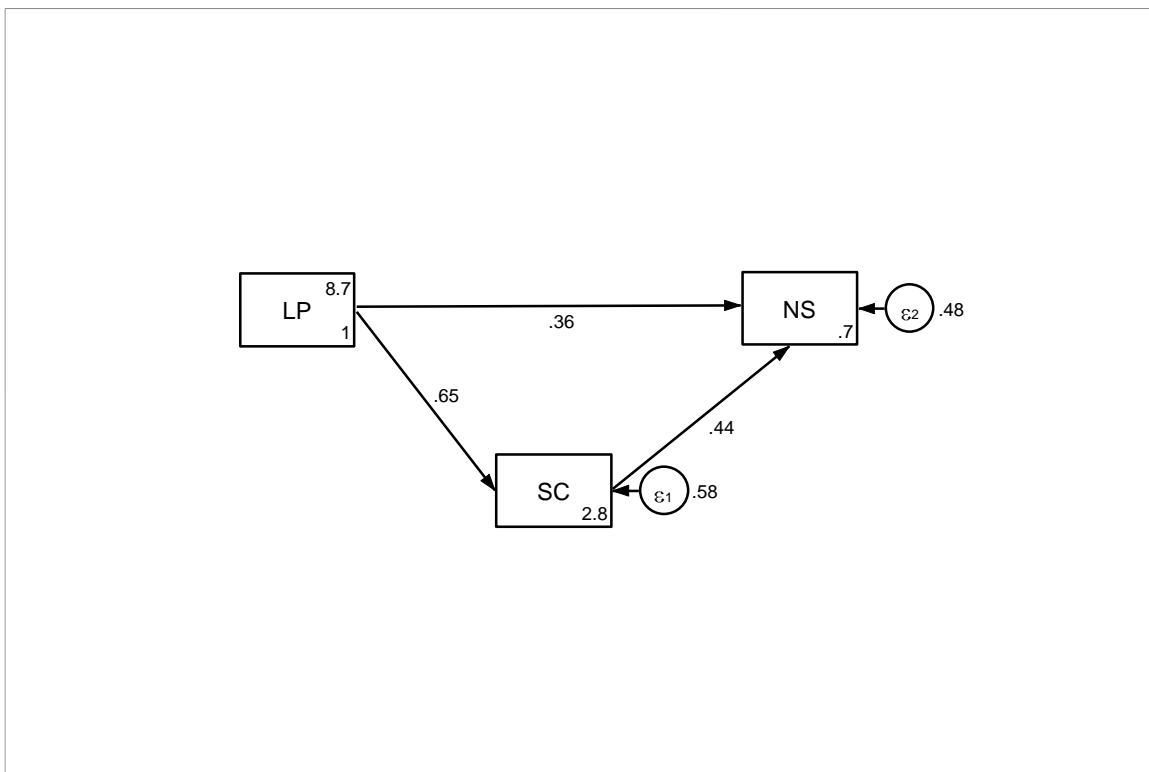


Figure 1: Structure Equation Modelling (SEM)

**Table 4: Structure Equation Modelling (With Mediator)**

Path	Coef.	Std. Err.	z-value	P-value	[95% Conf. Interval]	
<b>Indirect effects</b>						
NS <- SC <- LP	.319	.060	5.29	0.000	.2007878	.4373847



Table 4 shows the mediating effect of strategic communication on the relationship between language planning and national security. Using standardized coefficients, an indirect beta value of 0.319 and a p-value of 0.000 indicate that strategic communication partially mediates between language planning and national security. According to Kenny and Baron (2003), a p-value of 0.000 for a mediating variable, implies partial mediation. A p-value of 0.000 indicates that strategic communication partially mediates language planning and national security. This study is in alignment with Tasiu (2017) that strategic communication is the platform that connects language planning and national security. In the same way, Williams (2017) found strategic communications to be a strong predictor of national security. A study by Thomas (2007) argues that strategic communication paves the way for language planning to influence national security. Hence, **H4** is partially confirmed.

### **Conclusion**

This study examines the mediating effect of strategic communication on the relationship between language planning and national security. The study incorporated data from 200 participants, including lawyers, politicians, academics, and journalists, and Pearson Correlation and Structure Equation Modelling were used to analyze the data. Results show that language planning has important relevance for strategic communication and national security. It was also shown that strategic communications are positively related to national security. This study confirms previous research claims that language planning and strategic communication are powerful tools to bring complete peace to a nation. Evidence also shows that strategic communication partially mediates between language programs and national security. This means that strategic communications pave the way for language programs to influence national security. Therefore, the Nigerian government should develop and implement policies and programs that can address the root causes of Nigeria's unrest through a language understood by all citizens.

### **Recommendations**

Based on the results and conclusions, the following recommendations are made:

1. The Nigerian government must recognize the strategic importance of communications and language planning to national security.
2. All indigenous Nigerian languages should be introduced as courses in training programs for all appropriate organizations and federal agencies within the Nigerian power structure, such as DSS, Nigerian Police, Civil Defense, Nigerian Customs and Intelligence Community. It allows the exchange of sensitive information between non-English speaking people and government security officials about the activities of suspected terrorists, extremists and kidnappers in their communities.
3. Nigerians, especially politicians, should avoid inflammatory and thoughtless speech that threatens national security.
4. We need to strengthen the feedback mechanism and improve our communication skills.

5. The government should seek to establish an oversight board to oversee the implementation of educational policies for all Nigerian languages teaching and learning in primary and secondary education.

## References

- Adebakin, M. A. (2012). National Security Challenges and sustainable Economic Development. Evidence from Nigeria. Vol.1(1) 10-20
- Afe, C.T. & Olusa, K. (2012): The Role of Language in National Security and Sustainable Development in Nigeria. *Zonal Journal of Women in Colleges of Education (ZOJOWICE)* (1): 35 – 41.
- Ajibola, J. O. (2022). Economic Growth Amidst Insecurity: The Nigeria Experience. *Research Journal of Finance and Accounting*. 7(7); 56-27.
- Akanbi, O. & Fakeye, D.O. (2019). Textbook Content-Adequacy – A catalyst to effective teaching and learning of English Literacy Skills for sustainable development. A paper presented at the International association of Language educators at Obafemi Awolowo University Ile-Ife. 15th – 20th September.
- Ayoola, K.A. (2016) Linguistic human rights domination, minorisation and linguisticism in the language of governance and education in Nigeria. In Odebunmi, A and Ayoola, K.A (Eds) *Language, context and society*. Ile-Ife: Obafemi Awolowo Press. 112-127
- Babangida, M. A. (2012) The search for national security in Nigeria: Challenges and prospects. A paper presentation at ObafemiAwolowo Institute of Government and Public Policy, Agip Recital Hall, Muson-Lagos; Thursday, 27th September, 2012. Available at <http://www.nigerstate.gov.ng/articles/the-search-for-national-security-in-nigeria-challenges-and-prospects.html>.
- Bamiduro J. A., & Aremu, M. A. 2012. Assessment of the need for and effectiveness of the re-branding in Nigeria. *International Journal of Management and Administrative Sciences*, 1(4): 11-22.
- Central Bank of Nigeria Annual Report (2012): Functional Classification of Federal Government Expenditure in Nigeria, CBN Publication, Nigeria.
- Egwalusor, R. (2020). Achieving Sustainable National Security and Development in Nigeria Through French Language. *International Journal of Innovative Social Sciences & Humanities Research* 8(1):55-60,
- Eroukhanoff, C (2018). Securitisation Theory: An Introduction. Available at <https://www.e-ir.info/2018/01/14/securitisation-theory-an-introduction/>

- Ewetan, O.O and Ese. U (2014). Insecurity and Socio-Economic Development in Nigeria. *Journal of Sustainable Development Studies*. Volume 5, Number 1, pp 40-63.
- Essien, O (2005) National Development, Language and Language Policy in Nigeria. In Essien,
- Frandsen, F., & Johansen, W. (2017). Strategic communication. In C. R. Scott & L. K. Lewis (Eds.), *The international encyclopedia of organizational communication* (pp. 2250-2258). Hoboken, NJ: Wiley-Blackwell
- Imran Z et al (2012), '\_Non-Kinetic Challenges to the State of Pakistan', National Strategy Paper, Institute for Strategic Studies, Research & Analysis (ISSRA), National Defence University, Islamabad
- James G.S (2007), *Strategic Communication and National Security*, ( National Defence University, USA. issue 46, 3d quarter 2007).
- Liddicoat, A.J. (2008) Interculturalidad y evolución de las interpretaciones en el multiculturalismo y educación del lenguaje en la política nacional australiana. In R. Terborg & L. G. Landa (Eds.), *Los retos de la planificación del lenguaje en el siglo XXI* (pp. 113-132). Mexico: UNAM.
- Obadare, F.T. (2020). Language: A Catalyst To Peace And Security in Nigeria. *International Journal of Social Sciences and Conflict Management*. 5(1); 60-66.
- Obadare, F.T. (2015). Use of Language to eradicating the menace of rape of the girl child. *I kere Journal of Education*. 17(1); 9 – 15.
- Odebunmi, A (2016) Language, context and society: A theoretical anchorage. In Odebunmi, A and Ayoola, K.A (Eds) *Language, context and society*. Ile-Ife: Obafemi Awolowo Press. 3-33
- Ogbuleke, N.E and Erameh, T. (2020). Leadership and strategic communication in the actualization of overall national security in Nigeria. *Mediterranean Journal of Basic and Applied Sciences (MJBAS)* Volume 4, Issue 2, Pages 41-53,
- Ogunsiji, A. ( 2013) The Power of Language. In Ogunsiji, A; Kehinde, A.and Odebunmi, A. (Eds) *Language, Literature and Discourse*. Lagos: Stirling- Horden Publishers Ltd. 24-35.
- Ojie, P.A., Nnaa, B.G., Gbenegbara, S.N and Kia, B (2017). National Security Challenges and the Changing Economic Relations: Providing Alternative Explanation for Current Economic Recession in Nigeria. *International Journal of Humanities and Social Science* 7(6); 128-134.
- Olarewaju, A.J (2018). A Sociolinguistic Approach to Security Challenges and Sustainable National Development in Nigeria. *International Journal of English Literature and Social Sciences (IJELS)* Vol-3, Issue-5, 719- 727.

- Onifade, C., Imhonopi, D and Urim U. M (2013). Addressing the Insecurity Challenge in Nigeria: The Imperative of Moral Values and Virtue Ethics. *Global Journal of Human Social Science Political Science*. 13(2); 53-65.
- Otto, G. and Ukpere, W. I. (2012) National security and development in Nigeria. *African Journal of Business Management*. Vol.6 (23), pp. 6765-6770.
- Ozoigbo, B. I. (2019). Insecurity in Nigeria: Genesis, Consequences and Panacea. *European Journal of Social Sciences Studies*. 4(4); 270- 282
- Prabhakaran, P. (2008). *National Security: Imperatives and Challenges*. New Delhi: Tata McGraw-Hill. p. 521.
- Soludo, C. C. (2018). The Political Economy of Restructuring the Nigerian Federation. The Sun Newspaper, 2nd August 2018.
- Tasiu A. A. (2017). Strategic communications, Boko Haram and counterinsurgency. *Defence Strategic Communications*, 3(Autumn), pp. 143.
- Thomas X. H (2007), The Message is the Insurgency: Strategic Communications in the Society at War, ( Marine Corps Gazette 91, Vol. 11, 2007).
- Uhumwuangho, S.O. and Aluforo, E. (2011) Challenges and Solutions to Ethno-Religious Conflicts in Nigeria: Case Study of the Jos Crises, *Journal of Sustainable Development in Africa*, 13(5); 109-124.
- Umana, K (2019). Insecurity in Nigeria: Causes, Effects, and Solution. Retrieved from <https://researchcyber.com/insecurity-nigeria-causes-effects-solution/>.
- Umaru, A, Pate, H.A and Haruna, A (2015). The Impact of Insecurity and Poverty on Sustainable Economic Development in Nigeria. *International Journal of Humanities Social Sciences and Education (IJHSSE) Volume 2, Issue 2, February 2015, PP 32-48*.
- United Nations (2020). Build resilient infrastructure, promote sustainable industrialization and foster innovation. Available at <https://www.un.org/sustainabledevelopment/infrastructure-industrialization/>
- Uwaezuoke, O. (2016). Implications of missionary education for women in Nigeria: A historical analysis. *Journal of International Women's Studies*, 10, 186–197.
- Watson, C. A (2008). *U.S. National Security: A reference Handbook. Contemporary world Issues (2 (revised) ed.)*. ABC-CLIO. p. 281.
- Williams, J (2017). Weaponised Honesty: Communication Strategy and NATO Values', *Defence Strategic Communications*, 2, (2017), p. 205

**TEACHING READING COMPREHENSION AT SENIOR SECONDARY SCHOOL  
LEVEL OF EDUCATION: AN EXPLORATION OF ITS IMPORTANCE AND  
PROBLEMS IN CLASSROOM DELIVERY**

**Auta, Ibrahim Kanya <sup>1</sup>**

Department of English,  
Kebbi State Polytechnic, Dakingari  
Kebbi State, Nigeria.

**Ibrahim, Mustapha Afolabi <sup>2</sup>**

Department of English,  
Kebbi State Polytechnic, Dakingari  
Kebbi State, Nigeria.

**Kajinyana, Joseph Ayeace <sup>3</sup>**

Department of English,  
Kebbi State Polytechnic, Dakingari  
Kebbi State, Nigeria.

**ABSTRACT**

This paper takes a cursory look at the concept of reading comprehension – one of the basic components in English language as enshrined in the curriculum of senior secondary school level of Education in Nigeria. It identifies the advantages and roles played by reading comprehension in enhancing academic performance in virtually all school subjects among senior secondary school students in Nigeria. It explores some of the strategies to teaching reading comprehension and highlights practical problems associated with delivery of lessons in the teaching and learning of reading comprehension in typical classrooms of senior secondary schools in Nigeria. These problems include: lack of proper implementation of curriculum; unsuitable choice of language teaching strategies; inadequate instructional resources; and so on. The paper contends that to provide possible solutions to the identified problems, qualified English language teachers must be employed to handle reading comprehension; and the use of modern technology in lesson delivery by teachers should be encouraged. The educational implication which aims at stimulating students' academic performance in all school subjects may be ineffective if the issues are not handled wisely. The paper concludes that senior secondary school students must acquire the reading comprehension abilities, as it forms the basis for all learning activities. Finally, the paper suggests that teachers of English language should be exposed to more training so as to acquire knowledge of different language strategies. This could go a long way in ameliorating the problems in teaching reading comprehension at senior secondary school in Nigeria.

**Keyword:** English Language, Reading Comprehension, Classroom delivery, Comprehension Strategies, Language Teaching,

## INTRODUCTION

English language is a compulsory subject offered in Nigerian secondary schools. It is “a must to learn and speak” language for senior secondary school students. The development and contributions of the Language to national development led to its inclusion in the National Policy on Education (NPE). Hence, the policy stated as it relates to teaching and learning that:

“The medium of instruction in the primary school shall be the language of the environment for the first three years. During this period, English shall be taught as a subject. ii, From the fourth year, English shall progressively be used as a medium of instruction and the language of immediate environment...(NPE para.4&5). For Junior secondary and senior secondary schools, the stipulation for English is that of a core subject” (NPE, 2004).

According to Ezeafulukwe (2016), the NPE does not state clearly what the medium of instruction should be for secondary education. But from its provision, one can easily presuppose that the intention of the government is that English should be the medium of instruction while it is also taught as a core subject.

One of the objectives for learning English language at senior secondary school (SSS) level of education as contained in the English language SSS curriculum, is to develop students’ reading comprehension skills (NERDC, 2009). Yet, personal experience reveals that students’ reading comprehension abilities at the senior secondary school level still have much to be desired. This is probably because of the language teaching method employed by teachers in teaching English language.

As one of the four language skills, reading is the extension of communication and it naturally builds upon other language skills already acquired. According to Agwu (2003) and Nduka (2003), reading is an indispensable tool for learning at various levels of education. With practice and further exposure to reading materials, children gradually learn to read at primary school and perfect their reading as they move higher to secondary school and higher institutions. Skills for reading aloud, silent reading, intensive, extensive and fast reading are then acquired (Nduka, 2003).

The Senior Secondary Certificate Examination (SSCE) English Language Syllabus revealed the WAEC and NECO objectives for setting Reading Comprehension questions. According to the objectives, it is expected that after six years in the secondary school, candidates should be able to do the following:

- (i) Find appropriate equivalents for selected words and phrases
- (ii) Understand the factual content of a passage
- (iii) Make inferences from the content of the passages
- (iv) Respond to uses of English expressions to reveal, reflect sentiments, emotions and attitudes

- (v) Identify and label basic grammatical structures, words, phrases or clauses, and explain their functions as they appear in the context
- (vi) Identify and explain basic literary terms and expressions
- (vii) Recast phrases or sentences into grammatical alternatives (WAEC 2015-2021).

Success in all academic subjects at senior secondary school level depends largely on how well students can read and understand in English. The inability of students to read and comprehend in English is believed to have contributed to high rate of dropouts. Nwodo (2007) stated that the poor performance of students in reading comprehension contributed to the high rate of dropouts from schools in Nigeria.

The interaction between teachers and students during reading comprehension lessons in our senior secondary schools have more to be desired. Students are asked to read comprehension passages and answer questions provided at the end of the passages. Yet, there seem to be no improvement in performance at the internal and external examinations in our schools.

These problems cannot be divorced from the choice of language teaching methods by language teachers in teaching reading comprehension at senior secondary schools. This paper therefore, set to review the importance of reading comprehension, alongside; its challenges in the classroom delivery, with the urgent need to providing lasting solution that could facilitate and enhance effective reading comprehension among senior secondary school students in Nigeria.

### **CONCEPTUAL CLARIFICATION**

Important concepts such as, reading comprehension, importance of reading comprehension, classroom delivery and reading comprehension strategies are discussed in this segment

### **READING COMPREHENSION**

In a layman's understanding, reading comprehension means the ability to recognize and pronounce words correctly in a text and attribute meanings to them. Arua (2009) viewed reading comprehension as the process of simultaneously extracting and constructing meaning through interaction and involvement with written language. This definition coincides with the fact that comprehension is attained only when meaning is extracted from a text. In the same vein, Mamman (2014) defines reading comprehension as the ability to make out, to interpret, to expound, to look at and compare the meaning of written and printed words. This simply implies that a student who is able to read correctly all the words in a passage but cannot answer any question on the passage is actually not involved in the reading process. Mamman reiterated that although word recognition is necessary in reading comprehension, it does not guarantee that comprehension will be attained.

### **IMPORTANCE OF READING COMPREHENSION**

The ability to read and understand in English language is a “must to attain” for all senior secondary school students if they must succeed in their academics. Reading comprehension is believed to be

the bedrock for understanding complex parts of all school subjects. Oyetunde, (2009) itemized reasons why students must attain the ability to read and understand:

- (i) In science and arts subjects, reading comprehension is a prerequisite for performing different tasks as instructions for carrying out experiments have to be read and understood by students before they can perform such experiments.
- (ii) Information from textbooks, reading passages can be useful to students only when they are read and comprehended.

In view of the above therefore, if a student cannot read and understand, he/she will find it difficult to succeed in performing tasks required of him/her at school.

### **CLASSROOM DELIVERY**

Classroom delivery refers to the interaction among the student, the teacher, the content, the knowledge, as well as the mood students need for learning and collaborating with others in the classroom. Ali (2011) states that an appropriate lesson delivery requires a good lesson plan, objectives clearly supported by lesson delivery and evaluation of what has taken place in the lesson. In the same vein, To Avalon (2009), classroom delivery involves applying a repertoire of instructional strategies to communicate and interact with students around academic content, and to support student engagement. Avalon further classifies classroom delivery into four:

1. Project-based Learning: This is a delivery method in which students' gain knowledge and skills by investigating and responding to a real-world complex question, problem, or challenge. It is a dynamic classroom approach in which students actively explore real-world problems and challenges and acquire a deeper learning.
2. Blended Learning: A classroom delivery method in which students learn at least in part through online delivery of content and instruction with some element of student control over time, place, path, and/or pace.
3. Flipped Learning: A classroom delivery method in which individual students access concepts and skills prior to class, often through video or on-line learning, then spend class time in a dynamic, interactive learning environment as they apply concepts.
4. On-line Learning: A classroom delivery method in which student access content via the internet instead of in a physical classroom.

### **READING COMPREHENSION STRATEGIES**

The International Reading Association (IRA) Report (2001) suggests some reading comprehension strategies that teachers should use in the classroom delivery. These strategies are explained, thus: The use of prior knowledge: The IRA explains that prior knowledge is using what one already knows to help understand something new. To help students comprehend and learn from a specific reading material, teachers should help students use their previous knowledge on a subject to help them relate to the subject which they are learning at the moment. Hence, making such connections help students understand what the author's purpose is and what the story is all about.



**Questioning:** According to IRA (2001) there are several types of questions that a teacher should focus on. These include remembering, testing, understanding, application or solving, synthesis or creating, evaluation and judging. The suggestion is that teachers should model these types of questions through “think-aloud” before, during and after reading text (IRA, 2001).

**Visualization:** Visualization simply means creating a picture or movie in mind while reading a text. According to IRA (2001) teachers should use terms like “mental image” and ask sensory questions that will help students become better visualizes.

**Summarizing:** Summarizing as IRA (2001) states includes the answer to who, what, where, when, why and how. Meanwhile, students take what they already know about a subject along with their reflections from the book to create their own interpretation and ideas about a certain text (IRA, 2001). Putting these strategies together, therefore, gives students a toolbox of strategies to help them improve their reading comprehension abilities.

**SQ3R:** This strategy, according to Nist and Holschuh (2000), stands for *Survey, Question, Read, Recite, and Review*. In order to get an understanding of the text, one should first survey the passage. This involves quickly looking at the title, headings and any subheadings. While surveying, the reader asks questions about the topic scanned, such as “What did my teacher say about this passage or topic?” The next stage is to begin reading. After reading a portion or section of the book, the reader recites what has been read aloud. The last technique is to review what has been read again (Nist and Holschuh, 2000). Hence, exploring different reading strategies depending on the learning situation is very important for developing reading comprehension skills.

## **PROBLEMS IN CLASSROOM DELIVERY**

Given the numerous advantages that teaching reading comprehension has in the Nigerian educational system, the component should be approached with proper techniques and methodology for effective classroom delivery. Its instructional procedure should not be carried out without the use of appropriate teaching models, such as the interactive teaching strategies, which encourages active participation of learners in the learning process and appeals to the feelings of each participant. However, teaching of reading comprehension at the senior secondary school level is not without some challenges. Some of these challenges are explained below:

The English language Curriculum has not in any way supported the teaching of reading comprehension in the senior secondary school level in Nigeria. Reading comprehension is subsumed in the English language in such a way that it is seen as just a component. This has seriously deprived reading comprehension enough time in school lesson time table

The negative attitude toward reading comprehension is a problem bedeviling reading comprehension classroom delivery. Chinwe (2016) states that negative attitude toward learning inhibit intellectual growth and comprehension. Experience has it that many secondary school students prefer the listening and writing skills to the speaking and reading skills during language classes. This is probably because the later skills expose their weaknesses. The negative attitude toward reading therefore, is a significant impediment to the development of their reading comprehension abilities.

Ineffective implementation of the English language curriculum is another impeding factor to the teaching of reading comprehension at the senior secondary school level of education in Nigeria. The researchers' ten-year work experience reveals that classroom teachers who are part and parcel of the key implementers of the curriculum often skip reading comprehension aspect during lessons. Perhaps, because of their inabilities to teach the aspect or the hectic nature of the component.

Application of unsuitable instructional methodologies in teaching is also a stumbling block to teaching reading comprehension at senior secondary school level of education in Nigeria. Daniel (2013) reports that teachers use ineffective instructional tactics and do not always involve students in learning activities that would inspire them. They focus on preparing students for examinations, leaving out exciting instructional ideas that will push them to master the fundamentals of the subject matter. Meanwhile, they use classroom learning practices that are centered on the teacher and do not create or encourage students to actively participate in the learning activities.

Another problem that obstructs the teaching and learning of reading comprehension is lack of infrastructure in libraries, e-libraries, and multimedia learning facilities. There are no resources available to encourage students to read. Most schools lack libraries with enough textbooks for reading comprehension, they are merely consulting rooms with outdated materials which do not correspond to 21st century learning materials (Faluke, 2017).

The teaching of reading comprehension may also be adversely affected by lack of sufficient qualified English language teachers. In a classroom setting, competency and mastery of subject matter are important drivers of production. In Nigeria, the lack of expert teachers in English language has had a negative impact on the teaching of reading comprehension. Secondary school students require seasoned English teachers to carry them along with the appropriate teaching methods that could help them process reading texts for maximum comprehension.

Time allocated in the lesson timetable is quite insufficient to perfectly exhaust reading comprehension lessons. The forty (40) minutes per period allocated for English lesson in most senior secondary schools is not enough to apply some of the suitable strategies, such as the interactive strategy in teaching reading comprehension to senior secondary school students. This has seriously inflicted and is inflicting a serious problem in teaching reading comprehension at the senior secondary school level of education in Nigeria.

### **WAY FORWARD IN TEACHING READING COMPREHENSION**

Competent language teachers and appropriate learning resources are required in order to streamline the process of teaching reading comprehension at senior secondary school level of education in Nigeria. Ihejirika (2014) reports that seasoned teachers and proper resources go a long way in reducing the obstacles learners face in learning process. To this effect, competent teacher training and appropriate learning materials are required to prepare learners for the task and to modify their unfavorable attitudes toward learning.

Language teachers should also be fully aware of the different methodologies, strategies and learning activities suitable in teaching reading comprehension. Think-pair share, group discussion and Socratic dialogue under interactive teaching and learning strategies encourage students to

critically process a reading text for maximum comprehension. Incorporating modern learning technology such as, digital photo, slides and the like into the classroom could also assist to engage students and develop their intellectual thinking, learning interest and abilities. Hence, the availability and accessibility of these technology learning gadgets in our secondary schools could serve as a solution to the teaching of reading comprehension in particular and English language in general.

Teachers should be trained and re-trained at regular intervals through workshops, conferences, and seminars for continuing professional development schemes for innovative teaching to renew their teaching skills. This would help them grow in terms of competence and skill. Muhammad and Jauro (2022) state that teacher-training assist teachers in utilizing various ways in order to enhance and improve educational activities and Students' social skills and critical thinking would be nurtured and developed. Hence, a competent teacher who employs learning tools, tactics, and strategies to process knowledge and motivates students to learn is required for effective teaching. It has been stated earlier that the senior secondary school English language curriculum does not favour effective teaching of reading comprehension in our secondary schools. Secondary school teachers should therefore be included in the development of curriculum and modules for English language.

#### **EDUCATIONAL IMPLICATION OF THE STUDY**

Students' reading comprehension abilities stimulates and encourages learning: Students that can read texts and understand stay more focused in their learning activities than those who cannot read and understand. In Nigeria therefore, learning reading comprehension could be of great benefit to senior secondary school students because comprehending any reading text or material is believed to be the bedrock of success in their academic pursuit. It is also believed that students' reading comprehension abilities determines the rate of students' success or failure at the WAEC and NECO examinations. On the whole, adopting an appropriate strategy to teaching reading comprehension by teachers, such as the interactive teaching strategy could certainly provide a lasting solution to teaching reading comprehension at senior secondary school level of education in Nigeria.

#### **CONCLUSION**

It is evident that a senior secondary school student in Nigeria must acquire the reading comprehension abilities, as it forms the basis for all learning activities. Hence, it assists in the development and expansion of language knowledge. It is also obvious that teaching reading comprehension at senior secondary school level of education in Nigeria is faced with some problems at the classroom delivery. However, adopting appropriate reading comprehension strategies depending on the learning situation could go a long way in ameliorating some of the problems.

#### **SUGGESTIONS**

Based on observation and educational implications of the study, the following suggestions are made in order to improve the teaching of English reading comprehension at the senior secondary school level of education in Nigeria:

- (i) English language teachers' should use appropriate reading comprehension strategies depending on the learning situation. This could certainly ensure effective teaching and learning of reading comprehension.
- (ii) Considering its importance to students' academic pursuit, reading comprehension should be taught as a separate subject and not as a component under English language.
- (iii) Proprietors and principals of senior secondary schools should embark on vigorous monitoring and checks on lesson delivery and coverage of syllabuses in order to ensure full and effective implementation of the curriculum.
- (iv) Senior secondary school teachers should be part and parcel of the curriculum development process since they are the key implementers of the curriculum.

## REFERENCES

- Ali, M. J. (2011). *Lesson delivery as classroom procedure in teaching English: A review of approaches to teaching English language*
- Arua, A. E. (2009). *Reading comprehension skills for colleges and university students*. Dalag Printing Press.
- Avalon School. (2009). Project based learning. Avalon: Passion for Learning. Retrieved July 15, 2022 from <http://www.avalonschool.org/project-based-learning-pbl/>
- Chinwe, U. (2016). Literature in English as a tool for teaching English as a second language in Nigerian schools *International Journal of Language, Literature and Gender Studies*, 5(2) 60-70
- Daniel, A. (2013). A critical look at the teacher in senior secondary school students' Poetic Appreciation Skills Development *Journal of theory and practice in language studies*, 3(2), 222-232
- Ezeafulukwe, O. (2016) Nigerian language policy: English and French language. *Journal of Linguistic Association of Nigeria*, 2(5), 238-239.
- Foluke, F. (2017). Analysis of the factors affecting teaching and learning Literature in English in Nigeria secondary schools *Journal of the Nigeria English Studies Association*, 2(1), 1-20
- Ihijerika, R. C. (2014). Literature and English Language Teaching and Learning: A Symbiotic Relationship. *English Language Teaching*, 7(3), 85-90
- International Reading Association (2001). *Summary of the National Reading Panel Report on Teaching Children to Read: Paper Presented at the Annual Meeting of the International Reading Association*, DC. July, 2001.
- Mamman, F. N. (2014). *Use of English for undergraduate students*. Joyce publishers.
- Nduka, D. M. (2003). Developing Effective Reading Habits. In Ogbazi, I.J. Osakwe, N. N., and Ekpunobi, D.C. (eds.) *English for Communicative Competence*. John Jacob's Classic Publishers.
- Nigeria Educational Research and Development Council (2009). (F.M.E) Lagos, Nigeria. NERDC Press.
- Nist, S. L. & Holschuh, J. (2000). *Active Learning Strategies for College Success*. Boston.
- Nwodo, E. C. (2007). *English language methods*. But-Bass Interprise, Sokoto, Nigeria
- Oyetunde, T. O. (2009). *Beginning reading scheme: Empowering teachers to help their pupils become good readers*. LECAPS Publishers.
- National Policy on Education (2004). *Medium of Instruction for pre-primary, primary and post-primary schools*
- West African Examination Council. (2015). *Senior School Certificate Examination syllabus 2015-2021 May/June*, Nigeria

## **CYBER SECURITY CONCERNS AND THE IMPACT OF BREXIT ON THE SUB-SAHARAN AFRICA.**

**Rumana Kabir Aminu** ,

Department of computer Science,  
F. C. T College of Education Zuba  
, Abuja Nigeria

**Muhammad Aliyu** ,

Department of Computer Science,  
Federal Polytechnic Bauchi,  
Bauchi State, Nigeria

**Zainab Aliyu Musa**

Department of Computer Science,  
Federal Polytechnic Bauchi,  
Bauchi State, Nigeria

### **Abstract**

Cybersecurity, which refers to the methods, procedures, and safeguards that support the defense of computer networks, devices, and data against tampering, theft, and damage, has not been a key focus of Brexit discussions, either diplomatically or publicly. In fact, it feels fairly underappreciated considering its critical role in promoting economic growth and political stability. criminal cyber actors take advantage of the borderless nature of the internet coupled with the confusion that comes with brexit. While other articles focus on trade and development. economic , geopolitical , social implications Of brexit, this paper focuses on the implications of brexit on CyberSecurity, we presented the implications of brexit on uk cyber security policy, the African Cyber Security Land Scape and the Possible cyber security implications of brexit on sub-Saharan Africa. We concluded by recoomendations on how to strengthen the subsaharan Africa cyber security.

### **Introduction**

The economies of Africa and other developing nations are financially significantly reliant on the former colonizing nations and western finance in general. Even when they have formed free trade zones for themselves, these economies of the global South have found it extremely difficult to detangle themselves from the trade liberalization promoted by the global North because of this dependency. As a result, the dependent South is the one who suffers the most when a significant change affects the North's economy. According to this theory, economic protectionism for South American nations would reduce their reliance on North American integration and development models. The economies of Africa and other developing nations are financially significantly reliant on the former colonizing nations and western finance in general. The biggest economies in Africa are expected to suffer as a result of Brexit, according to forecasts. Bilateral trade between Nigeria and the UK, was valued at £6 billion (about \$8.3 billion) and projected to reach £20 billion by 2020, but because of the disruption “The total trade in goods and services (exports plus imports)

between the UK and Nigeria currently stands at £5.5 billion in November 2022. Additionally, according to figures from the National Bureau of Statistics, Nigeria's top foreign investor in 2015 was the United Kingdom. Because of this type of dependence, the recession in the UK brought on by the Brexit has severely hurt Nigeria's economy. Beyond commerce and investment, the UK also plays a significant role in Nigeria's Cybersecurity. In Nigeria's Cyberspace the European Union is a significant partner. For instance, the EU plans to invest 820 million Euros through its EU-Nigeria Digital Economy Package (Global Gateway Initiative) to support Nigeria's digitalization strategy through investments in digital infrastructure, the digitization of public services, digital entrepreneurship, digital skills, and digital governance. Nigeria's cyberspace is governed by several agencies including the Nigerian Communications Commission (NCC) and the National Information Technology Development Agency (NITDA).

### **The Cyber security Landscape**

Given the nature of the internet and other information networks, which stretch over numerous nations and regulatory boundaries, cyber security is a naturally global endeavor.

With major attacks like Wannacry and NotPetya, more businesses and people being victimized by cybercrime, efforts to deal with illegal activities and content online, and accusations of attempted political interference in elections, cybersecurity has quickly moved up the political agenda in recent years. These have all aided in raising awareness of the significance of safeguarding our digital selves, safeguarding the vital digital plumbing, and taking action against those who abuse and misuse it to hurt us. There's a limit to what a country can do on its own; inevitably there's a lot of cooperation, and a good deal has been done in the EU (King, 2020). So how will Brexit affect that cooperation?

In order to achieve effective cyber security, key stakeholders, including government security and intelligence agencies, cyber security companies, organizations like computer emergency response teams (CERTs), and a variety of other concerned actors, must exchange high-quality cyber threat intelligence (CTI) and take subsequent remediation and mitigation measures. The majority of CTI data comes from public sources, therefore its origin need not be hidden. However, it may occasionally be supplemented by knowledge of notable cyber actors learned from covert sources. A precise understanding of the cyber threat landscape provided by effective CTI enables organizations to prevent, discourage, or at the very least, prepare for future adversary activities. This is acknowledged in the Political Declaration, which lists "cyber-threats" as a particular justification for "timely and voluntarily" intelligence exchanges. Brexit might have negative consequences in one particular area of intelligence and security collaboration. Cybercrime is by far the largest cyber security concern in terms of scale, and Brexit will have an impact on the UK's judicial and policing counter-cybercrime capacities (Stevens & O'brien, 2019).

### **Brexit and implications on cyber security in the UK**

1. Compliance and Data protection challenges  
The incoming EU General Data Protection Regulation (GDPR) demonstrates a clear need for increased transparency across the EU at a time of escalating threats. (Sharf, 2016). The GDPR has significantly increased consumer and citizen data protection awareness, the UK's data protection framework will continue to be heavily influenced by the EU's GDPR (Stevens, 2021).
2. Confusion

There is chaos as to how companies will respond in a situation of cyber attack. Many in the UK security industry are unsure which decision is better for UK businesses and what impact Brexit—the UK's withdrawal from the EU—will have on this relationship and the industry's future. This confusion stems from the conflict between what the current UK Government wants and what the EU believes is best for its citizens.

### 3. Skills shortage

As the global cybersecurity workforce grows so does the gap of professionals According to 2022 cyber workforce study, Globally , the year 2022 records the highest so far in cyber security professionals shortage which is estimated to reach 3.7 million and the highest estimated size of the global cybersecurity workforce in 2022 is 4.7 million people (Study, 2022).

To adequately protect cross-industrial enterprises from increasingly complex modern threats, organizations are trying to fill the worldwide gap of 3.4 million cybersecurity workers.

The demand for cybersecurity services is increasing even more quickly than the workforce. The cybersecurity workforce gap analysis by (ISC)<sup>2</sup> showed that despite the addition of more than 464,000 workers in the past year, the gap has increased by 26.2% year over year, growing more than twice as much as the workforce, making it a profession in desperate need of more people. Due to a shortage of talent and the estimated 142,000 open positions throughout Europe, Brexit will certainly make it more difficult for UK businesses to hire employees from the EU. (Button,2018).

### 4. Data Access and sharing

There is more need for a systematic monitoring and information sharing. How simple it will be for cooperative data-sharing programs to continue once the UK exits Europe is one of the major challenges posed by Brexit. The UK's cyber-defence plan must prioritize information-sharing initiatives because numerous businesses experience comparable threats. Threats can be dealt with more quickly and successfully by sharing and pooling their knowledge.

### 5. Reduction in the operational effectiveness and cyber security decision making of both UK and EU(Version, 2021)

## **The African Cyber security landscape**

Africa is a continent with diverse population that is rapidly growing in terms of population , economy and global influence. Africa has a population of about 1.21 billion people (up from just 800 million in 2000) having the youngest population in the world with a median of 19.5 years. With the growing number of youth comes need for increased global connectivity as well as a productive social engagement. In addition, more people are adopting technology, as evidenced by the exponential growth of mobile device ownership, rising social media usage, and the impending commercialization of the Internet of Things (IoT). Even the most conservative metrics indicate that Africa is in a strong position to advance and contribute to future global growth. Along with this quick economic expansion, a thriving e-commerce sector has also emerged, with projections for it to reach \$75 billion USD by 2025. However, with this escalating wealth and digitization, new risks and weaknesses appear that could thwart advancement. The global increase in cybercrime is foremost among these concerns. A more skilled group of cybercriminals are becoming attracted to the population of the African Continent, their computer systems, and the continent's information

technology (IT) infrastructure as the economy of the continent moves online. Cybercrime is becoming more prevalent worldwide, not only in Africa.(GFCE,2016)

### Possible Cyber security implications of Brexit on Sub-Saharan Africa

1. Lack of Detailed and reliable threat information regarding cybercrime threats in Africa. Lack of this data is prone to affecting our decision making process and how to identify gaps as well as strengthen protection, prevention and response mechanisms to confront the diverse range of cyber threats.
2. Maintainance of data protection requirement and information exchanges  
For Africa to have full control of its data, a platform must be created to have its data resident within the African continent. The Malabo Convention sets a strong intention for the protection of personal data and ensuring cybersecurity in Africa. The Convention seeks to establish a credible framework for cybersecurity in Africa through organisation of electronic transactions, protection of personal data, and promotion of cybersecurity, e-governance and combating cybercrime. Countries like Nigeria, Kenya, Senegal, Rwanda and SouthAfrica have comprehensive data protection laws however (Tomiwa, 2020) finds that the status of the data protection in Africa is inadequate as a result of dependence on Data protection Authorities and lack of institutional capacity and others.

Table 1 Data protection across 4 major sub regions in Africa

Key data protection issues	Senegal	Nigeria	Kenya	Uganda	Morocco	Tunisia	South Africa	Mauritius
Legislation (Status)	<sup>23</sup> ✓ (Enforced)	<sup>24</sup> ✓ (Enforced)	<sup>25</sup> ✓ (Not yet enforced)	<sup>26</sup> ✓ (Not yet enforced)	<sup>27</sup> ✓ (Enforced)	<sup>28</sup> ✓ (Enforced)	<sup>29</sup> ✓ (Partially enforced)	<sup>30</sup> ✓ (Enforced)
Rights of data subjects	✓	✓	✓	✓	✓	✓	✓	✓
Data protection principles	✓	✓	✓	✓	<sup>31</sup> ✓	✓	✓	✓
Legal basis for processing	✓	✓	✓	✓	✓	✓	✓	✓
Data security	✓	✓	✓	✓	✓	✓	✓	✓
Data breach notification	✗	<sup>32</sup> ✗	✓	✓	✗	✗	✓	✓
Cross-border data flow	✓	✓	✓	✓	<sup>33</sup> ✓	<sup>34</sup> ✓	<sup>35</sup> ✓	✓
Registration with supervisory authority	✓	✗	✓	✗	<sup>36</sup> ✓	✓	✗	✓
Data protection impact assessment	✗	<sup>37</sup> ✗	✓	✗	✗	✗	✓	✓
Privacy by design and default	✗	✗	✓	✗	✗	✗	✗	✗
Appointment of data protection officer/information officer <sup>38</sup>	✗	✓	✓	✓	✗	✗	✗	✓
Supervisory authority	<sup>39</sup> ✓	<sup>40</sup> ✓	<sup>41</sup> ✓	<sup>42</sup> ✓	<sup>43</sup> ✓	<sup>44</sup> ✓	<sup>45</sup> ✓	<sup>46</sup> ✓
Remedies, enforcement and sanctions	✓	✓	✓	✓	✓	✓	✓	✓

(Tomiwa, 2020)



As seen in Table 1, while all of the countries have data protection laws, in some the laws are not yet in force. Kenya and Uganda fall into this category. Also, while some are in force, they are not fully enforced. South Africa is an example of such a country.

### 3. Uncertainties

It is still unclear what the effect of Brexit will be in both the short and long-term. According to reports, one of the top three sources of uncertainty for over 40% of UK businesses over the past two years was Brexit (Bloom et al., 2018). Nigeria, South Africa, Egypt, and Kenya are the African nations most dependent on trade with the UK, hence a recession in the UK would be economically detrimental to these nations. They will also experience the ambiguity that comes with having to renegotiate business deals, which might take years (Ansorg, Toni, & GIGA, 2016). Industries that depend more on trade with the EU and on migrant labor from the EU have seen higher level of uncertainty. Possible confusion, however, could make it easier for cybercriminals to exploit loopholes and lead to, for instance, a rise in new types of attacks, including social engineering scams.

### 4. Aid

The EU gives billions of euros to African nations, which are often used for democratization, poverty alleviation, and development promotion across the continent. In order to combat terrorism, the EU also offers military support to several nations (including Somalia and Mali). (Blazquez-lopez, 2016)

The UK's capacity to carry out its promises to aid and development will be impacted by a recession. According to early indications, the new administration would prioritize fostering commercial links over providing aid to those in need.

The EU's security policies in Africa will be affected by the UK's withdrawal from the Common Security and Defence Policy. It will have an impact on the financial support provided by the EU for the African Peace and Security Architecture, and consequently, the donors' capacity to continue providing crucial help in this area. (Ansorg et al., 2016). Defense expenditures have been drastically slashed, which will have an impact on future military operations by the EU in Africa and more budget cutbacks for AU missions (Shilaho, 2017)

### 5. Partnerships

In addition to commerce and investment, the UK is a significant security partner for Nigeria. The UK has played a key role in attracting attention to the Boko Haram insurgency, which is an Islamist insurgency in Northeastern Nigeria. While negotiating its exit from the EU, there is a chance that the UK could grow preoccupied and ignore dangers to world security, such as those posed by Boko Haram. (Oriloye, 2016)

## Recommendations

While African nations outside of this process need to define each of these factors, our degree of interdependence with Europe directly affects us.

The definition of all these aspects is essential for African countries, which are aside of this process, but their level of interdependence with Europe affects them directly.

Africa as a continent has to become less dependent on outside assistance. Africans like Aliko Dangote and Tony Elumelu must start looking inside to help find African solutions for African problems. We should also form Cyber security alliances and partnerships

In assessing how firms prepare for a cybersecurity threat, safeguard customer information, and detect red flags for potential identity theft, we should focus on areas including risk governance, access controls, data loss prevention, vendor management and Cyber Security capacity building.

## REFERENCES

- Ansorg, N., Toni, H., & GIGA. (2016). *Brexit Beyond the UK 's Borders : What It Means for Africa Focus* | *AFRICA Brexit Beyond the UK 's Borders : What It Means for Africa*. 3(1862–3603), 0–10.
- Blazquez-lopez, T. (2016). *How Brexit Can Change Britain 's Relationship with Africa*.
- Bloom, N., Bunn, P., Chen, S., Mizen, P., Smietanka, P., Thwaites, G., & Young, G. (2018). Brexit and Uncertainty: Insights from the Decision Maker Panel. *Fiscal Studies*, 39(4), 555–580. <https://doi.org/10.1111/1475-5890.12179>
- Oriloye, G. (2016). The impact of BREXIT on Nigeria and Africa at large. *Scholarly Journal of Science Research and Essay*, 5(5), 105–111.
- Sharf, E. (2016). Information exchanges: regulatory changes to the cyber-security industry after Brexit: Making security awareness training work. *Computer Fraud and Security*, 2016(7), 9–12. [https://doi.org/10.1016/S1361-3723\(16\)30052-5](https://doi.org/10.1016/S1361-3723(16)30052-5)
- Shilaho, W. K. (2017). the International Criminal Court (Icc), Impunity and the Rise of a Siege Mentality Among Kenya'S Kleptocracy. *BRAZILIAN JOURNAL OF AFRICAN STUDIES*, 2(2448–3923), 1–223. <https://doi.org/10.22456/2448-3923.75067>
- Stevens, T., & O'brien, K. (2019). Brexit and cyber security. *RUSI Journal*, 164(3), 22–30. <https://doi.org/10.1080/03071847.2019.1643256>
- Study, W. (2022). *(isc) 2 cybersecurity workforce study*.
- Tomiwa, I.(2020) Data protection in Africa and the COVID-19 pandemic: Old problems, new challenges and multistakeholder solutions
- Version, D. (2021). *King's Research Portal*.