



University of Abuja, Nigeria

# **NATIONAL CONFERENCE ON NATION BUILDING & DEVELOPMENT**



Theme:  
STRATEGIES FOR GOOD GOVERNANCE  
& SUSTAINABLE DEVELOPMENT  
**IN NIGERIA**

# **CONFERENCE PROCEEDINGS**

**9TH - 10TH AUGUST, 2023**

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# **NATIONAL CONFERENCE ON NATION BUILDING & DEVELOPMENT**

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## **THEME**

Strategies for Good Governance & Sustainable Development in Nigeria

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**TIME:** 9:00 am

**VENUE:** Conference Room – Department of Political Science and International Relations,  
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## **CONFERENCE LOC:**

**Prof. Yusufu Zoaka**

Department of Political Science & Int'l Relations  
University of Abuja, Nigeria (+2348033010927)

**Ogbu, Collins**

Department of Political Science & Int'l Relations  
University of Abuja - Nigeria (+2348031851931)

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University of Lagos, Nigeria

**Dr. Kabuoh Margret**

Babcock University, Nigeria

## **SECRETARIAT**

+2348174380445,

+2348060601893

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# **NATIONAL CONFERENCE ON NATION BUILDING & DEVELOPMENT**

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### **DAY ONE – Wednesday 9th August, 2023**

#### **OPENING SESSION/PLENARY**

Conference Registration	- 8:00am – 9:00am
Opening Prayer/Welcome Remark	- 9:00am – 9:15am
Institutional Brief/Chairman's Opening Remark	- 9:15am – 9:30am
Research Training	- 9:30am – 12noon
Launch Break/Group Photograph	- 12noon – 1:00pm
Plenary Session	- 1:00pm – 4:00pm
Policy Review Session	- 4:00pm – 5:00pm

### **DAY TWO – Thursday 10th August, 2023**

#### **OPENING SESSION/PLENARY**

Conference Registration	- 8:00am – 9:00am
Opening Prayer/Welcome Remark	- 9:00am – 9:15am
Institutional Brief/Chairman's Opening Remark	- 9:15am – 9:30am
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NATIONAL CONFERENCE ON NATION BUILDING & DEVELOPMENT  
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Wednesday 9th - Thursday 10th August, 2023

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# TRANSFORMATIONAL CURRICULUM THEORIZING: A PATHWAY TO SUSTAINABLE NATIONAL DEVELOPMENT

<sup>1</sup>Nwabuaku Louis & <sup>2</sup>Ubom Bassey A. E.

<sup>1</sup>Department of Science Education, Curriculum Theory  
Delta State University, Abraka, Nigeria

<sup>2</sup>Department of Science & Environmental Education  
University of Abuja, Nigeria

## **Abstract**

*This paper aims at examining the concept of transformational curriculum theorizing as a pathway to attaining meaningful and sustainable national development. It utilizes the descriptive phenomenological approach and contends that the traditional Nigerian curriculum framework does not satisfactorily address the complexities of the challenges faced by postmodern societies, thus, proposes an approach that thrives on innovation and critical thinking, bearing in mind the need for sustainable development across the different indicators of national growth. The study explored the theoretical foundations of transformational curriculum theorizing, the perceptions of transformation in curriculum theorizing, possible challenges to its implementation, and the different curricula pathways to achieving sustainable national development. The paper, therefore, bridges a knowledge gap upon which curriculum designers, educators, policymakers, and researchers can draw insights that foster positive transformation in the development of societies through education.*

**Keywords:** Curriculum theorizing, Curriculum Theory, Education, Nation building, Sustainable development, Transformational curriculum.

## **Background to the Study**

One significant responsibility of education can be seen in its planned and guided effort to provide learning experiences upon which citizens are enlightened and prepared to meet the contemporary challenges of their society. Education thus plays a pivotal role in shaping societies as well as individuals and cannot be jettisoned while negotiating for meaningful and sustainable national development. To properly employ the capabilities of education in this direction calls for deep levels of understanding and engagement of the major components and instrumentality which purpose reasonable formal education. One of these components of education which, consequently, has informed the basis for this paper is 'the curriculum: in

theory and practice'. It would therefore be expedient to begin this writing with a clear exposure to what one can call curriculum theorizing in Education.

The general belief on what curriculum theorizing entails is that it is a method of theory development in the curriculum. However, Biesta (2009), opined that curriculum theorizing not only recommences the question of how the curriculum is composed but further, promulgates an approach that begins rethinking the commonsense image of contemporary education, by opening up the conditions of their composition and sedimentation to enhance quality. Adegoke (2003) noted that curriculum theorizing offers a way of examining and understanding the operations of curricula issues. Furthermore, he stated that curriculum theorizing involves philosophizing, conjecturing, and an understanding of the complexities of curricula issues, techniques, developments, and paradigms at their frontiers. While Curriculum theory helps to prescribe functions for pragmatic progressivism in education, effective curriculum theorizing tends to examine the functionality of curricula functions to establish sustainable positive change and progressivism in education.

Consequently, theorizing in the field of the curriculum is a general procedure involving individuals in three separate but interrelated actions which include:

- i. Being sensitive to evolving trends or patterns of change in the educational environment;
- ii. Attempting to identify and engage these common trends or patterns, issues, and prospects that influence the teaching-learning process;
- iii. Relating and dealing with trends or patterns to promote one's practice, research, and service contexts in education (Marsh and Willis, 2007).

However, to assess and prescribe diagnosis for a curricula framework (such that engages sustainable development) would require an assessment of the various indices of meaningful and sustainable societal growth and development. Today, the typical Nigerian society is at the edge of many pitfalls, dominant amongst them is the age-long bedeviling issue of corruption which has hampered different levels of meaningful social and infrastructural development. Other issues include the battered national economy, quality of education, fractured polity, insecurity, increased youth restiveness, environmental degradation, social inequalities, etc. (adapted from Chukwuma, 2023). These notable challenges, reveal a failure of the traditional curriculum framework and a need for reconceptualization of the Nigerian curriculum. Negotiating for sustainable national development would necessitate salvaging a nation's education system as it has a direct impact on certain development indices such as national literacy, poverty level, total nominal gross domestic production (particularly in the establishment of knowledge-based economies and skilled labor force), life expectancy, etc. This paper therefore argues that the restructuring and reconceptualization of the Nigerian curriculum is long overdue, and transformational curriculum theorizing offers a promising pathway towards achieving the much desirable meaningful, and sustainable national development which the average Nigerian crave for. There is no doubt that education, ideally is supposed to be subservient to the needs and aspirations of the people it is meant to serve, and any shortfall in this regard calls for a reconsideration of the system.

Transformative curriculum theorizing can thus help to direct and guide significant and long-lasting changes in education; such that the observable variations which do not promote

gainful sustainability can be neutralized. Paris (2012), stressing the need for innovative transformation in the curriculum argued that education for sustainable development requires creating learning experiences that promote creativity, capacity for innovation, and open minds; such that learners are prepared for the transformation and innovations of the future. Transformational curriculum theorizing draws upon the key theoretical foundations of transformative learning, constructivism, and the social-cultural theory of education. It defies the traditional transmission framework of education, by reimagining the purpose, content, process, and delivery of education.

Transformational curriculum theorizing can therefore be seen as a mode of educational discourse and inquiry, which promulgates the development of critical thinking abilities, creative and transformative competencies, innovative behaviors, and problem-solving skills that are necessary for learners to contribute meaningfully to their society. Transformational curriculum theorizing challenges agents of education at all levels to reconsider the existing policies and theories which has purposed the national educational system, to re-conceptualize and reconfigure parameters that have not delivered meaningful and sustainable societal or national development. While the process of deriving any kind of transformation in an endeavor cannot be said to be a simple or easy one, it is important to clarify here, that the difference curricularists make (either theorists or practitioners alike), is in our distinguished ability to reason deep into the fundamental nature and reality of the processes which shape education while driving positive, meaningful, and sustainable change through it. To elaborate on what it means to upgrade and establish meaningful and sustainable national development in Nigeria calls for a reconsideration of what it means to be educated as a contemporary Nigerian and would thus engage reflections that must recount the peculiar needs and aspirations of the original Nigerian society.

### **Theoretical Foundations of Transformational Curriculum Theorizing**

Transformational curriculum theorizing draws upon various educational theories and approaches that emphasize student-centered learning, interdisciplinary education, and real-world relevance. It defies the traditional transmission model of education and advocates for a more holistic and inclusive approach. The key theoretical foundations include:

- i. Transformative Learning Theory
- ii. Theory of Constructivism, and
- iii. Socio-Cultural Theory of Education.

These theories underscore the importance of active engagement, collaboration, and experiential learning in fostering deep understanding and meaningful learning experiences among learners. This agrees with Fortaleza (2007), who communicated the ideas of Freire (2000) that Education ought to raise the awareness of the learners such that they become the subjects themselves, rather than objects of the world and that this can be achieved by teaching students to think democratically and innovatively and to continually question and make meaning from everything they learn.

### **Transformative Learning Theory**

Transformational curriculum theorizing drawing basically from Jack Mezirow's concept of transformative learning theory concerns itself with deep, useful, and constructive learning. It gives rise to a curriculum theory that provides a way of learning which transcends the simple

acquisition of knowledge, connects theory to practice, and offers constructive and critical ways for students to consciously give meaning to their lives. This approach tends to exemplify innovative practices such as project-based learning, inquiry-based learning, eclecticism, and interdisciplinarity in curriculum designs, thus preparing learners to become active contributors to meaningful and sustainable national development by developing in them transformative competencies (Merizow, 2000). These theoretical underpinnings align with the views of Bell, (2016) who argues the need for the traditional method of education to give way to allow for transformative education where teachers are not only to transmit or impart knowledge, but also facilitate the acquisition of skills that empowers learners' transformative competencies.

### **Theory of Constructivism**

Constructivism on the other hand is an educational theory that suggests that learners can construct their understanding and knowledge through experiences and a guided reflection on those experiences (Piaget, 1973; Vygotsky & Cole, 2018). The constructivist approach thus emphasizes learners' active involvement in the learning process, enabling them to construct their understanding and knowledge of the world around them. In the context of transformational curriculum theorizing, constructivism plays a crucial role by encouraging learners to question, explore, and challenge the status quo as they bid to develop transformative competencies, such that through guided learning experiences they would become fully prepared agents of social change, capable of challenging and reshaping societal norms, structures and systems. The constructivist approach also supports the notion that knowledge is not static but a dynamic construct that can be shaped and transformed by guided learners' experiences and interactions with the environment. This aligns with the goals of transformational curriculum theorizing which is to foster critical thinking and promote learner autonomy while creating guided learning experiences that can foster transformative competencies. Moreover, constructivism also encourages a learner-centered approach to education where learners are actively involved in their learning process, thus aligning with the transformative curriculum's focus on learner autonomy, which is characterized by processes that aim at enhancing sustenance for inquiry-based lessons, problem-based lessons, and project-based lessons.

### **Socio-Cultural Theory of Education**

Following the part of the sociocultural theory of education, Lev Vygotsky posits that social interaction and cultural context significantly influence learning and thus, the curriculum must align itself with the cultural inevitabilities of the society (Vygotsky & Cole, 2018). The theory emphasizes that learning is a socially mediated activity, and that culture plays a crucial role in shaping cognitive functions. Socio-cultural theory of education corresponds with transformational curriculum theorizing in several ways. First, both recognize the importance of context in learning. For the socio-cultural theory, this refers to understanding the learners' cultural and social context; while for transformational curriculum theorizing, it means acknowledging and addressing the socio-political context and challenges within which education takes place. Secondly, the sociocultural theory's emphasis on social interaction aligns with the focus whereby transformational curriculum theorizing seeks to foster critical dialogue and collaborative learning. Furthermore, the socio-cultural theory's emphasis on the role of culture in shaping cognitive functions also aligns with the goals of transformational curriculum theorizing directed at promoting cultural competencies and understanding

cultural challenges inherent to educational systems. Transformational curriculum theorizing budding its relevance from transformative learning theory, constructivism, and the sociocultural theories of education, relies on their shared emphasis on learner-centered education, critical thinking, social interaction, cultural competencies, and learning constructs which aligns with developing transformative competencies in learners. They all recognize the dynamic nature of knowledge, the importance of context in learning, and the role of learners as active agents of social change, capable of challenging and reshaping societal norms, structures, and systems.

### **Perceptions of Transformation in Curriculum Theorizing**

Transformational curriculum theorizing is a multifaceted and dynamic aspect of curriculum theory, and it seeks to examine and redefine the purpose, content, and processes of the curriculum, in a bid to nurture innovative and transformative competencies in learners. Bearing in mind the challenges of the postmodern world, and the fact that innovation is at the core of inclusive societal growth and sustainable development, transformational curriculum theorizing becomes a potent instrumentality for incorporating desirable innovations and transformative competencies in existing school curricula and pedagogical processes. By analyzing its different perspectives or perceptions, one can draw insights into the diverse approaches and ideas that shape national curricula while negotiating for sustainable societal development. OECD, (2019) in this regard, defined transformative competencies as the type of knowledge, skills, attitudes, and values students need to learn, to transform their society and shape the future for better living.

In furtherance of this work, two key perceptions of transformational curriculum theorizing would be discussed based on the reviews of relevant and current literature in the field. These perceptions include:

- i. Theorizing for Social Deconstructionism, and
- ii. Critical Pedagogical Perception.

### **Theorizing for Social Deconstructionism**

To understand transformational curriculum theorizing as a tool for social deconstructionism is to see the curriculum through the lens of reconstructing social anomalies via the critical analysis and diagnosis of educational factors such as lesson content, implementation procedures, and how they tend to influence society. This perception emphasizes the need for a curriculum to address social injustice, inequalities, environmental sustainability, moral and ethical decadence, skills for knowledge-based development, etc. Here, social deconstructionism does not imply the total demolition of traditional or existing curriculum framework but refers to its analytical breakdown to improve upon it. This perception advocates for an interdisciplinary approach integrating ecological literacy, ethical considerations, transformative competencies, and active engagement with the environment to meet social concerns through education. In line with this reasoning, Kincheloe, et al. (2018), argued that education should be a tool for societal transformation and liberation. They advocated for curriculum content that challenges dominant ideologies and promotes critical consciousness among learners. Similarly, Jickling and Wals (2008) argued that the curriculum should address environmental issues and promote sustainable practices. The work of Freire (2000) also highlights the importance of dialogue, critical reflection, and praxis in transforming oppressive educational systems. Educational systems become oppressive when

they can no longer service the social concerns, needs, and aspirations of the society that utilizes them, hence a need for deconstruction.

### **Critical Pedagogical Perception**

Critical pedagogy is another perception of transformational curriculum theorizing. This perception as popularized by scholars like Henry Giroux, focuses on empowering students to critically analyze and challenge social norms and power structures. According to McLaren (2020), critical pedagogy aims to develop learners' critical thinking skills and foster their agency to transform society. McLaren argued that curriculum design should emphasize problem-solving, collaborative learning, and the integration of real-world issues. Abbot's (2017) review of 'Teaching to Transgress', underscores the importance of creating inclusive classrooms that challenge dominant narratives and foster social justice in education. Similarly, scholars such as Moghli and Kadiwal (2021), explored decolonizing approaches to curriculum intervention, such that centers on indigenous knowledge and cultural diversity, thereby challenging colonial legacies and conceptions which no longer serve learners' needs. This perception calls for a re-evaluation of curriculum content, pedagogical practices, and assessment methods to foster equitable and inclusive education. Critical Pedagogy calls for a transformative curriculum that seeks to decolonize education, challenge dominant knowledge structures, and address issues of power, race, class, gender, and other forms of unprogressive domination in education. Transformational curriculum theorizing thus critiques the way that knowledge is constructed and disseminated within educational settings, and pursues the promotion of more valuable, inclusive, and relevant content in the curriculum.

### **Challenges to the Implementation of Transformational Curriculum Theorizing**

One of the biggest obstacles to implementing transformational curriculum theorizing is the potential resistance from various stakeholders, including government agencies, teachers, parents, and school administrators. These stakeholders may hold different beliefs, values, and goals, making it difficult to convince them of the benefits and potentials of transformational curriculum theorizing. Another challenge is the lack of awareness and understanding of the concept among educators and policymakers, and this can hinder the integration of transformative competencies, sustainability awareness, and creative innovations into the curriculum. Educators need to be educated and trained in the principles and practices of transformative competencies. Implementing transformational curriculum theorizing requires additional resources and time, which can be a challenge for schools and educational institutions facing financial and resource constraints. Consequently, teachers may need to undergo professional development programs, and curriculum materials may need to be developed or adapted alike.

Furthermore, many education systems and the Nigerian scenario alike, rely heavily on standardized tests to evaluate student performance, often prioritizing knowledge-based content over transformative competencies which builds the main focus of transformational curriculum theorizing. Aligning assessment systems with transformative competencies would thus require developing new assessment parameters and methods that can effectively evaluate skills such as critical thinking, creativity, collaboration, and adaptability. Additionally, balancing the inclusion of transformative competencies, creative innovations, and sustainability awareness with the existing content and standards requirements can be a



difficult task. Teachers may feel overwhelmed by the added workload thereby leading to further resistance or superficial implementation.

Finally, it is essential to address the diverse needs and contexts of students from different backgrounds and cultures. However, implementing transformative competencies, creative innovations, and sustainability awareness through transformational curriculum theorizing can be challenging in contexts where there are significant disparities in resources, access to quality education, and social-cultural norms. Adapting transformative competencies, creative innovations, and sustainability awareness to be culturally relevant and inclusive for all students is an ongoing challenge that requires careful consideration and collaboration with communities and the different organs of governance.

### **Curricula Pathways to Sustainable National Development**

Education is a crucial component of sustainable national development and through the curriculum can play a significant role in achieving sustainable national development. For this to happen, the curriculum must be designed, reviewed, or revised with a focus on national development and sustainability, such that learners are provided with the requisite knowledge, skills, and values they need to become responsible citizens who can contribute meaningfully to the development of their communities. There is therefore no doubt that quality education via transformational curriculum theorizing lays the solid foundation upon which meaningful and sustainable national development can be harnessed. Some notable pathways to achieving sustainable national development through education (*vis-à-vis*, transformational curriculum theorizing) include:

- i. Incorporating and promoting in the curriculum, values such as responsibility, empathy, integrity, honesty, and respect for humanity. The Promotion of sustainable national development goes beyond knowledge and skills, as it entails instilling values and ethics that prioritize sustainability. Ukpabio et al. (2023), highlighted the role of value-based education in fostering sustainable behaviors. As such, ethics and values in the curriculum can develop in learners, a sense of stewardship towards the society they live. If this is taken seriously at all levels of the Nigerian educational system, then the age-long issue of corruption bedeviling this nation would in no time become a thing of the past. Nigeria as a nation should as a matter of urgency, put parameters in place for compulsory ethical education at all levels of the nation's educational system, and the pursuance of such should be evaluated differently from the traditional system of standardized testing, but by using metrics such as 'a practical test of integrity'.
- ii. Another critical area that the curriculum provides a pathway to sustainable national development is by addressing environmental sustainability through interdisciplinary lesson content and pedagogy. Learners need to understand the impact of human activities on the environment and how they can mitigate negative effects. A curriculum that incorporates environmental education can help learners develop an appreciation for the environment and a commitment to protecting it. UNESCO (2010) in support of this, emphasized the importance of including environmental education in the curriculum to promote sustainable development practices. By raising awareness about these issues, the curriculum can nurture a sense of responsibility in learners, encouraging them to make ecologically conscious choices.
- iii. Transformation curriculum theorizing also significantly equips learners with the necessary skills which foster sustainable national development. This includes the

promotion of critical thinking, problem-solving, creative innovation, and transformative competencies in curriculum content. Brundiers et al. (2010) accentuated that the curriculum should teach learners how to analyze complex problems and propose sustainable solutions. By incorporating these skills into the curriculum, students can contribute to sustainable development by developing and implementing innovative solutions to societal challenges around them.

- iv. Transformational curriculum theorizing when used to facilitate partnerships and collaboration among educational institutions, local communities, businesses, and government agencies can become a powerful asset in attaining sustainable national development. Collaboration can enhance the effectiveness of sustainable development initiatives by pooling resources, knowledge, and expertise. Schnitzler (2019) highlighted the importance of collaborative learning in promoting sustainable development. To consider sustainable national development would thus challenge the curriculum to include opportunities for students to engage in real-world projects that involve collaboration with external stakeholders, fostering a sense of collective responsibility and promoting sustainable solutions from a local level, down to a national scale.
- v. Entrepreneurship and innovation are vital drivers of sustainable development. Therefore, the government can finance institutions to include compulsory entrepreneurship education in the curriculum, such that students can be inspired to develop sustainable business models and contribute to economic growth while promoting the gross domestic production of their nation's economy. The curriculum can also foster entrepreneurial skills, such as creativity, resilience, and adaptability, enabling students to create sustainable solutions and businesses that meet the social and economic challenges of their society.

### **Conclusion**

Transformational curriculum theorizing draws upon the key theoretical foundations of transformative learning, constructivism, and social-cultural theories of education. It defies the traditional transmission framework of education and pursues the incorporation of transformative competencies in learners, as well as sustainability education and awareness. Transformational curriculum theorizing helps to promote critical thinking, problem-solving, collaboration, creative innovation, knowledge, skills, values, and ethics; such that is necessary for learners to meet the demands of a continuously evolving world. To address the issue of sustainable national development in Nigeria would necessitate that the national curriculum be reviewed to promote a realistic transition from natural resource dependency to knowledge and technology-driven development. To reflect on what it means to transition from a dangerously moribund curriculum (like we have in Nigeria) into an upgrade with the capacity to deliver meaningful and sustainable national development, one must focus and recount what it means to be an average Nigerian today. As such, the needs and aspirations of Nigerian society must be taken seriously through quality education. To effectively engage education in a manner that will help the situation, would require a deep understanding of the curriculum: in theory and practice. The field of curriculum theorizing in Nigeria must therefore strive to reflect on the actual reality of transformational curriculum theorizing and thus construct its curriculum theory decisively.

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# LIBRARY AUTOMATED SYSTEM AND USAGE IN ACHIEVING SUSTAINABLE ACADEMIC EXCELLENCE OF STUDENTS IN COLLEGES OF EDUCATION IN DELTA STATE

**Okwudibe, Ernest Onyebuchi**

*E-Library Unit, College Library  
Federal College of Education (T) Asaba*

## **Abstract**

*The growth and development of Information and Communication Technology (ICT) is playing vital role in the field of library and information science and library automation system in particular. The present paper assessed library automated system and usage in achieving sustainable academic excellence of students in colleges of education in Delta State. The implementation of a library automation system is a pivotal step for libraries in their quest for enhanced efficiency, improved accessibility, and elevated user experiences. While the adoption of such systems brings undeniable advantages, various challenges may hinder their successful integration. This paper discussed the concept of library automation system and concept of sustainable academic excellence. Also, library automation system and students' sustainable academic excellence was also discussed in this paper. This paper further explores the advantages of library automation system, barriers to library automation system and solutions to barriers to the library automation system in sustainable academic excellence of students in Colleges of Education in Delta State. The paper recommends that before selecting an automation system, conduct a comprehensive assessment of your library's specific needs, workflows, and goals. This will help choose a system that aligns closely with your requirements. Also, involve library staff, administrators the decision-making process. Their input can provide valuable insights into system features and customization needs among others.*

**Keywords:** *Library Automated System, Usage, Sustainable Academic Excellence*

## **Background to the Study**

The development of Information Communication Technology (ICTs) is gradually changing the operations of academic libraries in world, with the speed of technological transformation in the development of information networks and electronic services in recent years; automation of library services has aided to expand the role of the academic libraries. Hence,

the creation of computer systems in the libraries towards maintaining efficiency has brought rapid growth to the centralized resource sharing among libraries and has changed the definition of librarians and libraries (Aswal, 2006). Consequently, the merging of computing has significantly affected the delivery of libraries and information services by making information related task easier. However, in recent year, Information Communication Technology has brought about paradigm shift in libraries from the traditional methods of operations to a new concept called Automation (Samuel & Echenzona, 2013).

Library Automation according to Sharma (2007), is the use of automatic and half automatic library actions as acquisition, circulation and cataloguing. However, these functions were performed traditionally in the 90s and observed that library automation is entirely different from automatic indexing, information retrieval, abstracting e.t.c. Yakubu (2014) sees library automation as the application of mechanical and electrical devices to carry out certain task in the library which is formally performed manually. It is the application of computer technology to acquire, organize and disseminate information quickly and accurately as possible. According to Das and Chatterjee (2015), library automation is the application of automatic and half automatic data processing mechanism to perform traditionally library house activities such as cataloguing, acquisition, circulation, reference and serial control. Library Automation as posited by Aswal (2016), is the computerization or mechanization of all library activities such as acquisition, circulation, cataloguing, serials and Online Public Access Catalogue (OPAC).

Application of automated system in library management entails involvement and use of ICT equipment in the general operation of libraries. This is of paramount due to the nature of activities in library, library automation refers to utilizing advanced technologies and software solution to streamline and enhance the operation and services within a library. Using technology to carry out functions in the library will promote effectiveness. The need for application of automated system to manage them is necessary. Library automation leverages cutting-edge systems and tools to automate and digitalize various aspects of library operations. The major component of library automation system is to adopt an integrated library management system (ILMS) which can also be called a library management software (LMS) this software enables library management to manage collections, track items and provide services to users which will allow students as part of library users to explore all opportunities available to sustain academic excellence with effective use of library resources. However, library automation extends beyond the management of physical collection, it encompasses digital libraries and online resources, providing access to e-books, e-journals, multimedia resources and database among others.

The application of computer and modern ICT based technologies (automated system) has brought a major change in the entire library processes and service delivery which has also helped in achieving sustainable academic excellence of students. Academic excellence is simply the demonstrated ability to perform, achieve, and/or excel in scholastic activities. Academic excellence is not limited to achieving good grades only, but academic excellence is characterized by its ability to achieve high grades and the ability to achieve unique performance among peers. To achieve academic excellence, it is essential to create an environment that fosters the development of a community that can grow intellectually, socially, and ethically, and is therefore able to pursue successful and fulfilling careers.

Therefore, using automated library system can go a long way in improving and sustaining students' academic excellence giving them more room to explore technological equipment.

### **Concept of Library Automation System**

Library automation system is the process of automating in house functions such as circulation, cataloguing, acquisition, serial controls etc. Automation means the application of machines to perform the different routines, repetitive and clerical jobs involved in functions and services of the libraries. Library automation system may be defined as the application of automatic data processing computers to perform traditional library house-keeping activities such as acquisition, circulation, cataloguing, reference and serials control. Today Library Automation is by far the most commonly used terms to describe the mechanization of library activities using the computer (Uddin, 2009). Library automation system can also be described as the application of computers and utilization of computer-based products and services in the performance of different library operations and functions in the provision of various services and production of output products. There is a great impact of computers and information technology and its application on the library due to a process of great change taking place in libraries. Modern technology is tending to alter radically the nature of our society and affect the prevailing economic, political and social values and libraries are also in the process. Industrialized countries were the first to realize that in the context of stock of knowledge, classical approaches relating to storage, retrieval and utilization of the information were no longer adequate and effective and that the solution lay in making fullest use of new developments in electronics, computer, telecommunications and micro-recording.

Library automation makes work easier in the library. The following are some of its reasons; Avoid retyping if we want to include or delete any matter, thus saving time and energy; Retrieve much more precise and accurate information in less time as compared to manual search; Get printed list of a specific subject within a few minutes; Heavy bulk of data can be stored in the computer and thus certain problems, which arise with storing records in wooden cabinet, are avoided (Hussain & Raza, 2002). Due to these advantages of a computer, computer became a universally accepted tool to provide assistance to man in all fields. In the field of Library Science, the need for making use of computers.

Some Library Automation software are; Alice for Windows, Automated Library (AUTOLIB). The Information Navigator Library Software (TINLIB), Graphic Library Automation System (GLAS), Web-Based Integrated Library System (WEBLIS), Koha, Automation of Libraries and Centres of Documentation (ABCD), Evergreen Software, Integrated Library Management System, Newgenlib, Computer Documentation System/ Integrated Set of Information Systems (CDS/ISIS).

### **Concept of Sustainable Academic Excellence**

Sustainable academic excellence according to Sterling, Maxey and Luna (2013), refers to the consistent achievement of high educational standards and accomplishments over a prolonged period while maintaining a focus on long-term viability, growth, and positive impact. It involves creating an environment where academic excellence is not just a short-term goal but is built upon principles that ensure the ongoing success of educational institutions, programs, and students. Sustainable academic excellence involves maintaining a balance between immediate goals and long-term planning, all while staying responsive to the evolving needs of

students and society. It requires a holistic approach that considers academic, social, financial, and environmental factors. Here are some key components and strategies that contribute to sustainable academic excellence:

1. **Quality Education:** The foundation of sustainable academic excellence is providing high-quality education that equips students with knowledge, critical thinking skills, and practical expertise. Quality teaching methods, up-to-date curriculum, and effective assessment practices are essential.
2. **Research and Innovation:** Promoting research and innovation enhances the reputation of academic institutions. Encouraging faculty and students to engage in meaningful research projects can lead to advancements in various fields.
3. **Student-Centered Approach:** Prioritizing the needs and well-being of students creates an environment where they can excel academically. Providing academic support services, mentorship programs, and extracurricular opportunities contributes to student success.
4. **Inclusivity and Diversity:** Creating an inclusive and diverse learning environment fosters a rich exchange of ideas and perspectives. This contributes to academic excellence by encouraging cross-cultural understanding and collaboration.
5. **Continuous Improvement:** Institutions should engage in a process of continuous improvement, regularly evaluating and refining programs, policies, and services to meet evolving educational needs.
6. **Environmental Responsibility:** Sustainable academic excellence also encompasses environmentally responsible practices. Implementing green initiatives and promoting environmental awareness aligns with a commitment to long-term well-being.
7. **Adaptation to Change:** The educational landscape is constantly evolving. Institutions that embrace change, technology, and new methodologies remain relevant and innovative.

### **Advantages of Library Automation System**

Many activities of a library are routine in nature; a few are repetitive. Automation of these activities helps in managing the library's resources in a better way at the same time saving time, money and manpower. For example, once the bibliographic details like author, title, edition, publisher, price, ISBN number, etc are entered at the time of ordering, the same data can be used for accessioning, cataloguing (OPAC), and circulation. Other important factors associated with automation are speed, and accuracy. One can imagine the time saved in literature searches and in preparing bibliographies. Automation also offers freedom from doing repetitive and routine work as well as enables providing services promptly and more efficiently, cutting down on time and improving productivity. Automation facilitates generation of a number of reports for better decision making in the effective management of the library. Availability of various statistical and other usage reports and performance reports will ensure better appreciation from library users. For example, vendor performance analysis is possible. Subject-wise or project department-wise budget can be monitored. Circulation data can provide information on titles that are in great demand so that more copies can be procured if needed. Many current awareness services like current additions, contents of books and journals, etc can be provided to users (Moorthy, 2004). A library automation system significantly modernizes and enhances the functioning of libraries, leading to improved user experiences, better resource management, and informed decision-making. It enables libraries to meet the demands of the digital age while continuing to provide valuable services to their communities.



### **Library Automation System and Students Sustainable Academic Excellence**

According to Aswal (2006), library automation is pivotal to librarian effectiveness because it increases staff productivity, enhances housekeeping operations, enables advancement in technology and easy access to external information through the Internet. The usage of a library automation system can have a positive impact on students' academic excellence by providing them with improved access to resources, efficient research capabilities, and enhanced learning experiences. Incorporating a library automation system into an educational institution not only improves the efficiency of library operations but also plays a crucial role in promoting students' academic success. It empowers students to become independent learners, efficient researchers, and critical thinkers, contributing to their overall excellence in academia. Sudhamani (2010), supporting the above enumerated how a library automation system can contribute to students' academic success:

1. **Access to a Wide Range of Resources:** Library automation systems provide students with access to a vast collection of books, journals, e-resources, and multimedia materials. This diverse range of resources supports students' research needs and enables them to explore various topics in depth.
2. **Efficient Search and Retrieval:** With advanced search features and user-friendly interfaces, library automation systems help students quickly locate relevant materials. This saves time and frustration, allowing students to focus more on studying and less on searching for resources.
3. **24/7 Accessibility:** Many library automation systems offer online catalogs and digital resources that are accessible around the clock. This flexibility empowers students to engage in research and learning at their own pace, whether they're on or off-campus.
4. **Personalized Learning:** Some library automation systems offer personalized features, such as recommending related resources based on students' interests and previous searches. This feature helps students discover materials they might not have found otherwise, enriching their learning experiences.
5. **Efficient Resource Management:** Library automation systems streamline the borrowing and returning of materials. Students can easily check out and renew items online, reducing the likelihood of overdue fines and ensuring they have access to materials when needed.
6. **Enhanced Research Skills:** By navigating the automation system's databases and catalog, students develop essential research skills, such as refining search queries, critically evaluating sources, and finding scholarly materials.
7. **Digital Literacy:** Interacting with online library resources and platforms helps students improve their digital literacy skills, which are essential for success in the digital age.
8. **Stress Reduction:** With intuitive interfaces and simplified resource management, library automation systems help alleviate stress related to finding and using materials, allowing students to focus more on learning and academic achievement.

### **Barriers to Library Automation System**

Library automation system brings great changes in the functioning of the library ensuring effective and efficient library services. In spite of these great advantages there are many barriers which occur at the time of implementing the automation in libraries. Raiz (2008) has given the following as barriers faced by the library during automation. Fear of adverse impact

on employment, apprehension that the technology could be too expensive, the library staff has to undergo extensive training, lack of support from the management, may be owing to budget constraints, retrospective conversion of data. Some of the common barriers include:

1. **Financial Constraints:** Implementing a library automation system can require a significant upfront investment in terms of software licenses, hardware, staff training, and ongoing maintenance costs. Smaller libraries or those with limited budgets might find it challenging to allocate funds for these expenses.
2. **Lack of Technical Expertise:** Library staff members may lack the technical skills required to effectively operate and maintain the automation system. Training and support are essential, but if the system's complexity exceeds staff capabilities, it can lead to frustration and underutilization.
3. **Resistance to Change:** Libraries with long-standing manual processes might face resistance from staff members who are accustomed to traditional methods. Introducing a new system can disrupt established routines and require a change in mindset.
4. **Data Migration Challenges:** Migrating existing data from manual records or legacy systems to a new library automation system can be complex and time-consuming. Ensuring data accuracy and integrity during migration is crucial for a successful transition.
5. **Integration Issues:** Libraries often use multiple software applications for various purposes (e.g., cataloging, circulation, e-resource management). Integrating a new automation system with existing software can be difficult if compatibility issues arise.
6. **Vendor Lock-In:** Depending on the system chosen, libraries might become dependent on a specific vendor for ongoing support, updates, and customization. This can limit the library's flexibility and potentially lead to higher costs over time.
7. **Customization and Flexibility:** Some library automation systems may lack the level of customization needed to match the unique workflows and requirements of a particular library. A rigid system might force the library to adapt its processes to fit the system, rather than the other way around.
8. **User Training:** Proper training is essential for library staff to make the most of the automation system. Inadequate training can lead to inefficiencies, errors, and underutilization of system features.
9. **User Experience:** If the user interface of the automation system is not intuitive or user-friendly, it can lead to frustration among both staff and patrons. A poor user experience can deter users from fully engaging with the system.
10. **Maintenance and Updates:** Ongoing system maintenance, updates, and troubleshooting are necessary to ensure the system's smooth operation. Libraries might struggle with keeping the system up to date and addressing technical issues promptly.
11. **Privacy and Security Concerns:** Libraries handle sensitive patron data, and the automation system must adhere to stringent privacy and security standards. Failure to address these concerns can lead to breaches of personal information.
12. **Transition Period:** During the transition from manual processes to an automation system, there might be a learning curve for both staff and patrons. This temporary period of adjustment can impact overall productivity.

Overcoming these barriers requires careful planning, sufficient resources, effective training, and a commitment to addressing challenges as they arise. Libraries that successfully navigate these obstacles can enjoy the many benefits that library automation systems offer in terms of efficiency, improved services, and enhanced user experiences.

### **Solutions to Barriers to the Library Automation System**

Certainly, there are several solutions and strategies that libraries can implement to overcome the barriers to adopting and effectively using a library automation system, here are some potential solutions:

#### **1. Financial Constraints:**

- i. Seek grant opportunities or partnerships with funding organizations to secure the necessary funds for system implementation.
- ii. Explore open-source or cost-effective automation solutions that provide essential features without a hefty price tag.
- iii. Prioritize and budget for the most critical components initially, with plans to expand the system gradually.

#### **2. Lack of Technical Expertise:**

- i. Provide comprehensive training to library staff on how to use and manage the automation system effectively.
- ii. Collaborate with the vendor or third-party experts to offer ongoing technical support and guidance.
- iii. Establish a helpdesk or support team within the library to address staff questions and concerns.

#### **3. Resistance to Change:**

- i. Communicate the benefits of the automation system to staff members, emphasizing how it will streamline their tasks and enhance their efficiency.
- ii. Involve staff in the decision-making process and gather their input to customize the system to better align with existing workflows.

#### **4. Data Migration Challenges:**

- i. Plan data migration well in advance and allocate resources for data cleaning, validation, and transfer.
- ii. Collaborate closely with the vendor or IT experts to ensure a smooth data migration process.

#### **5. Integration Issues:**

- i. Choose a library automation system that offers integration options with existing software applications.
- ii. Work with IT experts to implement necessary integrations and ensure data flows seamlessly between systems.

#### **6. Vendor Lock-In:**

- i. Before selecting a vendor, carefully review the terms of service and contracts to understand the level of vendor lock-in.
- ii. Consider open-source or modular systems that provide more flexibility and allow for customization without being solely dependent on a single vendor.

#### **7. Customization and Flexibility:**

- i. Prioritize automation systems that offer configurable workflows and customizable interfaces.
- ii. Work closely with the vendor to tailor the system to the library's specific needs.

**8. User Training:**

- i. Provide comprehensive training for staff members on all aspects of the automation system.
- ii. Offer ongoing training sessions and resources to ensure staff members are well-equipped to utilize the system's features effectively.

**9. User Experience:**

- i. Choose an automation system with a user-friendly and intuitive interface.
- ii. Request user feedback during the selection process to ensure the chosen system aligns with user expectations.

**10. Maintenance and Updates:**

- i. Establish a schedule for regular system maintenance and updates to ensure the system remains up to date and secure.
- iii. Maintain a direct line of communication with the vendor's support team for timely issue resolution.

**11. Privacy and Security Concerns:**

- i. Choose a system that adheres to industry standards for data privacy and security.
- ii. Implement robust security measures, such as encryption and user authentication, to safeguard patron data.

**12. Transition Period:**

- i. Offer guidance and support to both staff and patrons during the transition period.
- ii. Communicate the changes and improvements the automation system will bring to encourage patience and understanding.

By proactively addressing these barriers through careful planning, stakeholder engagement, and strategic decision-making, libraries can successfully implement and leverage a library automation system to enhance their operations, services, and user experiences.

**Conclusion**

In conclusion, the implementation of a library automation system is a pivotal step for modern libraries seeking to enhance their efficiency, accessibility, and overall impact. While challenges such as financial constraints, technical barriers, and resistance to change may arise, they can be effectively addressed through strategic planning, collaboration, and a commitment to continuous improvement. The benefits of a library automation system are far-reaching, touching both library staff and librarians alike. Library automation systems empower libraries to provide a seamless and user-friendly experience, enabling librarians to access a wide range of resources, engage in efficient research, and make the most of their academic pursuits. These systems streamline operations, from cataloging and circulation to reporting and data analysis, freeing up valuable staff time for more meaningful tasks and decision-making. With features like personalized recommendations, integrated digital resources, and remote access, automation systems support learning and research beyond the library's physical walls.

The journey towards sustainable academic excellence is supported by library automation systems. As libraries adapt to changing technologies and user expectations, these systems play a crucial role in promoting data-driven decision-making, promoting collaboration, and

enhancing resource sharing among institutions. With a user-centric approach and a focus on ongoing training, libraries can overcome barriers, embrace innovation, and create an environment that fosters learning, research, and intellectual growth. In an age where information is readily available and rapidly evolving, library automation systems empower libraries to remain relevant and impactful. By leveraging these systems, libraries can continue to be vital pillars of education, knowledge dissemination, and community engagement, ultimately contributing to the enrichment of individuals and society as a whole.

### **Recommendations**

Certainly, here are some recommendations to consider when implementing a library automation system to ensure its successful adoption and ongoing effectiveness:

1. Before selecting an automation system, conduct a comprehensive assessment of your library's specific needs, workflows, and goals. This will help choose a system that aligns closely with your requirements. Also, involve library staff, administrators in the decision-making process. Their input can provide valuable insights into system features and customization needs.
2. Secondly, research and evaluate different vendors and their products. Consider factors such as user reviews, customer support, flexibility, and integration capabilities. Also, invest in thorough training for library staff to ensure they are comfortable and proficient in using the automation system. Training should cover all key aspects, from basic operations to advanced features.
3. Develop a detailed plan for migrating existing data to the new system. Ensure data accuracy, integrity, and proper testing before fully implementing the system.
4. Develop a long-term plan for system maintenance, upgrades, and staying current with technological advancements. Regularly evaluate the system's effectiveness and relevance.

By incorporating these recommendations, libraries can effectively overcome challenges, maximize the benefits of their library automation systems, and provide enhanced services to their communities. The successful implementation of such a system can lead to improved user experiences, streamlined operations, and greater sustainable academic excellence of students.

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## DIASPORA REMITTANCE, FINANCIAL SYSTEM AND SUSTAINABLE ECONOMIC DEVELOPMENT IN NIGERIA

<sup>1</sup>Osayi, Valentine Igbinedion & <sup>2</sup>Akemieyefa, Matthew  
<sup>1&2</sup>Department of Banking and Finance, Federal University,  
Wukari, PMB 1020, Wukari, Taraba State, Nigeria.

### **Abstract**

*The Study x-rayed diaspora remittance, the Nigerian financial system and sustainable economic development in Nigeria. The study used remittance inflows as measure of Diaspora Remittance and the Gross Domestic Product (GDP) as a measure of sustainable economic development. The study examined the absorptive capacity of the Nigerian financial system to mobilize diaspora remittance and transform same into sustainable economic growth and development. Content Analysis (CA) technique was deployed to analyse and examine the data collected from the Central Bank of Nigeria (CBN) Statistical Bulletins for various years, Nigerian Bureau of Statistics (NBS) and the World Bank Development Indicators data base from 1987 to 2020. The data are comprised of the values of diaspora remittance, Gross Domestic product (GDP) and Official development Assistance (ODA). The analysis of the data revealed that the Nigerian financial system mobilized millions and billions of US dollars in remittance into the economy for the period which span thirty-four years with diaspora remittance reaching its peak of twenty-six billion, eight hundred and ninety one million, nine hundred and eighty thousand two hundred dollars in 2011. Between 2011 and 2020, the Nigerian financial system raked in an average of twenty-five billion US dollars in remittance inflows into the economy. Following from the foregoing findings, the study recommended that the Central Bank of Nigeria (CBN) being the monetary and regulatory authority of the banking system, should formulate policies that would further encourage the inflow of Diaspora remittance through the banking system such that diaspora remittances are well utilized to boost employment generation in order to engender sustainable economic growth and development.*

**Keywords:** *Diaspora Remittance, Gross Domestic Product, Sustainable Economic Growth and Development*

### **Background to the Study**

A major problem confronting most developing, less developed, emerging and frontier markets of the world economy today, Nigeria inclusive, is inadequate domestic investments. This insufficient and low level of domestic investment had its negative multiplier effects in the form of the levels of output, income, employment and consumption. The level of domestic investment in a country is directly reflected on the nature and level of the development of the country's financial sector. Investments in whatever capacities are one of the major catalysts of growing economies in the world today, and both local and foreign investments ensure the attainment of desired economic growth and sustainable development. This is due largely to the fact that lack of adequate investments creates disequilibrium between the required capital and the available saving capabilities. Many less developed, developing, emerging and frontier economies compensate for the inadequate domestic savings capital by resorting to foreign debt contraction. While some try as much as possible to attract foreign investment into their economy through the instrumentality of Transnational Corporations (TNCs) and Multinational Corporations (MNCs), others encourage their citizens abroad to send in remittances in addition to the domestic savings mobilization to grow the domestic economy. It is this remittance from foreign countries that constitutes what is globally known today as Diaspora Remittance.

According to Ajayi, Ijaiya, Bello and Adeyemi, (2009), Diaspora remittances are transfer of money by a foreign worker to his or her home country. They are capital transfers of financial assets made by migrants as they move from one country to another and stay for more than one year. As resources, both Diaspora and remittances, take the form of individual's initiatives and pooled efforts through "home improvement unions" and "hometown associations" by migrant groups or diasporas associations in the countries of destination (Singh, Haacker, Lee & Goff, 2010). It should however be noted that the level of development of the host country, especially the financial system absorptive capacity will go a long way in determining how much capital will be invested in or lent to such country, and what the impact would be as regards the country's short and long term domestic investments. The financial system is critical in the onerous task of mobilizing the needed financial resources to sustain domestic investment which will in the long run translate to sustainable economic development.

The Nigerian financial system is first classified into regulatory bodies, financial intermediaries and financial markets. The financial system and markets are controlled by the government through the agency of the various regulatory bodies like; Central Bank of Nigeria (CBN), Securities and Exchange Commission (SEC), Nigeria Deposit Insurance Corporation (NDIC), National Insurance Commission (NAICOM), Pension Commission (PENCOM) and the Federal Ministry of Finance. These regulatory bodies supervise and monitor the activities of the various players in the system to avoid markets malfeasance in order to guarantee market integrity by ensuring strict adherence to the government's fiscal and monetary policies for macroeconomic stability and sustainable economic development.

### **Concept of Sustainable Economic Development**

The concept of sustainable development came to the fore in economic development lexicon in the early 1980s by the International Union for the Conservation of Nature and Natural Resources. The official definition of sustainable development is traceable to the Brundtland Report in 1987. It defined sustainable development as meeting the needs of the present generation without compromising the needs of future generations.



Sustainable development connotes the continuous development and improvement of the human society. In the consciousness of sustainable development, human societies must live and meet their needs without compromising in whatever capacities the ability of future generations to meet their own needs. In specific terms, sustainable development is a way of organizing society so that it can exist in long term. This implies taking into account both the imperatives of present and those of the future, such as the preservation of the environment and natural resources for social and economic equity.

Sustainable development emphasizes the creation of sustainable improvements in the quality of life of all people through increase in real per capita income, improvements in education, health and general quality of life and improvements in quality of natural environmental resources. In a way, sustainable development cannot be separated from economic development as both are closely linked. In other words, sustainable development is a situation in which economic development does not decrease over time. It is the development that is continuous and everlasting which contributes to the quality of life through improvements in human and natural resources. In achieving the Millennium Development Goals (MDGs) which has now metamorphosed into the Sustainable Development Goals (SDGs), huge number of resources is required for which a number of countries depend heavily on foreign aids or official development assistance. Development Assistance (DA) was introduced in the 1970s by the Development Assistance Committee (DAC) of the Organization for Economic Co-operation and Development (OECD). As per the definition, Development Assistance comprises all official flows (financial or otherwise) disbursed from bilateral donors or multilateral institutions to developing countries listed on the Development Assistance Committee List of Aid Recipients for the primary purpose of promoting sustainable economic development and social welfare (Qian, 2014).

According to the Organization for Economic Co-Operation and Development, in order to be classified as Development Assistance, flows should satisfy the following criteria:

1. They must be administered by the official sector of the donor country.
2. Have as a primary objective the promotion of sustainable economic development and social welfare and
3. Must be given on concessional terms with a grant element, that is, an implicit subsidy included on the loan of at least 25% of the face value of the loan, calculated as the ratio of the grant equivalent part of the loan to the face value of a concessional loan and discount rate of 10% (Hudson & Mosley, 2001).

In addition to financial flows, Development Assistance also includes technical assistance or technical cooperation costs, however it does not include grant, loans/credits or equipment for military or peace-keeping purposes and nuclear energy (unless for civilian use) (Qian, 2014; Rajlakshmi & Becker, 2013). According to Hudson and Mosley (2001), transfer payments to private individuals, donations from the public, commercial loans and foreign direct investment (FDI) are also not considered as part of Development Assistance. The Organization for Economic Co-Operation and Development approach to defining and measuring official development aid has some shortcomings beginning with, perhaps unsurprisingly, that it includes too little. By excluding among other contributions by Non-Governmental Organizations (NGOs), faith-based organizations and other charity institutions, Development Assistance cash-flow-based measurement leaves out increasingly

important efforts and the impact that these institutions are playing in the developing world (Jablonski, 2014).

Further, in a continually evolving global environment, donors are providing more efforts in terms of guarantees, callable capital etc. These are not classified as Development Assistance but play important role in mobilizing investment for development particularly in present times when many developing countries require huge loans and equity, rather than grants, to boost infrastructure and finance sustainable economic growth and development (Lomoy, 2013).

Since 2000, official development assistance increased rapidly particularly within the framework of the Millennium Development Goals (MDGs) which were agreed upon in the Millennium Declaration agreed by members of the United Nations in 2000 (Lomoy, 2013). The Millennium Development Goals which have now transformed into the Sustainable Development Goals (SDGs) set a range of objectives to be met by 2015- 25, with the targets extended to 2030 with coming on board of sustainable development goals which required large amount of financial support to developing countries (Doucouliagos & Paldam, 2013).

### **Financial System as a Channel of Diaspora Remittance and Catalyst for Sustainable Economic Development in Nigeria**

For Diaspora remittances to be meaningfully sent from the migrant host country to the migrant home country for sustainable economic development, the need for a robust and vibrant financial system cannot be overemphasized. This is due largely to the inherent absorptive capacity and ability of the financial system to mobilize humongous financial resources from every sector of the economy and across countries. The financial system of every country is responsible for regulating the financial environment of the economy, determining the types and amounts of funds to be floated, cost of funds and the uses of the funds so procured.

The financial system of any country refers to a set of institutional and other arrangements that facilitate the transfer of savings through the economy from those who generate them to those who ultimately use them for investments and consumption purposes. According to Maduka and Onwuka (2013) in Isenmila (2017), Nigerian financial system consists of various institutions, instruments and regulations. The Nigerian financial system is made up of financial intermediaries, financial markets; financial instruments, rules conventions and norms which facilitate and regulate the flow of funds through the economy.

A critical part of the Nigerian financial system is the financial intermediaries. Financial intermediaries can be categorized into depository and non-depository intermediaries. While the depository intermediaries include Deposit Money Banks (DMBs), savings-thrift and loan associations, credit unions and discount houses; the non-depository intermediaries include insurance companies, investment companies and pension funds. The interaction between these intermediaries brings owners and users of funds together. They all operate in the different segments of the financial market.

The financial markets are the various facilities provided by the financial system for the creation, custodianship and the distribution of financial assets and liabilities. The Nigerian financial market is the collection of financial institutions set up for the granting of short-,

medium- and long-term loans. The market has three segments: the money market, the capital market and the foreign exchange market. The foreign exchange market is reputed to be largest in terms of the volume and value of diaspora remittance and foreign capital mobilization for sustainable development. The market has, for the past several decades, remained the most effective mechanism for mobilizing foreign financial resources into the economy for sustainable economic development.

Generally, in every economy, there are surplus units and deficit units. The surplus units are presumed to have money in excess of their immediate needs. While the deficit units, presumably, do not have enough to meet their consumption and capital needs. To bridge this gap, financial institutions are required to link them while government use monetary policies such as money supply control influence over cost of money-interest rates, control of credit to pursue economic and political goals and objectives. To link the surplus units with deficit units that do not have enough for their expenditures or investment plans, financial intermediaries develop facilities and instruments to link the required lending and borrowing. They link the savers and borrowers by providing convenient ways for lenders to save money, packaging amounts lent by savers as loans and overdrafts to borrow in bigger amounts, reducing risks such as bad debt-applicable to strong intermediary, and providing maturity transformation. It should however be noted that not all financial intermediaries intermediate only between savers and investors. For example, discount houses intermediate between institutions, and almost all intermediaries place funds with other institutions. The financial system provides the engine of growth for sustainable economic development. The financial system has the responsibility for regulating the financial environment, determining the types and amounts of funds to be issued, cost and use of funds. Financial institutions are firms that supply financial services to the economic community by filling the diverse needs of both ultimate borrowers and ultimate lenders. The financial markets are broadly made up of the money market and the capital market.

### **The Money Market**

The money market provides facilities for exchange of financial obligations whose maturities vary from one day to one calendar year (Isenmila & Eboiyehi, 2013). The money market refers to the mechanism involving transactions in short term funds and financial instruments with tenor that covers overnight to one year, that is, securities less than one year such as treasury bills and certificates, negotiable certificates of deposits, commercial papers, bankers' acceptances, bills of exchange and such other financial assets whose maturity tenor does not exceed one year and others; and for implementing monetary policies to arrest economic problem in order to stabilize the economy and ensure sustainable economic development. The money market has two components; namely: the primary and secondary markets. The primary market deals with the trading of new issues of short-term financial assets, while the secondary money market deals with existing short-term securities traded at rates determined by market forces. In this market, short-term instruments can be rediscounted before their due dates of maturity. This is the function of the discount houses. The discount houses constitute the operators of the secondary money market. A well-developed money market is not only an asset but essential to any economy as it performs several important functions. These functions can be divided into those performed for the economy, for the commercial banks, for the Central Bank and for the Government.

**Services to the Economy:** The money market in its functions as a borrower and lender of short-term funds discharges an important function for the economy by ensuring that no loose funds lie idle. It therefore promotes an efficient allocation and utilization of resources in the economy. As a borrower, the money market provides the facility by which those who have more funds than required for the moment can invest them for profit; in this way it ensures that no funds lie idle in the economy. As a lender, it provides opportunities for those who need short-term funds to borrow for productive investment. It lends to the commercial banks through the call money facilities, to the Government through treasury bills. By these means, the money market tends to bring about a more efficient allocation and utilization of funds in the economy. According to Osamwonyi, (2016), the existence of money market ensures that funds raised in the economy are used in the economy. Money market provides a fund of specialized skill and knowledge through constant and continuous dealings in the market. This specialized skill and knowledge tend to enhance the reputation of the country.

**Services to the Commercial Banks:** The money market gives the central bank of Nigeria (CBN) a channel for the injection and withdrawal of cash from the system and for the performance of its functions as lender of last resort. By the cash and liquidity ratios, which it helps the commercial banks to maintain, the money market provides a fulcrum for the Central Bank to carry out open market operations and operate special deposits. By these techniques, the Central Bank attempts to control the financial system. The money market is the traditional channel by which the authorities make the bank rate or rediscount rate effective. Through the operations of open market operations and special deposits, they can ease or tighten the money in the market, which will reflect in the structure of interest rates in the market.

By acting as the principal buyer, the money market enables the Central Bank to use treasury bill finance without putting too much cash in the market, as would be the case if Central Bank granted direct advance to the government.

**Services to the Government:** For the Government, the money market is an important source of borrowing short term funds. The Government borrows from the market through treasury bills, call money funds, treasury certificates and special deposits. Such borrowing enables the government to even out flows in its revenue. When revenue is short of planned expenditures, borrowing becomes inevitable in order to make up the short fall from the market, and when there is surplus, the excess is used to redeem previous borrowing. The existence of the money market thus enables the government to carry out its programme of spending without worrying about whether enough funds will be available. By making government financing easier, it reduces the need for direct advance by the Central Bank to the government and thus allows the function, which such a financing arrangement normally brings about (Osamwonyi, 2016).

**Eurodollar or Eurocurrencies Markets**– these are markets where banks lend and borrow in foreign currencies. Eurodollar or Eurocurrencies are deposits of freely convertible currencies placed with banks outside the country and available for lending. Most currencies held by banks outside the country of the currency are in US dollars, hence the markets are often described as Eurodollars. Eurodollar are dollar – denominated deposits in foreign commercial banks and in foreign branches of the home (where the bank is domiciled) bank. Interest rates are structured into seven days notice, one month, three months, six months and one year.

### **The Capital Market**

The capital market is a broad term which includes primary markets, secondary markets, term lending institutions, bank investors, and anybody engaged in providing long term capital (whether equity capital or debt capital) to firms and government. It is a complex of institutions through which intermediate term fund and long-term funds are pooled and made available to business, government and individuals. The capital market deals in ordinary stocks, shares and debentures of corporations, and bonds and securities of government.

Capital market is a financial market that provides facilities for mobilizing and dealing in medium- and long-term funds. The players on the capital market are the operators who act as intermediaries between the providers of the funds and the fund users. Ugwu (2006), describes the capital market as a financial platform that provides facilities for mobilizing and dealing in medium- and long-term funds through transfer from where they are less needed to where they are needed more through the operators who act as intermediaries between the providers of the funds and the users of such fund. Cooley and Roden (2009) see capital market as any place where securities greater than one year are bought and sold.

According to Al-Faki (2006), The Nigerian capital market was created with the intent of creating a chain for the supply of medium- and long-term capital for investment in various economic projects that spur development, the organization of a well-designed network of specialized financial institutions, series of processes and infrastructure. Because of the delicate structure of the capital market, funds are pushed to where they are needed the most and thus it increases the level of economic output because capital is being put to its best use (Pedro & Erwan, 2004). Fluctuations in business outputs can be easily controlled in a country where the capital market is more developed (Tharavaniji, 2007). This is because of the presence of a strong structured system that can easily finance projects when needed, so businesses can have access to the funds they need and there will be lower chances of an economic downturn compared to those with less developed capital market. The World Bank (1994) indicated that capital market development helps in predicting future growth rates of the inflow of capital, GDP and productivity levels.

The capital market can be further sub-divided into the primary capital market and the secondary capital market. The primary capital market deals with new issue of securities. It can be referred to as new issues market. Privatization also comes to the primary market. The secondary market on the other hand, is the market that deals with secondhand securities. The secondary market is made possible through the instrumentality of the stock exchange. According to Osamwonyi (2016), It is a complex mix of institutions and mechanisms through which funds longer than one year are pooled from surplus unit or institutions are made available to business, government and individual in exchange for instruments. Important institutions and participants in the capital market include the stock exchange, share registrars, issuing houses, stockbrokers, underwriters and Securities and Exchange Commission. While in the relationship structure the Central Bank of Nigeria (CBN) controls both the money market through the banks, the capital market through the Nigerian Securities and Exchange Commission directly controls the Nigerian stock Exchange where equities, term loans and gilts are traded.

The capital market always complements the effort of the banking sector by mobilizing

financial resources for long-term private investment (Ologunwa & Sadibo, 2016). Bencivenga, Smith, and Starr (1996) were of the opinion that a long-lasting economic growth rests on the well performing and properly functioning financial market. However, Ahmed and Ansari (1998) iterated that capital markets work well and contribute to sustainable economic growth and development when the Government policy is directed toward efficient allocation of financial resources. Another very important segment of the financial market is the foreign exchange market.

### **The Foreign Exchange (FOREX) Market**

Foreign exchange is the conversion of the currency of a country into the currency of another country; and in the case of Nigeria, the conversion of naira to other foreign currencies. The value of such currency can be pegged to another country's currency, such as the U.S dollar, or even to a basket of currencies, though such value is determined by market forces in a free market economy. A country's currency value may be fixed by the country's government. It should however be noted that most countries float their currencies freely against other countries currencies which enable them to be in constant volatility or fluctuation.

The foreign exchange market is where all transactions involving the sale and purchase of foreign currencies or conversion of local currencies to foreign currencies. The foreign exchange market is the market in which the participants can buy, sell, exchange and speculate on currencies. The market is made up of banks, commercial companies, and central banks, firms that manage investment, hedge funds, foreign exchange brokers and investors. According to Osamwonyi (2016), a foreign exchange market is a market for the interaction of sellers and buyers of foreign exchange. The market provides for sale and transfer of foreign currencies, for access to trade credits, and for hedging in the forward component. He asserts that market forces, real rates, international reserves, and foreign borrowing impact nominal exchange rate. The foreign exchange market allows for the exchange of one currency for another. Large commercial banks serve this market by holding inventories of each currency, so that they can accommodate requests by individuals or multinational companies. Individuals rely on the foreign exchange market when they travel to foreign countries.

According to Obadan (2013), it is made up of key convertible currencies that are generally acceptable for the settlement of international transactions and other external obligations undertaken. It is the largest financial market in the world. For instance, trading in foreign exchange market was averagely estimated at \$5.1 trillion per day in April 2016, this is according to the 2016 Triennial Central Bank Survey of foreign exchange and over-the-counter (OTC) derivatives markets. The market therefore provides for sale and transfer of foreign currencies, for access to trade credits, and for hedging in the forward component. It is important to outline major determinants and channels for accessing the market. Market forces, real rates, international reserves, and foreign borrowing impact nominal exchange rate. Monetary and fiscal policies are important. Economic policies have an inverse relationship with exchange rate. For example, research have shown that low interest rates can drive down cost of credits, increasing credits leading to increased demand for foreign exchange and imports. Domestic inflation reduces competitive exports and inversely affect exchange rate. Policy intervention and parallel market have inverse relationship with exchange rate while bank liquidity and inflation have positive relationship. According to Nnanna, Englama, and Odoko (2004), foreign exchange is the means of effecting payments for international

transactions. Migrant monetary remittance from the host country to the home country of the migrant are often channeled through the foreign exchange markets via the banking system.

Although the notion of remittances conjures only monetary aspect, remittances embrace monetary and non-monetary flows, including social remittances (Amuedo-Dorantes, & Pozo, 2004). The North South Centre of the Council of Europe (2006) defines Diaspora social remittances as ideas, practices, mind-sets, world views, values and attitudes, norms of behaviour and social capital (knowledge, experience and expertise) that the diasporas mediate and either consciously or unconsciously transfer from host to home communities. They are capital transfers of financial assets made by migrants as they move from one country to another and stay for more than one year. As resources, both Diaspora and remittances, take the form of individual's initiatives and pooled efforts through "home improvement unions" and "hometown associations" by migrant groups or diaspora associations in the countries of destination (Singh, Haacker, Lee & Goff, 2010).

It has been noted that "diaspora organisations can act as important intermediaries between traditional development actors and between diasporas and local communities for example, identifying needs and priorities of local communities and communicating those to donor organisations, foreign direct investment and diaspora members to solicit funding and expertise (Fayissa & Nsiah, 2010).

There are different transfer mechanisms available to migrants to send remittances, namely, banks, credit unions, small and large money transfer institutions such as Western Union, Money gram, hand delivery by the sender through a third party and other informal mechanisms (Singh, Haacker, Lee & Goff, 2010). However, lack of administrative structures and mechanisms for government to tap (leverage) directly into these foreign inflows from the Diaspora as an asset for investment and sustainable national economic development. Thus remittances including unrecorded flows through formal and informal channels, is believed to be even larger. According to Fayissa and Nsiah (2010), Remittance flows have other significant characteristics beyond their volume. The 2003 World Bank report also noted that they are more stable than other kinds of external financial flows, and indeed seem to be counter cyclical (Jongwanich, 2007). In times of crisis, whether natural or man-made, migrants tend to send more money to their families to help them survive or recover, whereas foreign investment and lending tend to dry up (Singh et al. 2010). There are two fundamental important characteristics of remittances that are worth underscoring; namely; they are largely not affected by political or financial crises, tending to increase in times of hardship and they are equally spread among developing countries than are other financial flows (Ratha, 2003; Jongwanich, 2007).

Diaspora remittances are experiencing growth and due to huge sums involved, it is now being recognized as an important contributor to the recipient country's economic growth and sustainable development (Rao & Hassan, 2011). Migrants living abroad typically send money home to help their families. Remittances are an important source of external financing to the recipient country and may alleviate credit constraints and act as a substitute for financial development (Schiopu & Siegfried, 2006). Unlike private capital flows, remittances tend to rise when the recipient economy suffers an economic downturn following crisis, natural disaster, or political conflict because migrants send funds during hard times to help their families and friends (Jongwanich, 2007).

In other words, diaspora remittances in the recipient country and the economic hardship therein have positive relationship. The more the economic hardship experienced in the migrant home country, the more the remittance inflows. On the other hand, the economic hardship of the migrant host country and the level of remittance outflow have inverse relationship. In other words, the more severe the economic hardship of the migrant host country, the less the level of remittance the migrant is able to send home. This is because the earning ability of the migrant is limited when its host economy is experiencing downturn.

### **Specific Channels of Diaspora Remittance in Nigeria**

There are several channels through which migrants' remittances are made. With the globalisation and automation of the Nigerian financial system, many easy channels of diaspora remittance have been developed and evolved over the years by International Money Transfer Operators (IMTO). According to the International Monetary Fund, remittances are household income from foreign economies arising mainly from the temporary or permanent movement of people to those economies. Remittances include cash and noncash items that flow through formal channels such as electronic wire, or through informal channels, such as money or goods carried across borders. A few of such channels are presented below:

- I. Electronic Fund Transfer (ETF):** The electronic fund transfer system allows a customer's account to be credited or debited electronically within 24 hours anywhere in Nigeria. The defunct Universal Bank of Nigeria plc was the first to venture into the Electronic Fund transfer System (ETF) in 1992. The Electronic Fund Transfer (ETF), provides a more convenient and suitable way of transferring funds. The ETF is even cost effective when compared to the traditional methods of transferring funds such as mails and telegraphic transfers. It is more secured and time saving when money is transferred electronically by individual banks through their accredited agents or branches.

The services of the Electronic Fund Transfer (ETF) system extended beyond the shore of Nigeria as deposit money banks capitalised on the services and repositioned and diversified their portfolio of foreign exchange as a strategy to attract foreign exchange inflows. Among the various funds transfer protocols and products owned by Nigerian deposit money banks are the Western Union Money Transfer and the RIA service owned and operated by the First Bank of Nigeria Plc. The United Bank of Nigeria Plc also owns and operates the Money Gram scheme. These three products and schemes have facilitated the movement and transfer of funds to any locations in Nigeria from over a hundred overseas countries. The schemes are operated in such a coded way that the recipients are only required to provide correct answers to coded question(s). This is to prove and ascertain that the funds get to the right ownership for collection. It should however be noted that the recipient does not have to be an account holder with the bank before he or she is allowed to collect the proceeds. Though some deposit money banks in a bid to mobilise and retain foreign exchange will request the funds collector to open an account with them as a yardstick for collection.

- ii. The Swift:** The SWIFT stands for Society of Worldwide Interbank Financial Telecommunication. It is a financial telecommunication network system that is made up of computer-based centres located and scattered around the various locations of



the world and interconnected through telephone leased lines or packet switches. The SWIFT network has a hub and is located in various access points usually one per country. The Nigerian access point is located in the domain of the Central Bank of Nigeria (CBN). With the SWIFT innovative technology in place, Nigerian banks have access and the opportunities to perform a number of innovative services which but not limited to funds transfer to and from any location abroad, documentary credits and collection and money and security market operations. The SWIFT technology has the merits of granting the users direct accessibility to the whole banking world. International payments are made easier, cheap, efficient and more secured with SWIFT technology. It is the safest and universally accepted means of transferring funds from one country to another and it has enhanced the portfolio performance of deposit money banks in Nigeria.

### **Recent Update and Policy Measure of the Central Bank of Nigeria (CBN) to Attract Diaspora Remittance Inflow**

Due mainly to scarcity of foreign exchange in the country and the declining state of the external reserves, the Central Bank of Nigeria pronounced a policy intervention known as the Naira4dollar initiative. The Naira4dollar policy intervention of the apex bank was to curb withholding of foreign exchange by deposit money banks and boost external reserves of the country. It is a policy incentive which rewards recipients with N4 for every \$1 they receive from licensed International Money Transfer Organisations (IMTOs) and deposit money banks. The policy incentive was introduced in 2020 amidst exchange rate depreciation and fluctuation. The Central Bank of Nigeria however, extended this initiative indefinitely earlier in May 2021, with a view to increasing remittances so as to boost external reserves.

According to the review of Nigeria's balance of payment as released by the Central Bank of Nigeria (CBN), Diaspora remittances into Nigeria increased by 15.6% Quarter on Quarter QoQ to \$9.22 billion in first half H1 2021 compared to \$7.98 billion recorded in the second half of 2020. It also represents a marginal 2.2% increase compared to \$9.02 billion recorded in the corresponding period of 2020. The increase follows the continuation of the Naira4dollar policy initiative by the apex bank.

From the release by the Central Bank, it is observed that although Nigeria's inflow is yet to reach pre-pandemic levels, it is beginning to move upwards compared to 2020, which was soured by the global economic downturn caused by the covid-19 pandemic. Notably, in H1 2021 diaspora remittance inflow into Nigeria rose to its highest levels since H2 2019. The latest increase in diaspora remittances has also supported the Nigerian current account balance, which has been on a net deficit since Q1 2021. However, Nigeria's current account deficit improved to \$424 million in the second quarter of 2021, from a deficit of \$2.1 billion recorded in the previous quarter.

The breakdown of the data as released by the Central Bank of Nigeria (CBN) shows that Nigeria has recorded diaspora remittance inflow of \$115.15 billion in over 5 years, while outflow stood at \$1.18 billion in the same period, indicating a net credit of \$113.96 billion. It is worthy of note that Nigeria's diaspora remittance outflow in the first half of 2021, dropped by 30.1% from \$34.59 million recorded in H2 2020 to \$24.18 million. It also recorded a marginal decline of 10.6% compared to \$21.86 million recorded in the corresponding period of 2020. The implication of this is that the Naira4dollar policy intervention of the Central Bank of

Nigeria designed to incentivized foreign exchange inflow has a positive impact on the economy.

According to a report released by Agosto Consulting titled: 2021 Nigeria Diaspora Remittance Report & Survey. Nigeria has over \$21 billion annually in inflows from diaspora remittances, making it the second-largest recipient of remittances on the continent, only after Egypt. The remittances from the Nigerian diaspora have become a major mainstay of the country's economy. At the macro level, diaspora remittances represent the second-largest source of foreign exchange inflow into the country, second only to crude oil earnings.

### **The World Bank Report**

According to the World Bank Economic Review Report, Nigeria had returned to growth in remittance inflows in 2021 as a result of the increasing influence of policies intended to channel inflows through the banking system, pointing at the Naira4dollar policy scheme by the Central Bank of Nigeria (CBN). The report also indicated that Nigeria is currently the largest recipient of remittance inflows in the Sub-Saharan region of Africa in 2021. Meanwhile, remittance inflows to Sub-Saharan Africa grew by 6.2% to \$45 billion in 2021 and are projected to grow by 5.5% in 2022.

According to the World Bank, remittances to low-and middle-income countries are projected to have grown by 7.3% to reach \$589 billion in 2021. In a statement by Michal Rutkowski, World Bank Global Director for Social protection and jobs, he said: “Remittance flows from migrants have greatly complemented government cash transfer programs to support families suffering economic hardships during the COVID-19 crisis. Facilitating the flow of remittances to provide relief to strained household budgets should be a key component of government policies to support a global recovery from the pandemic.

According to the World Bank, factors contributing to the strong growth in remittance are migrants' determination to support their families in times of need, aided by economic recovery in Europe and the United States which in turn was supported by the fiscal stimulus and employment support programs. The topmost bank (World Bank) also stated that in the recovery of outward remittances in the Gulf Cooperation Council (GCC) countries and Russia, was facilitated by stronger oil prices and the resulting pickup in economic activity. It therefore follows that the economic prosperity of the migrants host countries and economic adversity of migrants home countries of origin combined to influence the direction and magnitude of diaspora remittances. This reasoning is in tandem with the report of Nairametrics earlier in the year that remittances into the country fell by 24% in the first quarter of 2021, which was attributed to the downturn in developed economies, coupled with some Nigerian foreign policy that had left diaspora Nigerians with little option but to transfer funds through black market channels.

### **Concluding Remarks**

Diaspora remittances represent one of the most important sources of external flows of capital and foreign exchanges for many developing countries. They play an important role in the lives of their recipients. It is the second-largest source behind Foreign Direct Investment (FDI) of external funding for developing economies. The Diaspora remittances play a very important role in the economy. When they are low, the amount of foreign exchange in circulation

becomes low and people start chasing dollars which causes its value to skyrocket against the Naira.

1. It should however be noted that the Central Bank of Nigeria (CBN) reports diaspora remittances as workers' remittances in its balance of payment report. This, in the view of this study, is a matter of semantics. Workers's remittance or diaspora remittances are one and same thing.
2. However, with the clampdown of the Central Bank Nigeria (CBN) on cryptocurrency transactions in the country and the incentive to Nigerians for every unit of dollar received through official channel, the country has started recording appreciation in diaspora remittances. This increase, if it continues will boost dollar liquidity in the banking sector and the economy in general and help the apex bank continue foreign exchange market intervention to sustain liquidity so as to ensure sustainable economic development.

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## CONSTRAINT CURRENT CONTROL FOR GRID-CONNECTED POWER INVERTER

<sup>1</sup>Masud Ibrahim <sup>2</sup>Safiyanu Muhammad Babale  
<sup>3</sup>Ammar Muhammad Ibrahim & <sup>4</sup>Sulaiman Hassan  
<sup>1,2,3&4</sup>Department of Electrical Engineering, School of Technology,  
Binyaminu Usman Polytechnic Hadejia, Jigawa state)

### **Abstract**

Recent study has paid much attention in the areas of renewable energy (solar and wind) as an alternative method to derive electrical power rather than going by fossil fuels (coal, natural gases etc.) which constantly emits carbon dioxide and other harmful substances into the atmosphere. The emission of these undesirable harmful substances into the atmosphere have caused climatic changes for example global warming, acid rain, low precipitations and unwanted desert encroachment. These badly affect the quality life of humans and animals. In response to these problems, methods of reducing carbon content emissions become necessary through the use of renewable energy sources (Photovoltaic system, Wind power, Fuel cell etc.). As a result, research on grid-connected inverter have recently become a very hot topic as a means of interfacing renewable energy sources to utility grid. With good interfacing, the renewable energy sources can be able to solve not only the problem of carbon emissions into the atmosphere but also to efficiently support the grid from increased demand of electrical power. Thus, this research has focused on designing a constraint current controller for grid-connected inverter using linear quadratic regulations (LQR) method. The idea of using LQR control design as opposed to classical PI controller is that The LQR provides optimal current control by careful tuning of the input and state weighting matrices and therefore systematic control design can be achieved. Another advantage of LQR method is that constraint handling can be address through an offline optimization technique. This is necessary in order to protect the inverter system components (semiconductor switches) and improve its reliability.

**Keywords:** Grid-connected Inverter, LQR, Constraint handling, Optimization

### **Background to the Study**

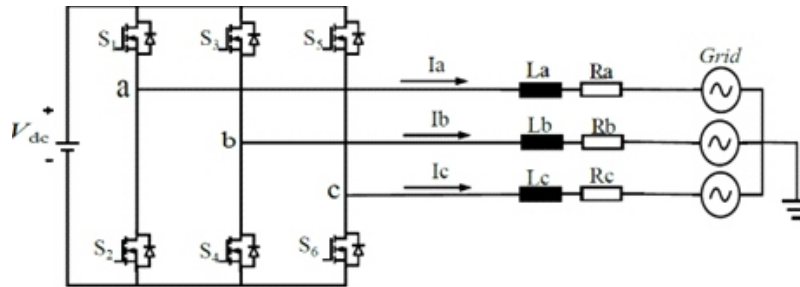
Inverter converts DC to AC voltage through semiconductor devices (IGBTs, Thyristors, and MOSFETs etc.). Grid-connected inverter is required to deliver power to the grid in order to support loads. Grid connected inverter is widely used nowadays to integrate many renewable energy sources such as PV, Wind, Fuel cell etc. The essence of using renewable energy sources is to mitigate the amount of carbon emission into the atmosphere, which can result in undesirable climatic change. Several methods of current control for grid connected inverter system have been investigated for many years. The current control for grid-connected inverter is useful to send active and reactive power to the utility grid. Also, power factor correction and active filtering is possible with current control to improve the grid power quality. One of the techniques employed for current control is classical PI controller, which is used for tracking of constant (DC) reference current signal. This type of control only works in synchronous reference frame (DQ) and require decoupling to achieve effective control [2][13]. In stationary reference frame (Alpha-Beta), PI controller led to large steady state error as it cannot track AC reference current signal. Hence, classical PI controller has perfect tracking at only zero frequency (DC). In order to track an AC reference current with zero steady state error, the so called Proportional resonant (PR) controller should be used [3][10][14][15][19]. However, the PR controller tracks a given reference current at specific frequency called resonant frequency. Any slight deviation of resonant frequency will lead to poor performance tracking. Therefore, for a grid where frequency fluctuates, a PLL should be implemented to synchronize the phase angle as well as the frequency of the grid by correcting any deviation between the grid and inverter [1][17][18]. A linear quadratic regulation (LQR) is an optimal control method that solve an optimization problem to minimize a given cost function. Minimization of cost function can be achieved by careful tuning of input and state weighting matrices (Q and R) [4][5][6][9]. LQR is in effect a proportional controller and thus does not provide reference tracking with zero steady state error. To achieve current control with zero steady state error, the state variable error should be formulated in the cost function [8][12][16]. For a constant reference tracking, an integral control is augmented in the LQR design (PI controller) to eliminate the steady state error. For AC reference tracking, a resonant controller is augmented in the LQR design (PR controller) to eliminate AC steady state errors [20][21][22]. Constraints design is necessary for the protection of inverter system. For example, the rated semiconductor voltage and current, DC-link rated voltage, power losses limitation, overshoot, non-minimum phase behavior etc. [14]. Therefore, an offline closed loop predictions using state space model of VSI can be applied to check whether the constraints design being imposed in the control are satisfied or not [7][11].

In general, this research investigates an idea of using LQR design method for the development of constraint current controller for grid connected power inverter. The LQR design method is investigated in both DQ frame and Alpha-beta frame. In DQ frame, the LQR is design to control a DC current signal and thus PI controller is used. However, in Alpha-beta frame, the LQR is design to control AC current signals and thus PR controller is used.

### **Methodology**

A typical three-phase voltage source inverter VSI configuration is presented in fig1. The output voltage or current of the inverter is controlled by applying appropriate pulse signals to six IGBTs switches (S1 to S6). These switches convert the DC into AC output signal, which eventually connected to the grid. For grid connected inverter, the objective is to control the

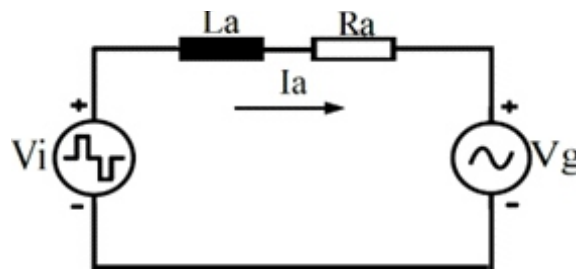
active and reactive power, and this depend on the current supplied into the grid. it is therefore imperative to derive the mathematical model of the inverter circuit which allow the control of the current. The mathematical modelling of VSI can be realized either with direct-quadrature (DQ) or in Alpha-Beta ( $\alpha\beta$ ) transformations [Kom+16]. With these transformations, the state space model of VSI can be obtained.



**Fig 1: Schematic diagram of grid-connected inverter**

**Modelling of the Inverter**

Before applying any control scheme, it is necessary to understand the behavior of the system (plant). In this case, the inverter configuration has to be modelled. The modelling is done by obtaining the differential equation (DE) from the single-phase equivalent circuit shown in fig 2. The DE of the single inverter is presented in Eqn.(1).



**Fig 2: Single-phase equivalent circuit**

$$\frac{di_a}{dt} = -\frac{R_a}{L_a}i_a + \frac{1}{L_a}V_i - \frac{1}{L_a}V_g \quad (1)$$

Where:  $i_a$  is the output current of the inverter,  $V_g$  is the grid voltage acting as disturbance, and  $R_a, L_a$  are impedance for the single-phase equivalent circuit of VSI.

For balanced three phase system, the impedance are equal. Thus, ( $R_a = R_b = R_c = R$ ) and ( $L_a = L_b = L_c = L$ ). Then the DE of the three phase circuit is formulated in a compact form as:

$$\frac{di_{abc}}{dt} = -\frac{R}{L}i_{abc} + \frac{1}{L}V_{abc} - \frac{1}{L}V_{abcg} \quad (2)$$



### State space modelling with Alpha-Beta ( $\alpha\beta$ ) frame

VSI inverter can be modelled in Alpha-Beta frame (stationary reference frame) with the aid of Clarke transformation. Clarke transformation converts three phase voltages or currents into orthogonal  $\alpha\beta 0$  components as depicted in Eqn. (3). The  $\alpha\beta 0$  components are time varying quantities (AC) shifted by 90 degrees and both have the same peak value as the three phase voltages/currents as shown in Fig3. The  $\alpha$ -component is responsible for active power control while the  $\beta$ -component is responsible for reactive power control. It is also important to highlight that if three phase system voltages or currents are balanced, then the third components '0' is neglected and thus reduce to two components  $\alpha\beta$ .

$$\begin{bmatrix} v_\alpha \\ v_\beta \\ v_0 \end{bmatrix} = \begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{bmatrix} \begin{bmatrix} v_a \\ v_b \\ v_c \end{bmatrix} \quad (3)$$

By applying Clarke transformation in Eqn. (2), the DE of the  $\alpha\beta$  frame can be obtained as presented in Eqn.(4).

$$\frac{di_{\alpha\beta}}{dt} = -\frac{R}{L}i_{\alpha\beta} + \frac{1}{L}V_{\alpha\beta i} - \frac{1}{L}V_{\alpha\beta g} \quad (4)$$

The standard state space LTI system in continuous form is depicted in Eqn. (5 and 6)

$$\dot{x}(t) = Ax(t) + Bu(t) + Ew(t) \quad (5)$$

$$y(t) = Cx(t) + Du(t) \quad (6)$$

By comparing Eqn 4,5 and 6, the state space variables can be obtained with

$$x = \begin{bmatrix} i_\alpha \\ i_\beta \end{bmatrix} \quad u = \begin{bmatrix} V_{\alpha i} \\ V_{\beta i} \end{bmatrix} \quad w = \begin{bmatrix} V_{\alpha g} \\ V_{\beta g} \end{bmatrix}$$

are state variables, inputs and disturbance respectively. The state space parameters are given as follows:

$$A = \begin{bmatrix} -\frac{R}{L} & 0 \\ 0 & -\frac{R}{L} \end{bmatrix} \quad B = \begin{bmatrix} -\frac{1}{L} & 0 \\ 0 & -\frac{1}{L} \end{bmatrix} \quad E = \begin{bmatrix} \frac{1}{L} & 0 \\ 0 & \frac{1}{L} \end{bmatrix} \quad C = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad D = 0$$

### State space modelling with DQ frame

The modelling of VSI in DQ frame (synchronous reference frame) is done with the aid of Park transformation. Park Transformation converts three-phase system into dq0. The three phase voltages or currents are first transformed into orthogonal ( $\alpha\beta 0$ ) components. Then the resulting  $\alpha\beta 0$  components is then rotated about a fixed angle  $\theta$  to form the dq0 which are DC quantities.  $\theta$  is a function of grid frequency ( $\omega$ ) obtained with phase locked loop that locks the original three phase voltages and align them with dq axis. For a balanced three phase system, the d-component is constant (DC) with the same peak value as the original three phase voltages/currents while the q-components is zero and the '0' components is often neglected.

The d-component is used to control the active power while the q-component for reactive power. The DQ transformation is given in Eqn.(7).

$$\begin{bmatrix} v_d \\ v_q \\ v_0 \end{bmatrix} = \begin{bmatrix} \cos \theta & \sin \theta & 0 \\ -\sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} v_\alpha \\ v_\beta \\ v_0 \end{bmatrix} \quad (7)$$

By applying Park transformation in Eqn.(2), the DE of the DQ frame is obtained as depicted in Eqn.(8).

$$\frac{di_{dq}}{dt} = -\frac{R}{L}i_{dq} + \frac{1}{L}V_{dqi} - \frac{1}{L}V_{dqg} - \omega \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} \quad (8)$$

With  $x = \begin{bmatrix} i_d \\ i_q \end{bmatrix}$   $u = \begin{bmatrix} V_{di} \\ V_{qi} \end{bmatrix}$   $\omega = \begin{bmatrix} V_{dg} \\ V_{qg} \end{bmatrix}$  are state variables, inputs and disturbances respectively. The  $\omega$  represent the grid frequency.

The state space parameters of the DQ frame is extracted as follows;

$$A = \begin{bmatrix} -\frac{R}{L} & \omega \\ -\omega & -\frac{R}{L} \end{bmatrix} \quad B = \begin{bmatrix} \frac{1}{L} & 0 \\ 0 & \frac{1}{L} \end{bmatrix} \quad E = \begin{bmatrix} -\frac{1}{L} & 0 \\ 0 & -\frac{1}{L} \end{bmatrix} \quad C = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad D = 0$$

Once the state space model of VSI is obtained, the LQR method can be designed to control the current variables in both DQ and  $\alpha\beta$  frame.

### Linear Quadratic Regulation (LQR)

Linear Quadratic regulation (LQR) is a proportional (P-type) controller with gain  $K_s$  to regulate all state variables to the origin. However, the interest here is to control the current variables to a desired reference value. Hence, a reference tracking is introduced in the LQR. An LQR is a method of designing an optimal feedback gain by systematic tuning/tradeoff between the importance of performance and control effort, which are formulated in the cost function. The cost function represents the measure of the quality of the closed loop behavior which comprises of settling time, maximum overshoot, rise time, offset, peak input value etc. Large cost function implies poor system performance while small cost function implies good performance. The cost function and control law in continuous form is depicted in Eqn. (9) and Eqn.(10) respectively.

$$\text{Min}_{u,x} \quad J = \frac{1}{2} \int_0^{\infty} (x^T(t)Qx(t) + u^T(t)Ru(t))dt \quad (9)$$

$$u = -K_s x(t) \quad (10)$$

Where  $Q \geq 0$  is a diagonal state weighting matrix which penalizes the state deviation and thus the control error,  $R > 0$  is a diagonal input weighting matrix which penalizes the input deviation and thus the control effort,  $u$  is the control law and  $x$  is the state variable.

By careful choice of the state weighting matrix  $Q$  and input weight matrix  $R$  [5], then an optimal feedback gain  $K_s$  is determined by solving the cost function which gives the minimum value. The  $K_s$  value is computed using the relation in Eqn. (11) and depends on  $P$  which is obtained by solving algebraic Riccati equation (ARE) presented in Eqn. (12). The ARE is solvable if there exist a semi definite matrix  $P \geq 0$ . Once the optimal feedback gains is obtained, the closed loop system stability is guaranteed.

$$K_s = R^{-1}B^T P \quad (11)$$

$$PA + A^T - PBR^{-1}B^T P + Q = 0 \quad (12)$$

### Linear quadratic regulation in DQ-frame

In DQ frame the control variables are  $i_d$  and  $i_q$ . The LQR should be designed to control these variables to their respective reference value. Therefore, the control law is modified to include a pre-filter gain  $K_f$  responsible for reference tracking. Nevertheless, the pre-filter is not enough to provide good reference tracking as it doesn't provide robustness with respect to parameter uncertainties ( $A$ ,  $B$ ,  $C$ ), disturbances and measurement noises. Thus, steady state error is always present. In order to provide good robustness against these uncertainties, the integral control is introduced in the control law. Therefore, additional integral state formulated in Eqn (13,14) is augmented with the original state space of Eqn.(5,6). The idea behind this is to integrate the error between the measured output current and the reference current until it becomes zero. The combined integral action is depicted in Eqn. (15) and the overall control input is expressed in Eqn (16).

$$\dot{x}_i(t) = r(t) - y(t) \quad (13)$$

$$\dot{x}_i(t) = r(t) - Cx(t) \quad (14)$$

$$\begin{bmatrix} \dot{x}(t) \\ \dot{x}_i(t) \end{bmatrix} = \begin{bmatrix} A & 0 \\ -C & 0 \end{bmatrix} \begin{bmatrix} x(t) \\ x_i(t) \end{bmatrix} + \begin{bmatrix} B \\ 0 \end{bmatrix} u(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} r(t) \quad (15)$$

$$u = -K_s x(t) - K_i x_i(t) + K_f r(t) \quad (16)$$

Since the new state space is formed in Eqn. (15), therefore new parameters are also formed as follows:

$$A_{aug} = \begin{bmatrix} A & 0 \\ -C & 0 \end{bmatrix}, B_{aug} = \begin{bmatrix} B \\ 0 \end{bmatrix}$$

The new input matrix  $R_{aug}$  and state-weighting matrix  $Q_{aug}$  is formed with the corresponding dimension of  $A_{aug}$  and  $B_{aug}$ . The augmented state feedback gains  $K_{aug}$  can be determined using the same formula as in Eqn. (11). Once  $K_{aug}$  is computed, the state feedback gains  $K_s$  and Integral gains  $K_i$  can be extracted. The pre-filter gain  $K_f$  of the augmented system is obtained from the relation presented in Eqn. (17)

$$K_f = (-C(A - BK_s)^{-1}B)^{-1} \quad (17)$$

The LQR current control for the DQ frame is summarized with a block diagram shown in Fig3.

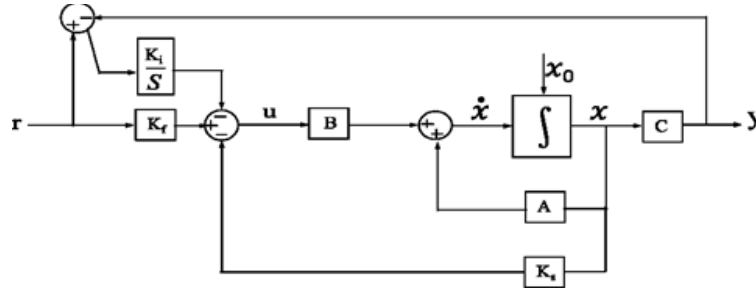


Fig3: LQR current controller with integral action for DQ-frame

### Linear quadratic regulation in $\alpha\beta$ -frame

It should be recalled that Alpha-Beta transformation convert three phases into orthogonal  $\alpha\beta$  components which are time varying quantities (AC signal). Therefore, the control variables are  $i_\alpha$  and  $i_\beta$ . The control aim in  $\alpha\beta$  is to track an AC reference signal as opposed to constant DC reference signal as in DQ-frame. To design a current control to track a given reference AC signal, a resonant controller should be used. A resonant controller operates just like the integral action in DQ-frame and is capable of tracking an AC signal with zero steady state error at a specified frequency called resonant frequency. For perfect tracking of reference current (zero steady state error), it is required at resonant frequency, the magnitude of the closed loop should be one (1) and the phase shift should be zero (0). One major drawback with resonant controller is that it is very sensitive to frequency variations. Slight change in frequency can lead to large steady state error (poor tracking). This problem can be solved with the aid of phase locked loop (PLL). The resonant controller transfer function is formulated in Eqn. (18).

$$G_{RC}(s) = \frac{K_c s}{s^2 + n^2 \omega^2} \quad (18)$$

From transfer function in Eqn. (18), the tuning parameter is  $K_c$  which determines the amplitude gain at resonant frequency. To obtain this parameter using LQR method, a resonant state space should be augmented in the plant model in similar fashion as done in DQ-frame with integral action. The state space of resonant controller for  $\alpha\beta$  is depicted in Eqn. (19).

$$\dot{x}_c(t) = A_c x_c(t) + B_c e(t) \quad (19)$$

$$y_c = C_c x_c(t) \quad (20)$$

$$e(t) = r(t) - Cx(t) \quad (21)$$

The augmented state space is expressed as:

$$\begin{bmatrix} \dot{x}(t) \\ \dot{x}_c(t) \end{bmatrix} = \begin{bmatrix} A & 0 \\ -B_c C & A_c \end{bmatrix} \begin{bmatrix} x(t) \\ x_c(t) \end{bmatrix} + \begin{bmatrix} B \\ 0 \end{bmatrix} u(t) + \begin{bmatrix} 0 \\ B_c \end{bmatrix} r(t) \quad (22)$$

With  $A_{aug} = \begin{bmatrix} A & 0 \\ -B_c C & A_c \end{bmatrix}$   $B_{aug} = \begin{bmatrix} B \\ 0 \end{bmatrix}$

Similarly, the augmented feedback matrix  $K_{aug}$  is found from the Eqn. (11). The gain matrix  $K_s$  and  $K_c$  can be extracted from  $K_{aug}$ . The resonant current controller block diagram for  $\alpha\beta$ -frame is shown in fig4. The overall control law is formulated in Eqn.(23).

$$u = -K_s x(t) - K_c x_c(t) + K_f r(t) \quad (23)$$

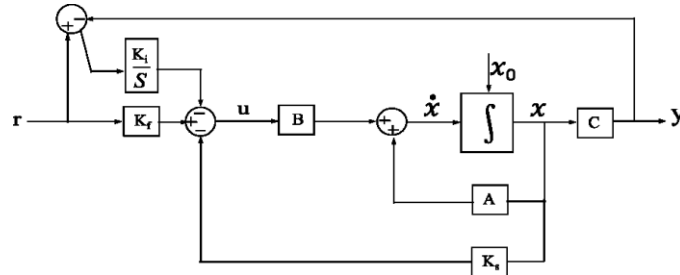


Fig4: LQR current controller with integral action for DQ-frame

### Optimization and Constraint handling

Constraint designs are necessary for components protection to improve reliability and safety. For instance, semiconductor rated voltage and current, DC-link rated voltage and filter saturation. Constraints are classified into hard and soft constraints. Example of soft constraints are output constraints, maximum overshoot, settling time etc. Hard constraints include input constraint, non-minimum phase behavior etc. To handle constraints, an algorithm is developed with a closed loop prediction. The predictions are done in an offline mode using discrete state space model. Still online predictions are possible but tedious and is still under research (for example MPC) [7][11]. The algorithm checks whether these constraints are satisfied or not. This is sort of user verification to check for constraints satisfaction. The procedures for the constraints design are summarized in the flow chart shown in fig5.

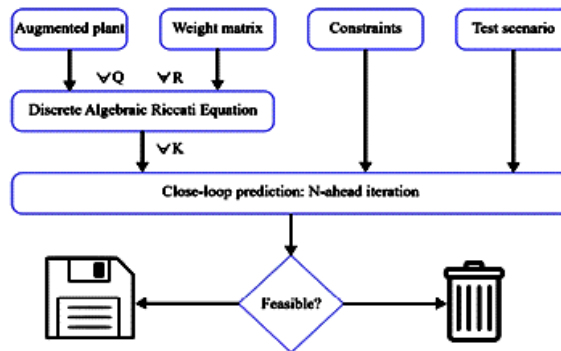


Fig 5: Flow chart for constraint verification

The pool of parameters Q and R are chosen to compute the corresponding optimal gains K. the values of these gains are used for simulation to observe whether the constraints are met or not. If the Q and R gives values of K that does not respect the constraints, then the solution is not feasible. Hence the values of Q and R should be changed to get new values of K until a feasible solution is obtained which doesn't violate the constraints.

### Simulation Results and Discussions

The control design and simulations are done with the aid of Matlab and PLECS software. The Inverter specifications and power ratings used are given in Table1. The current control simulations are done in both DQ-frame and  $\alpha\beta$  frame. The constraints imposed for the controller are provided in Table2. The maximum output current is chosen to be 10A for each phase, which reflect the standard rating for household outlet [1]. The constraint of this output is design to be less than the maximum overshoot of 20 percent i.e. 12A. Other constraints which should be respected are settling time define to be less than the time constant and the output current should not have zeros on the right half plane (RHP).

**Table1. Inverter specifications**

Parameters	Specifications
$V_{dc}$	700V
$V_{rms}$	230V
$f_g$	50Hz
$f_{sw}$	10KHz
$f_s$	10KHz
$L$	2mH
$R$	10m $\Omega$

**Table 2: Constraints specifications**

Constraints	Limits
Rate Input voltage ( $\Delta u$ )	$0 < \Delta u \leq 25V$
Output current ( $i$ )	$0 < i \leq 12A$

The tuning values of the weighting matrices Q and R is not straight forward as to which value should be used. Nonetheless, as a benchmark the state weighing matrix can be choosing as the inverse of the maximum of the between the square of the states. This is also treated the same for the input weighting matrix. Furthermore, other tuning methods can be found in literatures [5]. For this simulation, the pool Q and R were chosen between  $1e^6$  and  $1e^8$  and are values are changed by multiple of 10. This means that a possible of 144 different combinations of Q and R were used. Similarly, 144 optimal gains K were also computed. With these pools of gains being computed, the control law is set. The constraint design is checked with closed predictions over a prediction horizons N until a feasible solution is obtained. The prediction horizon is selected to have a prediction with  $t=1s$ . Thus with the sampling period of  $T_s = \frac{1}{f_s}$  which is equal to  $10^{-4}$ s, the number prediction horizons can be computed as follows;

$$N = \frac{t}{T_s} = \frac{1}{10^{-4}} = 10000 \text{ horizons} \quad (24)$$

The simulations result for input voltages  $u_d$  and  $u_q$ , output currents  $I_d$  and  $I_q$  and error for DQ-frame current control are illustrated in fig6 and fig7 respectively. It could be observed that, there is a step change in the reference current at 0.2s and the output current instantly track the reference current with an overshoot. It could be justified that the constraint design with a maximum overshoot of 12A is still respected. Furthermore, from the input plot, it can be seen

that with these step change, the input constraint of 25V is not violated. To see the effect of a switched model and the averaged (simulated) model, the comparison between the three-phase switched current of the inverter and that of the simulated plot is provided in fig.8 and fig 9 respectively. The control input and the output error for switched model in DQ frame are presented in fig.10 and fig.11 respectively.

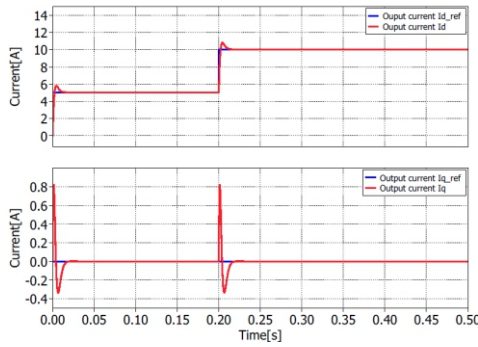


Fig 6: Average output currents  $I_d$  and  $I_q$  (DQ)

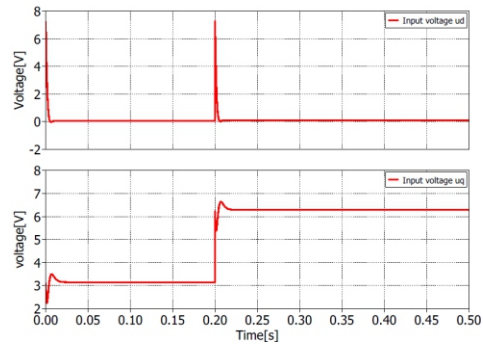


Fig 7: Average output inputs  $u_d$  and  $u_q$  (DQ)

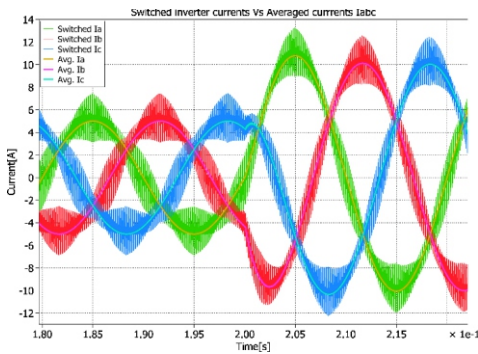


Fig 8: Switched output currents  $I_a$ ,  $I_b$  and  $I_c$  (DQ)

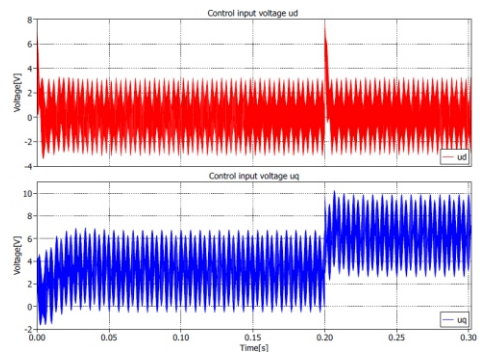


Fig 9: Switched output inputs  $u_d$  and  $u_q$  (DQ)

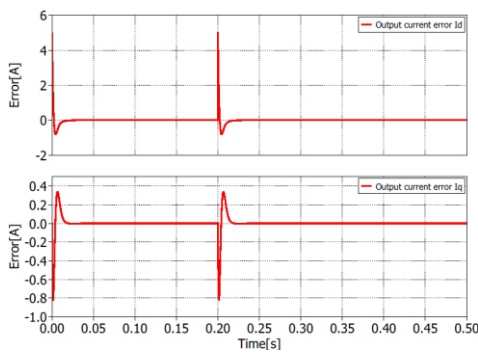


Fig 10: Averaged current errors (DQ)

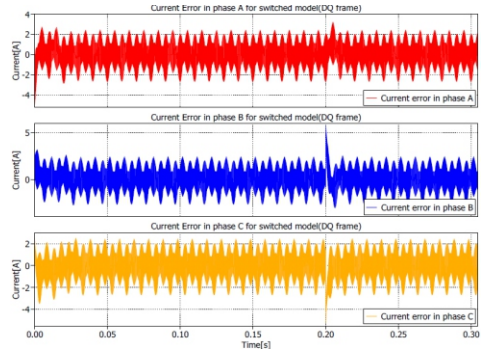


Fig 11: Switched current errors (DQ)

Similarly, the same simulations results are provide for Alpha-Beta frame. The input voltages  $u_\alpha$  and  $u_\beta$ , output currents  $I_\alpha$  and  $i_\beta$  and error for  $\alpha\beta$  frame current control are illustrated in fig.12 and fig.13 respectively. Just like in the DQ-control, it could be seen as well in  $\alpha\beta$  frame that the output currents and the input voltages do not violate their constraints. However, there is one

observation with the plot of three phase currents between switched model and averaged model as presented in fig14 and fig15. It could be carefully seen that there are more switching ripples present in DQ-frame compared to  $\alpha\beta$  frame. Furthermore, for the same target value of the output currents, the control effort required for  $\alpha\beta$  frame is slightly lower than that of the DQ-frame. The control input and the output error for switched model in  $\alpha\beta$  frame are presented in fig.16 and fig.17 respectively.

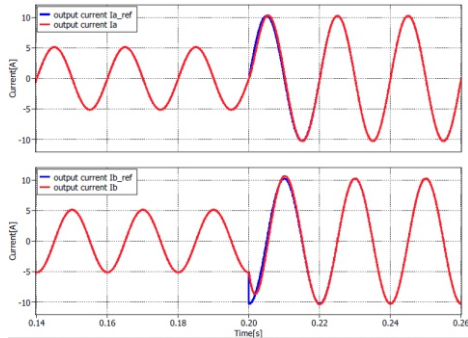


Fig 12: Average output currents  $I_{\alpha}$  and  $I_{\beta}$  ( $\alpha\beta$ )

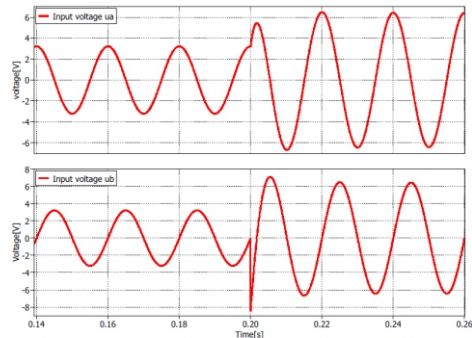


Fig 13: Average control inputs  $u_{\alpha}$  and  $u_{\beta}$  ( $\alpha\beta$ )

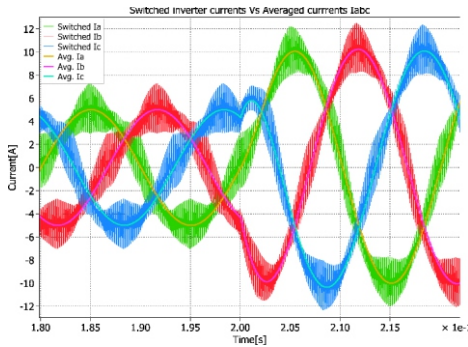


Fig 14: Switched output currents  $i_{\alpha}$  and  $i_{\beta}$  ( $\alpha\beta$ )

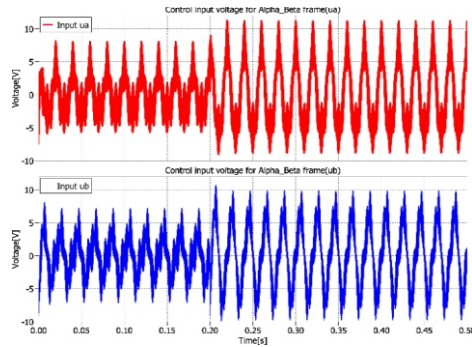


Fig 15: Switched control inputs  $u_{\alpha}$  and  $u_{\beta}$  ( $\alpha\beta$ )

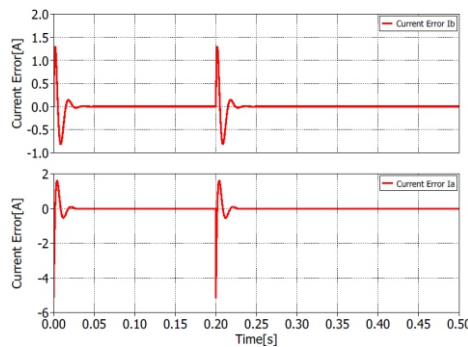


Fig 16: Average current errors ( $\alpha\beta$ )

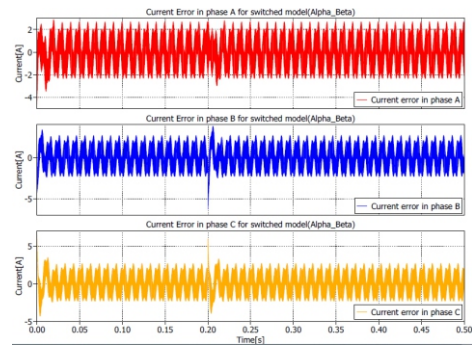


Fig 17: Switched current errors ( $\alpha\beta$ )

### Conclusions

In this research, an LQR controller is design to control the currents of the VSI. The VSI is first modelled before the control scheme is applied. The control is applied to two different scenarios. The first scenario is the DQ frame where three phase is transform into constant dq variables using park transformation. This scenario requires a constant reference tracking and



is achieved using LQR controller with integral control. The second scenario is the  $\alpha\beta$  frame in which the three phase is transform into time varying  $\alpha\beta$  variables. Thus this scenario requires an AC reference tracking and is achieved using resonant controller.

The constraints is important in the controller design for the safety and reliability of the inverter system components. Consequently, an offline closed loop predictions is used to check the feasible solution that respect the constraint being imposed in the control design.

Simulations results were obtained with the aid of Matlab and PLECS software. The performance of constraints current controller for both DQ and  $\alpha\beta$  frame were shown in the research. It was observed that in DQ frame, it requires more control effort and computational burden, which result from the transformation. Furthermore, there is more ripples in DQ frame compared to  $\alpha\beta$  frame. On the other hand, in  $\alpha\beta$  frame, the control is very sensitive with frequency variations. This means that its large errors could be realized from slight frequency variation in the grid and eventually could lead to poor performance.

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## A HISTORICAL STUDY OF THE PREVALENCE OF EPIDEMIC DISEASES AND VACCINATION IN WUKARI AREA, 1922 - 1950

**Tanko Angyetsokwa Adihikon**

*Department of History and Diplomatic Studies  
Federal University Wukari*

### ***Abstract***

*The saying that health is wealth is an incontrovertible fact. This aphorism underscores the paramount significance that has been attached to human health since the pre-literate era. Wukari Area as well as in other parts of Northern Nigeria, particularly during the colonial period witnessed a lot of epidemics. The sudden outbreak of epidemic diseases which spread like wildfire across Nigeria in the early twentieth century threatened the life of Europeans and natives, and adversely affected the economy and social strata of the people. Thus, vaccination was conceived as a viable control measure. It was made a compulsory exercise in Wukari Area. However, its success was limited. The aim of this paper is therefore, to examine the prevalence of epidemic diseases, and vaccinations in twentieth century Wukari Area. The paper is divided into five sections starting with the introduction. Section two centres on clarification of some key concepts and theoretical framework of analysis. Section three and four examine the causes, prevalence and symptoms of the epidemic diseases, and the preventive measures adopted and section five dwells on conclusion. The outcome of the study reveals that the acute shortage of medical and health personnel, the difficult geographical terrain of the area under survey coupled with high rate of illiteracy and the prevalence of traditional medicine posed some challenges against the effective and efficient control of epidemic diseases and vaccinations in Wukari area. The functionalist theory and multi-disciplinary approach of historical analysis were adopted. Thus, in an attempt to overcome the numerous health challenges in contemporary Wukari area, especially in case of epidemic diseases in the future, both the orthodox and traditional medical practitioners must be properly integrated into the national health system.*

***Keywords:*** Epidemic diseases, Vaccination and Wukari area.

### **Background to the Study**

The sudden outbreak of epidemic diseases in Northern Nigeria started in the early 20<sup>th</sup> century and ferociously spread into mid twentieth century<sup>1</sup>, generated a lot of worries and pandemonium across the length and breadth of Nigeria especially in Northern Nigeria and Wukari area in particular. Besides, the rising cases of death coupled with the acute shortage of medical and health personnel to combat epidemic diseases heightened the anxiety and apprehension of both the European colonial administrators and the natives respectively<sup>2</sup>. In Wukari area of Northern Nigeria, the diseases that appeared in epidemic forms especially between 1922-1950 included: *penkahwan* (cerebrospinal meningitis), *Awowafoko* (relapsing fever), *Nyiza* (smallpox) and *Anwe* (influenza). Out of these, the first three were the most widespread and devastating<sup>3</sup>. The preponderance of death associated with them was high. As a result of this, holistic and articulate measures were initiated by the British colonial authority to fight and control the transmission of the above epidemic diseases. In this perspective both curative and preventive measures were adopted. While the former was based on proper treatment and cure of infected patients by medical personnel, the latter was responsible for the control of situations that predisposed healthy individuals to epidemics<sup>4</sup>. This was done through advocacy and sensitization of the natives on the need to maintain personal hygiene and good sanitary habits. In the bid to achieve an epidemic free Wukari area, *Basengon* (District Heads) and youth leaders were integrated and advised to properly encourage their communities and members to get vaccinated<sup>5</sup>. However, the vaccinations against epidemic diseases were successful in Wukari area<sup>6</sup>. This section is therefore, an attempt to examine from the caboose of history, the prevalence of epidemic diseases and vaccination in Wukari area.

### **Wukari Area: Geographical Location and Features**

This paper examines the prevalence of epidemic diseases, and vaccination in Wukari Area, 1922-1950. It is centrally concerned with defunct Wukari division. Wukari division was one of the five divisions of the old Benue province. Other divisions were Idoma, Tiv, Nasarawa and North Benue. Wukari Area became part of Benue province in 1926 following British colonial reorganization. The traditional political head of Wukari Area is known as *Aku Uka*. Wukari division was an administrative area created by the British colonialists, the area was approximately located between longitudes 9°08' and 11°00' East and Latitudes 6°30' and 8°38' north. Wukari as one of the five divisions in Benue province located on the North eastern part of the province. It was bounded on the North and North-West by the lowland division of the Plateau Province and Awe District of Lafia Division. On the North-East it was bounded by Muri Division of Adamawa Province, on the South - East by Bamenda Division of the Cameroons, on the south and West by Tiv Division of Benue Province.<sup>7</sup>

The total land mass of Wukari Area, after the divisional boundary reorganization of 1952 was approximately 6,373 square miles (10,197 square kilometres). It was made up of four districts namely; Wukari, Donga, Takum and the Kentu mandated area<sup>8</sup>. Geographically, the whole of Wukari area is made up of a series of undulating plains which is only broken up in Gindin-Dorowa and Takum by hills. Gindin-Dorowa and Takum both have features consisting of a series of hills as high as 3,000 feet. The area is abundantly wooded with deciduous trees of 7-12 height.<sup>9</sup>

Wukari area based on this paper refers to Southern Taraba. The former Kentu district under the defunct Wukari division is not part of the area since it is no longer located in southern

Taraba. In line with political arrangements as applicable in other states of the federation, Taraba State is structured into three (3) senatorial districts namely; Taraba Central, Taraba North and Taraba South Senatorial districts. Taraba South senatorial district is known today as Wukari Area, and it comprises Donga, Ibi, Takum, Ussa, Wukari Local Government Areas and Yangtu special Development Area.

### **Literature Review**

Against this background, the review is presented in three main categories. The first set contains published and unpublished works on Missionaries health care delivery in Wukari area. The second is a selection of works on colonial healthcare delivery in Wukari area. The last category is a brief review of some archival sources. E. H. Smith's *Nigerian Harvest* enjoys extraordinary attention of every scholar on missionary activities in Wukari area.<sup>10</sup> This is because the work analyzed the impact of the Christian missionary activities on the people of the study area. The book is presented in an orderly manner making it easy to follow the line of thought. It is clearly illustrated with appropriate figures and tables. The book discusses the evangelical works of the missionaries among the people which were explained in education, economic, agriculture, social and religion activities. He further analyzed the missionaries' healthcare services to the people. Here, he looked at the efforts of the missionaries by introducing primary healthcare service which fought some of the diseases that hitherto contributed to death toll in the area. The book also points out the efforts of the Christian missionaries in combating epidemic diseases that broke out in Wukari area in the early 20<sup>th</sup> Century. Therefore, Smith's work is relevant because it provides historical information to the subject matter of this paper.

The next work that is related to the subject matter of this paper is D. P. Ashu's *Christian Reformed Church of Nigeria: A Legacy of Faithful Servants of God*.<sup>11</sup> Ashu's bold and stimulating analysis of the practical relevance for the missionaries and healthcare services in Wukari area is commendable. The book at first looks at the humble beginning of the Christian Reformed Church of Nigeria where the author describes the concerted efforts of the Sudan United Mission at the establishment of the church. The book also discusses the medical and healthcare efforts of the missionaries in the study area. The author argues that through the development of primary healthcare facilities in the area, some health challenges which posed difficulties to the people were overcome. Other areas which the author analyzed include agriculture, education and socio-religious services provided by the missionaries which substantially influenced on the people's social and economic institutions.

Another work, a doctoral thesis by P. M. Lere, titled: "the Activities of the S.I.M/S.U.M among Leprosy patients in Northern Nigeria, 1928-1988"<sup>12</sup> is important research which deepens our understanding of missionaries' medical services in Northern Nigeria with some statistical evidence relevant to the present study. The thesis is based on extensive field work (oral history as well as colonial archival sources, National Archives, Kaduna). Lere examines both the internal and external dynamics that shaped the healthcare services in northern Nigeria for a period of 60 years.

The author notes that in addition to the educational programmes among others, the missionaries involved themselves in healthcare services. In this case, they worked among the Leprosy patients in Northern Nigeria where they discovered that the disease was rampant and

had eaten deep into the Fabric of Northern Nigerian populace. The author avers that the missionaries further discovered that cerebrospinal meningitis and small pox have posed serious challenge to Northern Nigeria. Consequently, the missionaries did not only set up hospitals and clinics as centres of healing for all kinds of diseases but approached the colonial government to run their existing leprosy centres which were poorly managed by the government. Lere's work is relevant to the present study within the larger context of Northern Nigeria for several reasons. It mainly traced the circumstances leading to the outbreak of some diseases in northern Nigeria, which eventually ended up in serious healthcare challenge in the region. Furthermore, Lere's work should be commended for its bold attempt to break new ground in Northern Nigeria medical history. As a matter of fact, we should take advantage of the work to enrich the present study. T. T. Maikarfi's work is one of the relevant unpublished works on medical history of Donga Local Government Area.<sup>13</sup> Although it is a giant stride in its own right and Level of study for which it was done, it is limited in scope as an undergraduate work compared to the analysis of the present study. Besides, the work is limited to Donga Local Government Area and may not apply to either the rest of Wukari Area. However, the analysis still has strong leanings on the healthcare services of Wukari area which is part of the relics of the most popular terrain in the medical historical reconstruction of the area. R. Schram's *A history of the Nigerian Health Service* is perhaps the most popular literature in Medical history in Nigeria and also relevant to our present study for a number of reasons.<sup>14</sup> For example, it sets the pace for research in contemporary medical history in Nigeria and automatically serves as good reference book on the subject. Schram successfully captured the missionaries and colonial administrator's works whose healthcare services contributed greatly to the fight against epidemic diseases that were witnessed in the early 20<sup>th</sup> century.

Schram's book ranks as one of the best recently attempted analyses of the Nigerian medical history. It combines clarity, originality, details, brevity of data and theory. To some, his cataloguing approach may be too boring to follow. However, Schram has successfully underpinned the importance of empirical research.

The next category of literature related to the subject matter of this paper is a bevy of works on colonial healthcare service in Wukari area, numbering in their hundreds and therefore many for us to list here, the leading ones are hereby isolated such as those of Leslie Omeeboh<sup>15</sup> and Roberta Bivins<sup>16</sup> who were obviously inspired by the colonial administrators' approach to health service in Nigeria. Both works in turn have further stimulated this paper. The important thing to grasp from these, among other things, is that they serve as useful historical materials on colonial health service in Nigeria.

### **Archival Sources**

The nature of the data in this category is characterized by colonial writings of provincial official correspondence, colonial anthropologists, reports, personal diaries, annual reports etc in the National Archives Kaduna (NAK). The full details of the particular files used are provided in the reference section of this paper. In the National Archives, Kaduna (NAK), the sections under Kaduna Ministry of Health (Kad/Min/Health) and Makurdi provincial office (Makprof), were consulted with particular reference to occurrences and control of epidemic diseases. Other material includes vaccination notes, vaccines and analysis information on the distribution network of vaccines was obtained through the operations of Regional Health Service Boards in the relevant files.

### **Conceptual Clarifications and Theoretical Framework**

Conceptual and theoretical clarifications are important aspects of any research for several reasons. First, it provides an operational scope within which a term with multifarious meaning is used in a study. This helps in curtailing confusion and ambiguities in usage<sup>17</sup>. Clarification of concepts and theoretical framework according to helps to engender logical flow of analysis in any academic research<sup>18</sup>. It is on this basis that key terms in this paper, such as epidemic, disease, and vaccination are clarified, while the theory of functionalism is adopted.

**Disease:** The term disease has different meaning; however, in this paper it is seen as illness affecting human, animals or plants, often caused by infections<sup>19</sup>. It connotes a more severe physical medical problem or disorder that may lead to acute malfunctioning of the body organs and even death<sup>20</sup>.

**Epidemic:** An epidemic is the rapid spread of infectious diseases to a large number of people in a given population within a short period of time, usually two weeks or less<sup>21</sup>. It is defined as a disease or infection that spreads rapidly among the people in a community at the same time.

**Vaccination:** Vaccination is the administration of antigenic material (vaccine) to stimulate an individual's immune system to develop adaptive immunity to pathogen<sup>22</sup>. A vaccine is a substance that is put into blood to protect the body from disease<sup>23</sup>. Vaccines therefore help to prevent or ameliorate morbidity from infections.

**Functionalism:** Functionalism is a theory best suited for analyzing social problems like medical/health issues in the society. Linked to Emile Durkheim, functionalism, states that a social organization is made up of different social elements or parts<sup>24</sup>. Thus, for a society to function properly, all component parts must work together as a united whole. According to Talcot Parson, functionalism is the relationship between the various social institutions with emphasis on the contribution of each institution to the maintenance of the whole system<sup>25</sup>. Functionalists argue that good health and effective medical care are essential for a society to function properly. In fact, it is imperative to assert that the manifestation of epidemic diseases hinder the smooth functioning of the society. In other words, if many people are unhealthy, the society's functioning and stability suffers. This was the situation during the sudden outbreak and spread of deadly epidemic diseases in Wukari Area during the colonial period. Furthermore, in the context of this paper, the theory implies that the emergence of epidemic diseases caused a malfunctioning of Wukari Area especially as it led to loss of lives and material resources. The social structure of Wukari area contributed to the challenges that the early British colonial administrators, including medical and health personnel witnessed in the fight against these epidemic diseases. Although the colonial authorities came up with novel strategies to combat these epidemic diseases, the inadequacy of its medical and health personnel at the initial stage, the efficiency and effectiveness of the curative and preventive measures were affected.

### **Causes, Prevalence, and Symptoms of Cerebrospinal Meningitis, Relapsing Fever and Small Pox**

The causative agents for the above-named epidemic diseases differ. Cerebrospinal meningitis is caused by meningococcal organism which cannot survive long, under natural conditions,



away from the human body<sup>26</sup>. The disease occurs in epidemic form during the cold and dry season. In terms of transmission, the disease was transmitted by healthy carriers who harbour the organism in their nasopharynx. It was a droplet infection that requires much close contact or association with carriers. It was more prevalent among people who live in an overcrowded room or in rooms with poor ventilation. Furthermore, during the course of an epidemic, the ratio of carriers to cases was high while the condition lasted from 4 – 6 weeks<sup>27</sup>. The communities that were affected by cerebrospinal meningitis in Wukari area during the period under consideration included Ibi, Donga, Rafin – Kada and Akate. Both the colonial administrators and the Christian missionaries expressed their commitment to continue to intensify efforts to stop the deaths and further spread of the disease in worst hit Ibi community. Out of 809 suspected cases of meningitis reported across the area in March 1949, Ibi had the highest number of confirmed cases of 109.

**Table 1: Cases of Cerebrospinal meningitis treated in Ibi from 1947 - 1949**

a.1947	Cases treated	b.1948	Cases treated	c.1949	cases treated
January	224	January	380	January	472
February	189	February	288	February	407
March	232	March	248	March	420
Total	645		916		1299

**Source: T. A Adihikon, “A History of Primary Health Care in Wukari Area of Taraba State, 1900 –2015, 171**

The symptoms of cerebrospinal meningitis include sudden chill, headache, vomiting, irritability and fever. At times, there was stiffness of neck muscles often associated with bending of the head backward. In children, the entire body arched while twitching and spasms of the limbs and face occurred. The early irritable condition was succeeded by coma and in fatal cases, death occurred within the first week<sup>28</sup>. Shortly after the vaccination exercise in Donga, there were reports of new cases, which made the colonial health administrators to order for a resurvey in order to engender holistic coverage. At Donga N.A dispensary, there was a report of a case of acute shortage of staff and medical equipment like drugs, lint and bandage for dressing wounds. In terms of the treatment of relapsing fever in Donga N.A dispensary, the number of new cases treated and relapsed is given below.

**Table 2: Cases of Relapsing Fever treated in Donga N.A**

Months	No. of cases	Relapsed
April	5	1
May	-	2
June	2	1
July	5	5
August	3	1
September	7	2
October	7	2
November	3	-
December	1	2
January	3	3
February	5	2
March	6	1

**Source: T. A Adihikon, “A History of Primary Health Care in Wukari Area of Taraba State, 1900 - 2015”, P. 171**

Relapsing fever was a special kind of fever inoculated into man by the bites of lice or ticks. The main cause of the spread of this disease was therefore either lice or ticks or humans. Human beings harboured lice on their bodies, clothes or blankets, and therefore were active agents in its spread.<sup>29</sup> The symptoms of relapsing fever were chilliness, giddiness, bleeding from the nose, vomiting and severe headache. There was also weakness of the body, cough and sweating as symptoms of relapsing fever. The fever was painful and severe and could last for three to six days. The fever breaks suddenly, and the patient feels a bit better but still weak. After a few days, the fever relapses and re-occurs. If not properly treated, the patient dies after five days of second attack.<sup>30</sup>

On the other hand, small pox was a deadly viral infectious disease that had no cure except vaccination.<sup>31</sup> Human beings were the natural host of Variola, causative agents. The disease was conspicuously identified with the appearance of raised bumps on the face and body of an infected person or people. Generally, smallpox appeared in two forms. These include; Variola major characterized with extensive rashes, severe headache, fever, sweating and Variola minor.

Transmission of smallpox was usually through direct physical face to face contact with infected person or direct contact with infected bodily fluid or contaminated objects like bedding or clothes. Also smallpox was transmitted through air by virus especially when non-carriers were in an enclosed arena like buildings, trains or buses. Highly contagious, the disease kills within a short period of time.<sup>32</sup> Smallpox as an epidemic disease in this area, received attention through the enforcement of vaccination. Traditional treatment for smallpox called for the isolation of the patients because of the stigma associated with it. Thus, they tended to escape notice because they remained in hiding. In order to locate the sufferers, vaccinators were empowered to enter house to house to search for people suspected to have smallpox, vaccinate them or prosecute them if they resisted vaccination. They also vaccinated all people within any community in the area where an outbreak of smallpox occurred in order to control the spread of the epidemic. The table below illustrates the expansion of vaccination measures in the various districts in the study area and attests to the efforts of the colonial administration to eradicate smallpox in the area.

**Table 3: No of vaccinations by years**

District	1922	1925	1928	1930	1933	1952
Wukari	453	423	375	341	315	N.A
Ibi	389	361	321	293	285	N.A
Akwana	218	220	189	190	180	N.A
Donga	371	390	340	313	300	N.A
Takum	400	420	412	382	362	N.A
Total	1831	1814	1637	1519	1442	N.A

**Source: T. A Adihikon, "A History of Primary Health Care in Wukari Area of Taraba State, 1900 – 2015" P. 173**

**Note: N.A means Not Available**

Vaccination extended beyond the township and district headquarters; usually vaccinators toured villages within districts assigned to them and would render their services to more distant rural communities only during outbreaks of smallpox there. In 1936, for example, a vaccinator was sent to Sarkin-kudu in Ibi district to attend to smallpox patients.<sup>33</sup>

In 1951, a medical census conducted in Wukari area uncovered the reoccurrence of smallpox epidemic in the area. Dr. D.W.McLaren's tour confirmed its prevalence.<sup>34</sup> To counter the danger posed by such incidence of contagion, the divisional administration intensified its campaigns against the disease through medical tours of towns and villages to treat smallpox as well as to administer vaccinations. The table below illustrates the success of the medical tours embarked upon in the area.

**Table 4: Tours of towns and villages for vaccinations against smallpox in Wukari area, 1951**

Town/Village	No of Cases	No of Deaths	No of Vaccinations
Ibi	20	2	162
Sarkin-kudu	6	0	41
Wukari	42	6	274
Kente	6	1	41
Akwana	3	0	37
Donga	23	3	218
Tor Damisa	15	4	198
Akate	2	0	31
Mararaba	4	0	44
Rafin-kada	3	0	92
Abako	6	1	75
Takum	48	8	321
Manya	3	0	66
Sai	18	5	176
Total	199	30	1776

**Source: T. A Adihikon, "A History of Primary Health Care in Wukari Area of Taraba State, 1900 – 2015" P. 174**

The table above shows that intensified campaign reduced the number of cases and the number of deaths from smallpox, a trend that continued in subsequent year. No cases were reported in the area in 1952.

On the spread of these epidemic diseases, N. B Akoga argued that Wukari area had not experienced some of these diseases before the contacts with the Europeans. However, through the contacts with European traders particularly the Royal Niger Company in the late 19<sup>th</sup> century, some of these diseases were taken across the river Benue to infect the area.<sup>35</sup> Cerebrospinal meningitis had not been experienced in Ibi before the last decade of 19th century, but it was seen in the area thirty – five years after the European traders had established their business base there. Consequently, it spread to Rafin – Kada, Akate and Donga. Akoga's argument was supported by D. P. Ashu when he stated that Ibi was free from meningitis up to 1890 but when it became the port and hub of Royal Niger Company in agricultural products which attracted population. Therefore, the outbreak of the disease in the area in the early 20<sup>th</sup> century seemed to have been brought to the area through the trading activities of the Royal Niger Company.<sup>36</sup> Yakubu Bete asserted that smallpox was introduced to Wukari area through the European trade:

*...epidemic of smallpox was introduced in Dampar by a trader infected by that disease who travelled together with other traders in a boat from Makurdi province to the village of Dampar to purchase benniseed.<sup>37</sup>*

It is worthy to note that Ibi was the only market town of major importance in Wukari area because of its location at the bank of the river Benue and it was there that the European traders concentrated their activities. People from Wase and other neighbouring communities while crossing the river Benue at Dampar, used to carry their goods to Ibi and return equally loaded. When the trade was fully developed in the early 20<sup>th</sup> century, commodities that constituted the principal items of trade were agricultural products like benniseed, ground nuts, cotton among others. Therefore, many traders used to come to Dampar which served as an outlet market to Ibi to obtain the above-mentioned commodities. It was from Dampar that smallpox spread to Chinkai, Ndokatswen, Bete, Fete and others in 1927. Like cerebrospinal meningitis and smallpox, relapsing fever, transmitted by *ornithodorosvenezuelensis* in Wukari area and had links with trade in Ibi.<sup>38</sup> Finally, it should be noted that the European trade that was concentrated in Ibi town located at the bank of river Benue led to the spread of a number of epidemic diseases in Wukari area which brought about suffering and misery upon the people from 1922 to 1952. Generally, the British medical team through the office of the director medical and sanitary service Lagos issued a circular on 9<sup>th</sup> March, 1925 in which it identified and discussed explicitly how these epidemic diseases could be easily and immediately controlled. In the case of relapsing fever, the washing of the body and hairy parts with soap was recommended. Also, it was recommended that all clothes and blankets should be boiled in water to kill the lice.<sup>39</sup>

#### **Epidemic Diseases and British Preventive/Control Measures and Its Challenges in Wukari Area**

The British colonial administrators were generally perturbed by the high prevalence of these epidemic diseases in Nigeria and Wukari area in particular<sup>40</sup>. This was because the epidemic diseases retarded the mental, economic and social productivity of the natives. It was believed and correctly too, that ill persons cannot work in farms or engage in any meaningful venture to earn income or pay tax. In fact, the health of the natives was of immense concern to the Europeans because the natives provided the labour force they needed. Following the renewed outbreaks of epidemic diseases, especially cerebrospinal meningitis and smallpox in Wukari area in 1925, the European administrators immediately swung into action to nip in the bud their spread.<sup>41</sup> Two major steps or measures were adopted. These included curative and preventive measures<sup>42</sup>. The curative measure involved the direct administration of anti-epidemic diseases drugs or medicine to patients. Medical and health officers usually carried out this type of treatment on patients. On the other hand, the preventive measures were more widespread and profound. Preventively people were sensitized on the need to always maintain good hygienic attitudes such as constant bathing, shaving of pubic hair and avoiding overcrowding.<sup>43</sup> Efficient dissemination of health information to the villagers through their traditional rulers was advocated and adopted. In this perspective, the Aku-Uka was directed to mobilize his traditional rulers across the length and breadth of the area to further integrate their districts into the mainstream anti-epidemic diseases campaigns.<sup>44</sup> The district heads were saddled with the responsibility of ensuring that the natives in the remotest parts of their domain were properly treated or vaccinated. They were also mandated to ensure that all information in connection with epidemic diseases especially cases of outbreak and prevention were made available to the villagers and medical officers alike. They provided the direct link between the Europeans and the natives.<sup>45</sup>

The medical and health officers carried out collaborative and often similar work. Their roles

were both curative and preventive.<sup>46</sup> As medical officers, they were saddled with the onerous task of systematically and periodically circulating information on Preventive measures. This was carried out through a cordial and subtle collaboration with the chiefs and district heads that have great influence over the minds of those whom they rule and whom they can mentally influence for good in time of need. Furthermore, every medical officer was mandated to spread the skills and steps germane for the prevention of epidemic diseases to the natives. One of the strategies employed in the realization of this was through regular routine meetings with traditional rulers. Meetings were held between medical and districts officers and the chiefs.<sup>47</sup> During such meetings, simple facts relating to the causation, spread and prevention of the epidemic diseases were clearly explained to the people through the service of a good interpreter. Due to the shortage of medical personnel and the high cases of the epidemics, meetings were held every fortnight. Participants at such meetings usually included the division officer (D.O), district officers, medical experts, the Aku-Uka and his district heads. During such meetings, the attendees were properly lectured and equipped with basic knowledge on preventions while enquiries as to what the chiefs and district heads have done in their respective domains to spread the necessary information and also to ascertain that their advices have been carried out.<sup>48</sup> For instance, in September 1938, the senior health officer of Akwana District distributed a total of fifty leaflets comprising twenty-five on cerebrospinal meningitis for use in the district.<sup>49</sup> Also, in the case of cerebrospinal meningitis and influenza, families especially large polygamous families were advised to promptly isolate individuals affected to curtail its spread.

Also, the European medical officer advised the natives on how best they could curtail the spread of relapsing fever. In Wukari area, these measures involved the boiling of all clothes and blankets to destroy lice. Personal cleanliness involving total shaving of head, armpits and pubic area to ensure freedom from body louse were strongly advocated and adopted.<sup>50</sup> Cases of smallpox as well as its devastating effects were equally widespread in the early years of twentieth century hence vaccination was very great. Medically, it was recommended that the best preventive measure against smallpox was and still is vaccination.<sup>51</sup> Thus, further analysis in this section shall focus on vaccination. A. Ato observes that vaccination was a veritable way of preventing the spread and transmission of smallpox and other epidemic diseases as well.<sup>52</sup> Thus, vaccinators were recruited and trained to carry out the exercise across the length and breadth of Wukari area.<sup>53</sup> However, this was not without its challenges. First the success of vaccination depended on two major factors, namely, transport of lymph and the use of lymph.<sup>54</sup> Consequently, vaccinators working in collaboration with medical officers were educated on how to administer the lymph. Apart from proper monitoring and supervision of the vaccinators, the medical officer ensured that vaccine lymph was always used early and also to assist vaccinators to get cases for vaccination whenever difficulties were encountered in the work.<sup>55</sup>

Vaccination was systematic and thus, carried out from village to village, town to town, and house to house. This was to ensure that all young people including children were properly vaccinated. Their jobs were holistic. That is, from start to finish.<sup>56</sup> Funds for the payment of the allowances of the vaccinators were made available through the colonial welfare development fund and certain percentage contribution from Wukari Native Authority. In spite of the good plans and control measures put forward by the British colonial administrators to combat these epidemic diseases, it was met with some teething challenges. These challenges were both internal and external in nature.<sup>57</sup>

Geographical factor posed a major problem to vaccination programme in Wukari area.<sup>58</sup> Wukari area had a large land mass with villages scattered in different areas. As a result of this, remote villages were not adequately covered by the vaccinators. In Takum district, villages like, Fete, Bete, and Kashimbela were not properly covered.<sup>59</sup> Besides, distant communities posed another serious problem to vaccinators as potency of vaccines were often lost.<sup>60</sup> The poor state of Kente, Tsokundi, Ndokatswen, Chinkai roads, and the paucity of vehicle to convey the vaccinators constituted another challenge to effective administration of epidemic diseases vaccines in these parts of Wukari area.

Another problem that hampered the effective control or prevention of epidemic diseases and administration of vaccines in this area was illiteracy and ignorance.<sup>61</sup> As a matter of fact, during the period under study, most of the rural dwellers in the study area were comparatively speaking, illiterate, lacking in basic knowledge of Western healthcare. The natives due to their ignorance often preferred traditional medicine to orthodox medicine.<sup>62</sup> Closely related to the above problem, were poor method of communication. Lack of effective means of communication affected vaccination negatively. Even in places where outbreak was reported, it took many days before medical and health personnel arrived. The absence of modern means of communication like telephone, negatively affected information dissemination between the natives and health officers or colonial administrators who often resided in Government Residential Area (GRA) located far distance from villages.<sup>63</sup>

Apart from the aforementioned, the acute shortage of trained medical and health personnel in Wukari area compounded the problem of epidemic diseases and vaccinations in the entire area.<sup>64</sup> The number of European medical experts in this division was so small.<sup>65</sup> The reasons for this unsavory scenario are linked to the prevalence of malaria and harsh weather that negatively affected the health and lifestyles of the European medical workers.<sup>66</sup> Although some European missionaries provided some basic health services as some of them doubled as medical experts. Even with that, only few were medically trained. For instance, in 1925, the whole of Wukari area had only one medical doctor, who lived 330 miles away from Wukari, the headquarters of the area. He, among other things, also controlled a 100 bed hospital in Jos, so, he was able to visit Wukari for only a day or two every six months.<sup>67</sup> However, further problem was encountered in the vaccination exercise in early January, 1926 when the only medical doctor was transferred out of the area to Kaduna.<sup>68</sup> The area thus, had no medical officer until April 1926 when a qualified missionary nurse, Miss Bertha Zagers from the United States was posted there. Even with her presence, the medical and healthcare services did not increase. Instead, it decreased as the work was too much for her to bear.<sup>69</sup> This affected the prevention of epidemic diseases and vaccination exercise in the area. In 1926, major hiccups were encountered in the treatment of cerebrospinal meningitis even with the support of traditional rulers who managed to disseminate health information to the people.

In terms of vaccination, the inadequacy of trained European medical and health personnel worsened. The Wukari Native Authority was forced to wade into the matter to curtail spread and death. Thus, the 1926 vaccination was carried out by Native Authority vaccinators but the number of success was poor.<sup>70</sup> This was as a result of their lack of requisite vaccination skills and improper coordination, at the end of the year a total of three hundred and ten (310) Persons were vaccinated. Out of this number of people, only one hundred and eighty-seven (187) cases were adjudged successful.<sup>71</sup>

Similarly, on 16<sup>th</sup> January, 1927, there was an outbreak of small pox in Dampar village,<sup>72</sup> fifteen cases were identified. As a result of poor means of communication and shortage of medical experts in Wukari area at that time, response to this outbreak was delayed. It took the intervention of the Wukari Native Authority who made a lorry available to convey the medical officer from Wukari to Ibi then from Ibi to Dampar through canoe. It took two days before the medical officer arrived Dampar. No wonder it had spread to thirty-eight (38) people by 23 January, 1927.<sup>73</sup> After the Dampar case, one solitary case of smallpox was identified at Wukari town in October 1927 and this led to total vaccination of the villages. By the end of the Year, total vaccination in Wukari town was three hundred and sixty-five (365) with successful cases pegged at eighty one (81) and unknown results of two hundred and eighty – four (284).<sup>74</sup>

By 1932, there was a massive outbreak of smallpox in Takum, Chinkai and Galumje.<sup>75</sup> Due to the above problems, deaths occurred. There was thus, upward of twenty - two deaths while three thousand five hundred and forty (3540) vaccinations were effected with 80% successful.<sup>76</sup> The success of this vaccination was credited to the meticulous works of the medical officers, Dr. Roy Davis and Bertha Zagers and Tena Huizenga all were missionary nurses who personally toured the affected areas with a view to engendering native confidence in the benefits of vaccination.

Although there were few hospitals at Wukari, Takum and Lupwe, the death tolls were still high in the midst of vaccination exercises. One of the factors responsible for this was the poor attitude of the natives towards Western medicine. The natives believed much in the efficacy of traditional medicine which had served them well in various areas of life since time immemorial.<sup>77</sup> A Medical officer speaking on the high preference for traditional medicine stated that the natives in this area are extraordinarily backward, being mostly pagans, *juju* appeared rife. It is understood that traditional medicine practitioners made lucrative living by selling talisman against diseases and for safe Journey etc. In the interest of all concerned, it would be very desirable to put before these people the advantage that can be derived from Western medicine.<sup>78</sup> In this perspective, the colonial administrators urged the Native Authority to recruit sanitary inspectors to ensure that the natives embraced and maintained adequate personal and public hygiene measures that do not endanger their lives or predispose them to epidemic diseases.<sup>79</sup> The sanitary inspectors had the right to arrest or fine individuals that failed to keep their surrounding clean. Generally, sanitation day was observed two times every month. This was usually every Saturday in the first and last week of every month. In Wukari for instance, district heads mobilized the people for public sanitary duties. In this way, public centres like markets, roads and streams were properly cleared and kept clean. Individuals who defaulted without good reasons were sanctioned.<sup>80</sup> By late 1950, there was a vaccination programme, which was not exhaustive. This led to a resurvey of the area in 1951. The data for the resurvey in Donga axis of Wukari area is given below.

**Table 5: Re-Survey (Carried out by S.S Staff in Donga, 1951)**

	NO. Exam	Glands Palp	Gland	%
April	25	8	5	20
December	1302	35	12	1.3
March	3858	55	7	0.1

**Source:** T. A Adihikon, "A History of Primary Health Care in Wukari Area of Taraba State, 1900 – 2015" P. 182

In 1951, there was a sporadic return of smallpox throughout Wukari area. However, attempts were made to checkmate its spread through the use of sanitary inspectors. In all, by 1951, there were a total of one hundred and twenty-three cases of small pox.<sup>81</sup> For instance; writing on the challenges that faced Donga Native Authority Dispensary in Wukari area, a colonial Medical Inspector, Mr Joel stated on the 12<sup>th</sup> November 1951 that the Donga N.A dispensary lacked qualified staff and necessary health facilities. He also decried the insufficient knowledge of the dispensary attendant at Takum N.A dispensary. He states that:

*Supplies of drugs are received from Wukari Native Authority Store and Dispensary; attendants do the mixing, compounding and dispensing of simple mixtures. Judging from my observation the day of inspection, mixing and compounding of the mixture cannot be left in the hands of any of the Dispensary attendants in Takum dispensary. Concentrated Stock mixtures compounded by the pharmacist in charge of Wukari General Hospital should be forwarded to this unit in lieu of drugs. Evidence of inaccuracies was clearly shown. Mallam Tsokwa Takum, the SS Dispensary attendant receives his supplies of medicines from Donga<sup>82</sup>*

From the foregoing, it is cleared that the central objective of this paper is to analyse the nature of epidemic diseases in Wukari area, 1922 – 1950, access the effects of the epidemic on the area and examine the roles of both the Christian missionaries and Colonial government in combating the epidemic.

### **Conclusion**

The menace of epidemic diseases was one of the major problems that affected the British colonial administrators in Wukari area. Also, it adversely affected the physical, mental and socio-economic well-being of the people (natives). Prominent among these epidemic diseases were relapsing fever, cerebrospinal meningitis and small pox. Their sudden outbreak coupled with the acute shortage of medical and health personnel and facilities, accounted for the deaths that were linked to these diseases. Consequently, the British colonial authorities instituted a swift anti-epidemic diseases campaign in all parts of Wukari area. These preventive and curative measures though encountered some challenges, were successful due to a number of factors.

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79. Interview, Clement Angyunwe, 70, Retired Nurse, interviewed in Wukari on 26<sup>th</sup> Oct., 2017.
80. NAK\WUK\353\1936, P. 4.
81. NAK\WUK\405\ P. 1.
82. NAK\WUK\405\ P. 1.



# BASIC EDUCATION AND TECHNOLOGY LEARNING RESOURCES AS STRATEGIES FOR THE ATTAINMENT OF KNOWLEDGE, SKILLS AND ATTITUDE OF GOOD GOVERNANCE AND SUSTAINABLE DEVELOPMENT IN NIGERIA

**Iroriteraye-Adjekpovu, Janice Imizuokena**

*Department of Science Education  
Delta State University, Abraka*

## ***Abstract***

*Education as a dynamic instrument for solving societal challenges and good governance is one major challenge that saddles Nigeria society. Basic Education as one of the levels of Nigerian Education is the foundation of education that is free and compulsory for all citizens. The paper highlights how basic education and technology learning resources as strategies to expose learners to training and education of the following access to information, collaboration and engagement, agreement on element of success, facilitation of innovation, motivation of interest in politics and practical demonstration of governance (good). Through the strategy (medium) of technology learning resources for an expected outcome of utilization of technologies in the process of governance and an observed outcome of good governance and sustainable development.*

***Keywords:*** *Basic Education, technology learning resources, sustainable development, good governance.*

## **Background to the Study**

Every society is saddled with varied challenges and the challenges of society differs from one another. The major agency or instrument for solving societal challenges have been identified to be education. Education is responsible for the training of individuals for the society they will function in assertion Ekpoh and Edet (2008) in Asuquo and Edet (2019) says education at any level is a potential for all around development of an individuals and a nation general. Thus, the education provided to these individual members of society has been classified into lower levels of basic education, post-basic education, and higher education, creating the 9-3-4 in Nigeria.

### **Basic Education**

Basic education is the education for children between the ages of 6 years to 11<sup>+</sup> with the following aims and objectives among others as (Wisdom, 2023).

- i. To inculcate permanent literacy and numeracy. Which implies knowledge gained at this age will remain permanent and transferable to the society.
- ii. Character and moral training and the development of the right attitudes. Which implies training and education of the principles of good governance learnt at this level can be utilized at adult age in the society. These potential aims and objectives and qualities of basic education accorded it the foundation are built and as the key to the success or failure of the other levels of education with a resultant failure or success of governance and governance.

Governance institute in McDonald (2022), defines governance as the system by which an organization is controlled and operated and the mechanisms by which it and its people are held to account while UNESCAP, (2013) sees the process of which decision-making is taking, and the process by which decisions are implemented or not implemented.

From the definitions above governance is deduced to have two components and can be seen to be a coin with two sides. When decisions are not properly or not implemented with lack of mechanisms of accountability we have bad governance, one side of the coin with the following effects on society.

Individuals are likely to have a short life span because of structurally defectiveness during early development for account of poor nutrition intake and poor food security (Jaja, 2014).

- i. Poor health delivery
- ii. Unemployment
- iii. Poor housing system
- iv. Poor judicial system
- v. Poverty
- vi. Corruption among others.

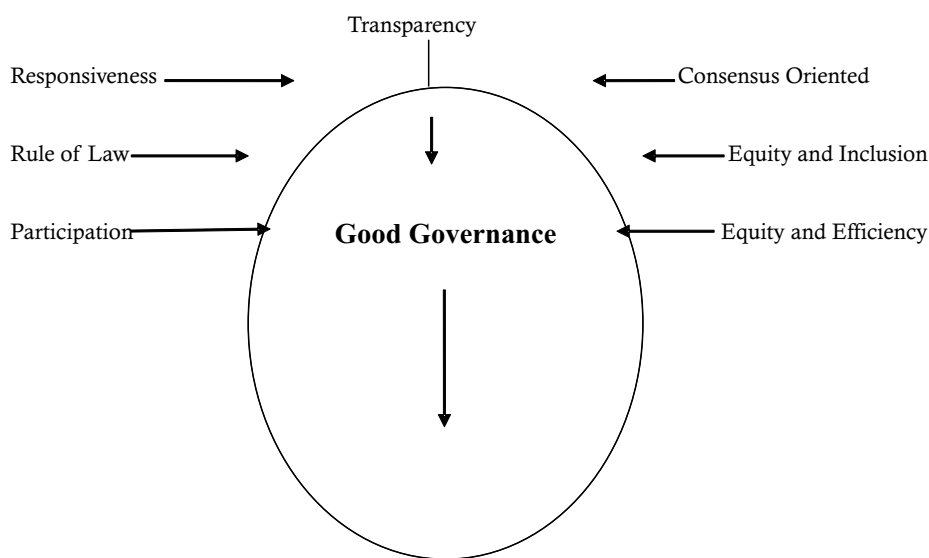
These consequences of bad governance could be attributed to the fact that politicians rule the world and are responsible for the development of society both in developed and developing world. And in the case of Africa and Nigeria in particular our politicians are background in terms of their values such as unfulfilled promises, political corruption, greed, violence, tribalism and intimidation (Ndum, Udoye & Henshaw, 2020). Also, they enter into the business of sustainable development with the quest to wants. Human wants are insatiable, this insatiable desires for wants result to bad governance.

Secondly our politicians were not prepared for these crucial roles of good governance they have to fulfilled in their future from an early stage of life. In agreement Ndum, Udoye and Henshaw (2020) stressed that there is a lack of early acquisition of core political values of peace, love, non-violence, surrender to failure, morality, discipline, etc. can be passed on from generation to generation to basic education. So when decisions are properly implemented and accounted for we have good governance the other side of the coin.

### **What is Good Governance?**

Good governance is accountability of government being responsible and answerable to its

decisions and actions that are guided by its principles. This concept originated in 1980 according to Robert (1992) in Anca and Claudiu-Vasile (2018). As being used by the first time by the World Bank and the international Monetary Funds in a Project on helping developing countries like Nigeria. Defines it as a recognition that the nation, institution or enterprise is operated for the benefit of others with an obligation of accountability. Also identified eight key dimensions taking part in good governance as Figure 1:



**Figure 1: Good Governance and Its Dimensions**

In recognition of the above goal of helping developing countries to develop for which Sustainable Development (SDG)16 was established, among other objectives, as a tool to achieve the development of developing countries. develop and be understood as; promote peaceful and inclusive societies, ensure access to justice for all, and build effective, accountable and inclusive institutions at all levels.

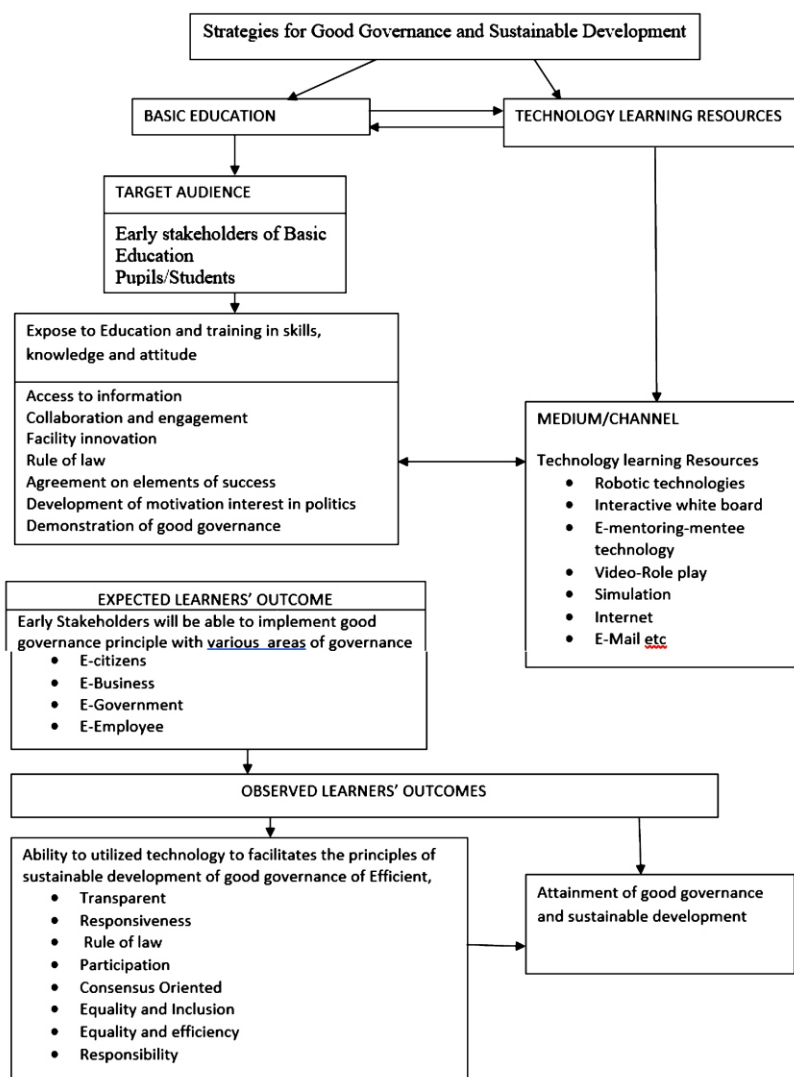
To what extent has Nigeria been able to achieve this goal and the purpose of good governance for overall goal of sustainable development?

Nigeria gain democracy in 1999 which account for 24 years with eighteen political parties that operates a multi-party system such as:

1. APC - All Progressive Congress
2. PDP - Peoples Democratic Party
3. NNPP - New Nigeria Peoples Party
4. LP - Labour Party
5. APGA - All Progressive Grand Alliance
6. AP - Accord Party
7. ADC - African Democratic Congress
8. ADP - Action Democratic Party

9. AAC - African Action Congress
10. APM - Allied Peoples Movement
11. BP - Boot Party
12. PRP - Peoples Redemption Party
13. NRM - National Rescue Movement
14. SDP - Social Democratic Party
15. YPP - Young Progressive Party
16. ZLP - Zenith Labour Party
17. APP - Action Peoples Party
18. AA - Action Alliance

And continuous enthronement of leaders that is nothing is shown for good governance and sustainable development. Hence this paper seeks to highlights strategies for good governance and sustainable development. Figure 2:



The above expected and observed learners' outcomes results of good governance and sustainable development is a result of exposing basic education pupils to training and education in the knowledge, skills and attitude in access to information, collaboration and engagement, facilitating innovation, rule of law, agreement on elements of success, development of motivation interest in politics and demonstration of good governance. Through the strategy (medium and channel) of Technology Learning Resources.

Technology Learning Resources are diverse technological encompass ICT, E-learning, E-mentoring-mentee, interactive white board, video-rle play, simulation, internet, E-mail e.tc. Apagu and Wakili (2015), argues that technology learning resources as human-assisted, electronic or computer-based interactive material devices that can be used for a variety of teaching and learning purposes. as well as for personal use. The following potentials are attributed to technology learning resources because of their ability to help develop skills, stimulate, model, and adapt interactions, and their use applies to many disciplines (Osakwe, 2013).

It has the potentials of not only making the learners to acquire the necessary knowledge, skills and attitudes but also a vehicle in transferring the knowledge of skills into the society for good governance and sustainable development. While Otiko and Inuwa (2021), asserts the potentials of technology learning resources as promotes good governance in three ways

- i. By increasing transparency, information access and accountability.
- ii. By facilitating accurate decision making and participation and
- iii. Enhancing the efficient delivery of public goods and services.

Furthermore, according to Prabhu (2012), employing internet-based online systems lessens interactions with efficient mediators and lowers the likelihood of corruption. The above is facilitated when learners use their skills acquired from technology learning resources to engage in governance in the following ways:

- A. E - Citizens
  - E - Access to information immediate and updated election processes and implementation
  - E - registration of voters
  - Social Issues
  - Public information
  - Complaint trackling
  - Participating in decision making
- B. E - Business
  - Supplies
  - Procurements
  - Change management
- C. E- Employee engagement
  - Intranet
  - GIS (Planning and logistics)
  - Executive information system
  - Resource planning
- D. E – Government



- Data sharing
- Joint power government
- Planning
- Reporting
- The rule of law

### **Conclusion**

The paper highlighted the concept of education, basic education and its objectives, governance, good governance and its principles, impact of bad governance on the society, good governance and its purposes, technology learning resources and its potentials in learning and its effectiveness as a tool to good governance and highlights how strategies of basic education and technology learning resources can be used to achieve good governance and sustainable development.

### **Recommendations**

Based on the foregoing the following recommendations are made.

1. Government at various levels should provide technology enabled classroom environment at the basic education level to enable them to acquire the necessary technological skills for hands on experience for efficiency and effectiveness of good governance for sustainable development.
2. Teachers at the basic education level should be retrain on how to employ technology learning resources for teaching-learning.
3. Technology learning resources, knowledge, skills and attitude of the principles of good governance should be an integral part of the curriculum of basic education.

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## EFFECT OF TAX AGGRESSIVE MEASURES ON FINANCIAL PERFORMANCE OF SELECTED MANUFACTURING COMPANIES IN NIGERIA

<sup>1</sup>Elaigwu, Bernard Emmanuel & <sup>2</sup>Ali, Bako Khikando

<sup>1</sup>Department of Accounting, Federal University, Wukari

<sup>2</sup>Kwararafa University Wukari

### Abstract

*The study investigates effect of tax aggressive measures on financial performance of selected manufacturing companies in Nigeria. Tax aggressive measures includes THINCAP=Thin Capitalization and CAPINT=Capital Intensity, while profitability is the measure of financial performance. The researcher adopted the use of Expost-facto research design in conduct of the study. Data for study were collected from the Annual Reports and Accounts of purposively selected 19 Health and Industrial Goods Manufacturing companies for the period 2011-2021. Data collected were analyzed in three-phase procedure: pre-estimation, estimation and post estimation. Findings from the study showed that, Thin capitalization and Capital intensity do not have any significant effect on profit before tax of the selected manufacturing companies in Nigeria. Based on the findings, it can be alluded that the selected manufacturing companies in Nigeria have been found to be engaging in various aggressive tax management practices in order to reduce the tax liability which has enhanced the financial performance of the organizations. Based on these observations, the researcher recommends amongst others that; relevant tax authorities should initiate tax reforms aimed at clarifying tax reliefs to manufacturing companies who are affected by various policies that financially affects profitability of the companies, manufacturing companies are also encouraged to exploit the accruing benefits in various tax reliefs to reducing tax expenses. It is also recommended that; government should properly define and monitor tax management practices to deter organizations from evading taxes.*

**Keywords:** *Tax Aggressive Measures, Thin Capitalization, Capital Intensity and Profitability*

### Background to the Study

Corporate organizations tax aggressiveness is seen as an avenue for improvement in corporate profit performance which has now been structured into a strategic cost saving approach employed by organizations globally because no country has been found to be immune from the growing practices tax aggressiveness. Corporate tax aggressiveness has existed through

history and will continue to exist as long as corporate organizations are still subjected to tax payment. Taxes have been a significant cost to firms, its shareholders and, as a result a reduction in the cash flow available to the organization. It is generally noticed that business managers prefer tax aggressive activities in an effort to increase not only after-tax earnings per share but also cash available for shareholders. This has made organizational managers tax express concern to device various strategies to increase firm value through reducing tax liability of businesses to the government. To ensure the revenue of firms are maximized, managers play a critical role by employing strategies to reduce tax expenses. Reduction of tax expenses are measures classified as being tax aggressive (Elaigwu, 2023).

Shareholders normally have preference for managers that guarantees more investments returns through tax avoidance mechanisms that reduces organizational tax liability and on the other hand promoting wealth maximization goal of the firm. Dhamara and Violita, (2018) noted that taxpayers have used various tax aggressive strategies to minimize their pre-tax income and reduce their tax burden. This made tax aggressiveness an effort to apply lawful loopholes to avoid or minimize the organization tax liability. When this is achieved within the confines of tax laws, the acts protect investors and other stakeholder's interest and enhance the credibility of financial reports and procedures of preparing such reports. Kiabel & Nwikpasi (2001), sees tax aggressiveness as the planning and operation of business activities within the context of existing tax legislation in such a way that the business realizes the optimal tax position while achieving its set financial goals and objectives. Tax aggressiveness can thus be said to include all the strategies aimed at minimizing tax liability of a business, and as well looks at the cash flow effect on the business regarding when it is most beneficial for a corporate entity to remit its tax liability and not incur any additional liability/punishment. Summarily, tax aggressiveness is an act of technically within the confines of the law transferring value from the state to the firm. Tax aggressiveness plays an important role in enabling organizational managers promotes corporate governance in business management and as well maximize shareholders' wealth.

Thin capitalization is part of financing techniques used by corporate organizations to enhance increasing costly debt ownership so that the company's capital structure becomes lower (Richardson, Taylor, & Lanis, 2013). Thin capitalization reduces owner's equity by making use of debt capital in financing the business operations. These results in business returns given to debt owners in the form of interest expense which is allowable as deductible expense under tax laws. The capital composition of an organization often determines the amount of profit it reports for tax purposes as the tax rule allows deduction of interest paid or payable in arriving at taxable profit. The higher the level of debt in a company increases interest payable on debt with the consequent effect to reduction of its taxable profit (Gordon, 2010). Considering this position, debt can be seen as a tax efficient method of financing an investment compared to equity. This benefit has made multinational companies to mostly structure their financing arrangements to maximise these opportunities. Many organizations around the globe have also established tax aggressive efficient mixture of debt and equity, and as well also able to influence the tax treatment of the lender who receives the interest. For instance, these arrangements may be structured in a way that allows the interest to be received in a country jurisdiction that either does not tax the interest income or subjects such interest to a lower tax rate (Gordon, 2010). Considering the influence of thin capitalization in determining the taxable income of organizations, researchers have had various positions on influence of thin

capitalization on taxable income of organizations. Some of these researchers include; Taylor & Richardson (2012), and Falbo & Firmansyah (2018) who have proved that thin capitalization has been found to have a positive effect on tax evasion. Darma (2019) and Andawiyah, Subeki, and Hakiki, (2019) in their own research also found that thin capitalization have effect on tax aggressive practices. From the observations of these, this variable is seen as an important measure to tax aggressive mechanism for the purpose of the study.

Tax aggressiveness is also influenced by capital intensity. Capital intensity can be described as the amount of cash or its equivalent invested in tangible assets which include; property, plant and equipment and other non-current assets of a business entity. Capital intensity is seen as the amount of capital invested by the company in acquisition of fixed assets (Muzakki & Darsono, 2015). The more asset acquired by a business organization, the more the organization is seen to be capital intensive which will affect the firm either positively or negatively as it relates to taxable income. Investing more in the form of fixed assets is one of the company's strategies in carrying out tax avoidance practices, because almost all fixed assets experience capital allowance. Capital allowance is a deductible expense from profit in tax calculations, a large expense of a company will lower the pre-tax profit so that the tax that must be paid by the company will be lower. The higher capital intensity in a company, the higher the probability of the company practices of tax avoidance mechanism. Concept of capital intensity is crucial to an organizations ratio between non-current assets and the total assets of an organization. It is of great importance, not only because it impacts on the financial situation of the company, and also affects the assets efficiency and its performance. Chukwu and Egbunike (2017), noted that investments made by companies in fixed assets will be reasonable and necessary. Subject to this, the study will investigate how capital intensity has helped to evaluate how this tax mechanism variable has fared on the financial performance indicators of corporate organizations. Based on the above observations, the study therefore investigates effect of tax aggressive measures on financial performance of selected manufacturing companies in Nigeria.

### **Statement of the Problem**

The increase in government attention to non-oil sources of revenue such as the corporation tax despite the huge amount of resources investors are contributing to their business without guaranteed return considering the bedeviled challenges facing Nigeria business environment which includes but not limited to, high cost of input operations, deficiency in basic amenities and infrastructural facilities, inflation, high and multiple government taxes just to mention few. Broadening the corporation tax base in Nigeria is a concern to both government and business owners in the light of the economic challenges faced by the nation. The reports from Federal Inland Revenue Service (FIRS) tax statistics showed that, the revenue agent has not been able to achieve its target on corporate income tax collections over several years. In the period 2016 - 2018, to be precise, the agent only met 52% - 85% of its target as within the previous years of 2013 – 2015 were a 99.6% - 125% of target was achieved. Tax avoidance practices have been recorded among factors responsible for low revenue target starving government of revenue needed for development in African countries (Mayah, 2015).

The difference in interests from the government and companies expected tax and payable tax considering the various expectations of organizations to its major stakeholders who chose to

invest their limited resources with the hope of a good return on investment has been a challenge in recent times which as mandated organizations towards aggressiveness in tax management. Tax management enhances organizations return performance, therefore any attempt towards tax reduction contributes to the earnings and return to organizational investors disclosed in the financial statement. This is in support of the main purpose of firms' activities which is creating value for shareholders; therefore, actions taken to minimize the tax burdens are in line with that objective. To this end, the study therefore investigates effect of tax aggressive measures on financial performance of selected manufacturing companies in Nigeria.

### **Objectives of the Study**

The broad objective of this study is to examine the effect of tax aggressiveness on the financial performance of selected manufacturing companies in Nigeria. Specifically, the study seeks to;

- i. Ascertain how thin capitalization has impacted on profit before tax of selected manufacturing companies in Nigeria.
- ii. Investigate the effect of capital intensity on profit before tax of selected manufacturing companies in Nigeria.

### **Research Questions**

The following questions are structured to help researcher seek answers to the objectives of the study.

- i. Has thin capitalization impacted on profit before tax of selected manufacturing companies in Nigeria?
- ii. Has capital intensity impacted on profit before tax of selected manufacturing companies in Nigeria?

### **Research Hypotheses**

The researcher designed the below hypotheses in its null form to guide the study:

- H<sub>0</sub>1:** There is no significant impact of thin capitalization on profit before tax of selected manufacturing companies in Nigeria.
- H<sub>0</sub>2:** There is no significant impact of thin capitalization on profit before tax of selected manufacturing companies in Nigeria.

### **Significance of Study**

The study will be of benefits to various users both within the private and the public settings amongst which are business owners, policy makers, the public as well as the research world. A study of this nature will help business owners who seek avenues to eliminate unnecessary and avoidable cost with the aim of optimizing profits. At same time, the study will provide useful information to the tax authorities in understanding more about tax aggressive corporations. The study will also help to ascertain extent of tax morality by organizations which connotes standards of good or bad behaviour, fairness and honest. Finally, the study will be useful to tax researchers interested in studying the tax aggressiveness of companies and as well adds to the extant literatures by providing evidence of measures and measurement effects of tax aggressiveness on financial performance of manufacturing firms.

## **Review of Literature**

### **Concept of Tax Aggressiveness**

Tax aggressiveness are strategies adopted by firms within the ambit of the law to reduce the firms explicit tax liability. Hanlon and Heitzman, (2010), note that tax-reducing device transfers interest from the government to shareholders to maximize shareholders value. Therefore, some level of tax avoidance is desirable as it benefits the shareholders and management as well. If a firm pays less tax through legitimate tax saving strategies, shareholders benefit as well as management when incentives are properly aligned (Slemrod, 2004). Thus, the terms such as tax management; tax planning; tax sheltering; and tax avoidance are interchangeably used with tax aggressiveness (Lanis & Richardson, 2011; Tang & Firth, 2011). Tax aggressiveness is a reduction of the present value of tax payments or a strategy of minimizing taxes through legal means by exploring, the complexities, technicalities and loopholes in the tax laws. Taxpayers take advantage of the provisions of the tax laws to reduce their explicit corporate tax liabilities such as arranging to take income in the form of lightly taxed capital gains or untaxed fringe benefits rather than as fully taxed wages and salaries (Annuar, Salihu, & Obid, 2014; Dowling, 2013; Rego, 2003). Is therefore, the legal utilization of the tax regime to ones' own advantage, to reduce the amount of tax that is payable by means that are within the law (Pasternak and Rico, 2008).

Otusanya, (2011), noted that tax aggressiveness is not an unlawful practice which has the effect of reducing the government revenues needed for the provision of infrastructures, and for public services and public utilities. It is a practice of using the legal exploitation of the tax system to one's advantage to reduce the amount of tax that is payable by ways that are within the law while making a full disclosure of the material information to the tax authorities (Desai & Dharmapala, 2006). Desai and Dharmapala (2009) posited that tax aggressiveness can also be seen as a transfer of value from the state to shareholders of organizations. This involves strategies designed to create information asymmetry between tax authorities and the firm so as to prevent the detection from tax authorities. It represents a continuum of tax planning strategies, encompassing activities that are perfectly legal and more aggressive transactions that fall into the grey area (Wang, 2010).

According to Seyi (2003), tax can be avoided in Nigeria, where a capital expenditure is incurred with the purpose of claiming capital allowance and a foreign investment is made with the aim of being exempted from income tax. It is any activity that reduces tax paid given the level of earnings. Tax aggressiveness involves any transaction that has any effect on the firm's tax burden. This includes real activities which have tax benefits, lobbying activities aimed at reducing a firm's tax burden, and activities undertaken solely for the purpose of avoiding taxes (Guo, 2014). If successfully deployed, tax aggressiveness strategy would transfer wealth from the state or government to shareholders. Therefore, it should result in relatively low taxes payable (that is, low Effective Tax Rates), and higher after-tax cash flows, which will show up in analysts' financial reports and ultimately, stock prices (Chena, Cheokb, & Rasiahc, 2016). Effective tax avoidance seeks to minimize taxes but only to the extent that such planning maximizes after-tax returns (Scholes, Wolfson, Erickson, Maydew, & Shevlin, 2005). For the purpose of this study, the tax aggressive practices investigated include the Thin Capitalization and Capital Intensity as extrayed below.

### **Thin Capitalization**

The financing decision in an organization has been a major key decision when it involves aggressive tax management mechanism. An organization has opportunity of deciding percentage of debt financing to its equity financing. If a firm decides on equity financing, although it can be a cheaper alternative, it has a cost associated through the remuneration of investors, which is payment of dividends. Dividends are not deductible for tax purposes. The deductibility of interest expense leads firms to prefer debt financing rather than equity financing. As pointed out by Ribeiro (2015); Kraft (2014), firms financing decisions may also contribute to the alignment of shareholders and managers interests.

Managers of firms with higher levels of leverage are subject to the discipline of financing agreements imposed by creditors through the inclusion of limiting clauses. These restrictions reduce the leeway available to take decisions that are not value maximizing only for the purpose of extracting private benefits. This stands to reason that more leveraged firms exhibit lower effective tax rates. Kraft (2014), Richardson and Lanis (2007) find a significant negative relationship between leverage, used as a proxy for capital structure, and effective tax rates.

### **Capital Intensity**

Capital intensity is the amount of fund invested in fixed assets by an organization. It is a known fact that all fixed assets are subject to depreciation every year, which give rise to depreciation expenses in the company's financial statements. Investment decisions on asset acquisitions are characteristic that can influence effective tax rates. As pointed out by Hanlon and Heitzman, (2010) managers' investment decisions can be to some extent constrained by corporate taxes due to the uncertainty of tax payments and deductions that have to be incorporated in the calculation of an investment's present value. As well as the deductibility of interest expense, capital allowance and amortizations are an important slice of firm's costs.

Capital allowance is the amount of capital investment costs, or money directed towards a company's long-term growth, a business can deduct each year from its revenue via depreciation. Thus, capital intensity has an influence on tax avoidance. Also research conducted by by Dwiyanti and Jati (2019), Artinasari and Mildawati (2018) also affirms that capital intensity has a positive effect on tax avoidance, and Budianti and Curry (2018), Sinaga and Suardikha (2019), Muzakki and Darsono (2015), Rifai and Atiningsih (2019), which shows that capital intensity has a negative effect on tax avoidance. Therefore, firms that are more capital-intensive benefit more from depreciations deductibility. This is even more important because an asset economic life is usually longer than the depreciation period (Richardson & Lanis, 2007). From the existence of different depreciation methods, organizations that are capital-intensive can easily manage taxes by increasing or deferring depreciation expense and, consequently, they can take advantage from temporary book differences.

### **Financial Performance**

Success of an organization is explained by its performance over a certain period of time. Performance measurement is critical for effective management of any firm (Demirbag, Tatoglu, Tekinkus and Zaim, 2006). The process improvement is not possible without measuring the outcomes. Hence, organizational performance improvement requires measurements to identify the level to which the use of organizational resources impact



business performance (Gadenne and Sharma, 2002). Performance measurement can offer significant invaluable information to allow management monitoring of performance, report progress, improve motivation and communication and pinpoint problems (Al-Matari, Al-Swidi, & Fadzil, 2014). It is to an organizations best interest to evaluate its performance. Researchers have extended efforts to determine measures for the concept of performance as a crucial notion. Finding a measurement for the performance of the firm enables the comparison of performances over different time periods. However, researchers have measured performance using various indicators which include but not limited to; return on investment, return on equity, return on asset, turnover, profit before tax amongst others. Measuring financial performance in this study will focus on profit before tax.

### **Profit before Tax**

Profit before tax (PBT) is a measure that looks at a company profits before the company pays corporate income tax. It deducts all expenses from revenue including interest expenses and operating expenses except for income tax. Profit before tax combines all of the company's profits before tax, including operating, non-operating, continuing operations and non-continuing operations. PBT exists because tax expenses constantly changes and helps an investor to have a good idea of the changes in the firms' profits yearly. PBT includes all income earned regardless of the source. This includes sales, commissions, service revenue, interest and rent received. All expenses are subsequently deducted except for corporate income tax. PBT provides the internal management and external users of financial data with a company's operating performance. The elimination of income tax expense from the PBT allows for a greater comparison of the operations of two or more firms regardless of how the taxation policies define their net profit. Therefore, by excluding income tax, PBT minimizes one additional variable that may hold different indicators which influence the way financial data reads. This is because one firm may receive substantial tax benefits that will positively influence the net income of one entity, while an entity under unfavorable taxation policies will be negatively influenced.

Also, taxation differences may also exist heavily between companies as the age, capital utilization and geographical location will play factors in how much income tax a business must pay. PBT eliminates any influence a taxation jurisdiction which may have on a company's financial information. When profitability is measured based on profit before tax it is expected that more profitable firms have higher earnings and, consequently, pay more taxes. This point of view is the one most evident in the literature. A positive association between firms' profitability and Effective tax rate (ETR) was found by Armstrong, Blouin, Jagolinzer, and Larker (2012), Minick and Noga (2010), Richardson and Lanis (2007). As pointed out by Rego (2003) more profitable firms have lower costs associated to managing taxes because they have more resources to invest in tax planning activities that contribute to lower effective tax rates. Furthermore, firms with higher profit before tax have more incentives to reduce their taxation burden and, consequently, to decrease ETRs. PBT is a performance measurement which emphasizes the general operations of a business and therefore a sensitive indicator with aptitude to influence effective tax rate, hence the choice of PBT as a proxy for performance in this study.

### **Theoretical Framework**

The study is based on the Hoffman's tax planning theory (1961)

### **Tax Planning Theory**

Hoffman tax planning theory (1961) seeks to divert cash, which would ordinarily flow to tax authorities, to the corporate entities. Tax planning activities are desirable to the extent that they reduce taxable income to the barest minimum, without sacrificing accounting income. The theory is premised on the fact that firms tax liability is based on taxable income rather than accounting income. The idea is thus to intensify activities that reduce taxable income but has no indirect relationship on accounting profit. The theory thus recognized a positive association between firm tax planning activity and firm performance.

Hoffman (1961) also recognized the role of tax cost in the tax planning activities. The theory thus provided that the positive association between tax planning and corporate performance is on a basic assumption that tax benefits from the tax planning exceed tax cost. The scope of the Hoffman's tax planning theory does not address the dynamics of tax planning and market performance. As capital markets develop and the separation of ownership and control of corporate bodies become well-spread, the need for a comprehensive tax planning theory becomes expedient.

Accordingly, Hoffmann (1961) noted that since taxation are mostly based on business or accounting concepts, thus a firm can modify such activities towards the attainment of reduction in tax liability. Hoffmann identified some ambiguity and loopholes in tax laws due to unclear intentions of the legislators and concluded that successful tax schemes work with the legal concepts and precise wording of the statute and complying with these concepts very precisely as it relates to individual firm tends to be advantageous to firms in form of tax savings.

### **Empirical Studies**

Empirical studies reviewed in relation to this study include research carried out by Yetty, Eka, and Eneng, (2016) investigated whether thin capitalization can have significant effect on tax avoidance. The population of their study was limited to manufacturing firms listed on Indonesian Stock exchange for period 2010-2014. By purposive sampling, 108 samples are selected. The study made use of secondary data such as Annual Report Financial Statements that are published during the observation year. The multiple linear regression equation was used. It was discovered that Leverage does not have a significant effect on tax avoidance.

Ilaboya, Izevbekhai and Ohiokha (2016), examined the influence of capital intensity on tax aggressiveness as capital intensity is the cash invested in property, plants, and equipment of a business entity. The study made use of Ordinary least square method with a sample size of 70 firms for a period of 10 years from 2004 to 2014. The more capital invested, the more the firm is said to be capital intense, and this will affect the firm's value positively. They document that a positive relationship exists between capital intensity and tax aggressiveness.

Herbert and Overeseh (2015), documented that the variable capital intensity (*CAPINT*) is the quotient between property, plant and equipment and total assets. The association between ETR and *CAPINT* is also ambiguous. The most widely obtained result is a negative correlation with tax avoidance, which leads to the assumption that a high level of property, plant and equipment causes a tax reduction in ETR due to the deductibility of high depreciations regarding international tax planning strategies, higher capital intensity might also indicate less

mobility of taxable income. The study therefore finds a negative effect of capital intensity on the ETR DIFF.

Gamlath and Rathirane (2013), submitted that capital intensity indicates how much money is invested to produce one rupee of sales revenue. Business tangible properties or tangible assets are real things that a company has such as buildings or equipment. Capital intensity and tangibility has the vital role in the firms' financial performance. They explored the impact of capital intensity and tangibility on the firms' financial performance in the Colombo Stock Exchange (CSE). Capital intensity was represented by the capital intensity ratio which is calculated by dividing the Total assets by the sales and the Tangibility is represented by the Total Debt Ratio and Debt to Equity Ratio. The financial performance of the firm represented by the Profit Margin (PM), Return on Assets (ROA) and Return on Capital Employed (ROCE). The findings of the study revealed that there is a significant relationship between the Capital Intensity and tangibility and the financial performance. This means that as the firm's capital intensity and tangibility increase it will significantly increase firm's financial performance and future stability, and the financial managers always act to increase firm's value in order to maximize the shareholders wealth.

Lanis and Richardson, (2012) study used capital intensity (CAPINT) as a control variable given that previous research show that physical plant and equipment makes a corporation much more visible to the public and to the community at large. Thus, capital intensive corporations disclose more CSR information than non-capital-intensive corporations. The study measured CAPINT as net property, plant and equipment divided by total assets. The study made of OLS to test the formulated hypothesis. Of the 40 corporations listed on the Australian Stock Exchange (ASX), 20 were considered to be tax aggressive, as they were accused of such aggressiveness during the 2001-2006 period. The empirical result of the study documents a positive and statistically significant association between corporate tax aggressiveness and CSR disclosures, thereby confirming legitimacy theory in context of corporate tax aggressiveness.

### **Literature Gap**

From the reviewed studies carried out, tax aggressiveness on firm performance were more of foreign based leaving Nigeria under-explored as the few that existed were not robust since they basically looked at the determinants of tax aggressiveness instead of its bottom-line effect on firm performance. Therefore, there is a research gap which our study seeks to research address.

### **Methodology**

#### **Research Design**

The study adopted ex-post facto research design to explain the relationship between tax aggressiveness and financial performance. Ex-post facto research design according to Louis, Lawrence and Keith (2005) is a method of testing out possible antecedents of events that have happened and cannot therefore, be engineered or manipulated by the researcher. The justification for adopting this design is that requisite data were not manipulated but sourced from secondary materials with a view of gaining deeper information and obtaining good knowledge about the study.



the profitability of businesses within the same industry. For the purpose of the study, the PBT is the ratio of profit/loss to sales performance of the selected companies which is arrived at by dividing the value of profit/loss by the total sales for the period/financial year.

**Thin Capitalization (THINCAP):** Thin capitalisation refers to the situation in which a company is financed through a relatively high level of debt compared to equity. In this study, Thin Cap is arrived at by dividing debt with equity,

**Capital Intensity (CAPINT):** Capital intensity is the amount of fixed or real capital present in relation to other factors of production. The capital intensity ratio is total assets divided by sales.

## Results

### Correlation Coefficient on Measures of Tax Aggressiveness on Financial Performance of Selected Manufacturing Companies in Nigeria.

		PBT	THIN CAPITALIZATION	CAPITAL INTENSITY
Pearson Correlation	PBT	1.000	-.158	.046
	THIN CAPITALIZATION	-.158	1.000	.068
	CAPITAL INTENSITY	.046	.068	1.000
Sig. (1-tailed)	PBT	.	.253	.424
	THIN CAPITALIZATION	.253	.	.388
	CAPITAL INTENSITY	.424	.388	.

Source: SPSS Output, 2023

Result on table above indicated a negative relationship of -.158 between thin capitalization and profitability indicating that thin capitalization has reduced the profitability of the manufacturing companies. The lesser the thin capitalization has helped in improving the profit performance of the companies. Also relationship between capital intensity and profitability indicated a positive relationship of .046.

### Model Summary<sup>b</sup> on Measures of Tax Aggressiveness on Financial Performance of Selected Manufacturing Companies in Nigeria.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df 1	df 2	Sig. F Change	
1	.475 <sup>a</sup>	.141	-.021	1.45885	.141	.872	3	16	.476	1.823

A. Predictors: (constant), Thin capitalization, capital intensity

b. Dependent Variable: PBT

Source: SPSS Output, 2023

Result on table above a R value of .475 which indicated a positive relationship of 47.5% between the independent variable (THINCAP and Capital Intensity) relationship with the dependent variable (PBT). The R<sup>2</sup> value of .141 also shows that both of ThinCap and Capital Intensity explains 14.1% of the profitability of the selected manufacturers in Nigeria. With Adjusted R<sup>2</sup> showing a value of -.021, it can be concluded that the effect of all the independent

variables are not significant on the dependent meaning combination of ThinCap, and Capital Intensity are not negatively affecting the profitability performance of the companies under study.

**ANOVA<sup>b</sup> on Measures of Tax Aggressiveness on Financial Performance of selected Manufacturing Companies in Nigeria**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.567	3	1.856	.872	.476 <sup>a</sup>
	Residual	34.052	16	2.128		
	Total	39.619	19			

a. Predictors: (Constant), THIN CAPITALIZATION , CAPITAL INTENSITY

b. Dependent Variable: PBT

Source: SPSS Output, 2023

Table above indicated with the F-value of .872 with a significance value of .476 above the traditional significance value of .05 indicated that the effect of each of the predictors on the dependent variable is highly significant.

**Coefficients<sup>a</sup> on Measures of Tax Aggressiveness on Financial Performance of selected Manufacturing Companies in Nigeria**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-.476	1.477		-.323	.751					
	THIN CAPITALIZATION	-.001	.002	-.142	-.611	.550	-.158	-.151	-.142	.992	1.008
	CAPITAL INTENSITY	-.021	.272	-.018	-.076	.940	.046	-.019	-.018	.948	1.054

a. Dependent Variable: PBT

Source: SPSS Output, 2023

The result on table above showing B-values of the independent value prediction of the dependent variables shows a value of -.001, and -.021 for Thin Cap, and Capital Intensity respectively. For every unit increase in profitability, there is a -.001 decrease in the predicted profitability which simply means that thin capitalization is not statistically different from 0. Also result of capital intensity also shows a value of -.021 also indicating that for every unit increase in profitability, there is a -.021 decrease in the predicted profitability which simply means that capital intensity is not statistically different from 0.

The t-value result shows a value of -.611 for Thin capitalization which is less than the traditional .196 acceptance value for a regression coefficient. Based on the above, it can be concluded from hypothesis one that; There is no significant impact of thin capitalization on profit before tax of selected manufacturing companies in Nigeria. Also the t-value result for capital intensity show a value of -.076 for Capital Intensity which is less than the traditional

196 acceptance value for a regression coefficient. Based on the above, it can also be concluded for hypothesis two that; Capital intensity does not have any significant effect on profit before tax of selected manufacturing companies in Nigeria

### **Discussion of Findings**

From the finding of the study which showed that, thin capitalization does not have any significant effect on profit before tax of selected manufacturing companies in Nigeria. The findings show manufacturing companies are not tax aggressive as it relates to use of debt capital to financing investment as against use of equity capital. This justifies position of Hanlon and Slemrod (2009), pointed that organization with high tax aggressiveness experiences firm decline. This is as a result of investors fear that the reputation cost of the organization might be affected which is synonymous to tax avoidance.

Finding showing that capital intensity does not have any significant effect on profit before tax of selected manufacturing companies in Nigeria justify the position of Gamlath and Rathirane (2013), who's finding revealed that that there is a significant relationship between the Capital Intensity and tangibility and the financial performance which means that as the firm capital intensity and tangibility increases it will significantly increase firm's financial performance and future stability, and the financial managers always act to increase firm value in order to maximize the shareholders wealth. The findings is also related to the findings of Lee (2010) who discovered that capital intensity has a negative effect on U.S. restaurant firms' value performance. The findings of Ilaboya, Izevbehai and Ohiokha (2016), as it is expected that investment in assets should increase outflow of cash and reduction of tax payable through depreciation expense which reduces profit of an organization available for tax purposes which is they documented as to have a positive relationship between capital intensity and tax aggressiveness.

### **Conclusions and Recommendations**

The researcher concludes based on the findings that thin capitalization does not have any significant effect on profit before tax of selected manufacturing companies in Nigeria. It was also concluded that capital intensity does not have any significant effect on profit before tax of selected manufacturing companies in Nigeria. The researcher still concludes that the measures are effective as measures to aggressive tax management on profitability of the health and industrial goods manufacturing companies.

In line with the conclusions of this study, the researcher recommends that:

- i. Government should properly define tax incentives and reliefs to organizations to enable organizations be aware of cost saving benefits to improving financial performance to business investors into the health and manufacturing sector which is the bedrock of growth in any economy.
- ii. Manufacturing companies should exploit the accruing benefits in capital allowances and depreciation by investing in PPEs to enjoy reduced tax expenses.
- iii. Managers of manufacturing should engage in tax planning activities that will reduce the effective tax rate, actual interest expense rate and improve overall financial performance.

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# ENHANCING GOOD GOVERNANCE AND SUSTAINABLE DEVELOPMENT IN NIGERIA VIA EMOTIONAL INTELLIGENCE AND LEADERSHIP DEVELOPMENT IN EDUCATION

**Idris S. Sabdat**

*School of Education, Department of Educational Psychology,  
Federal College of Education Okene, Kogi State*

## **Abstract**

*This study aims to investigate how the integration of emotional intelligence and leadership development in education can contribute to enhancing good governance and promoting sustainable development in Nigeria. The abstract provides a comprehensive overview of the key concepts, emphasizing their relevance to address the pressing challenges faced by the nation. Nigeria, like many other developing countries, grapples with various socio-political issues that hinder its progress towards sustainable development. Rampant corruption, inadequate infrastructure, social inequalities, education and public school are pervasive problems that demand effective solutions. Poor governance and lack of visionary leadership have been identified as major factors contributing to these challenges. Drawing from real-life scenarios, this study underscores the significance of emotional intelligence and leadership development as transformative forces, by equipping educators and students with self-awareness, empathy, effective communication, and conflict resolution skills. Emotional intelligence empowers future leaders to navigate complex social landscapes. This, in turn, enables them to address societal issues with a greater understanding of the human dimensions involved. The researcher made recommendations which include inter alia, that: The Nigerian government should prioritize the integration of emotional intelligence and leadership development programs among Educators and integrate this into the national educational curriculum. Educators should emphasize ethics, social responsibility, and sustainability across various subjects, cultivation of leadership skills among students. Furthermore, trained Guidance Counsellors should be employed in the Nigerian educational sectors to cushion the effect of unwholesome development of emotional intelligence and enhancing good governance and sustainable development in Nigeria.*

**Keywords:** *Education, Emotional Intelligence, Sustainable Development, Leadership Development, Good Governance.*

### **Background to the Study**

The development of a nation depends largely on her education. This is because education is viewed as key to human development and an instrument for good governance and leadership development. Education is the sum total of all those experiences that enlighten somebody's mind, increase one's power of knowledge, foster insight, develop different ability and attitudes and strengthen one's will power (Ogunyiriofo, 2002). Good governance and sustainable development are key pillars for the growth and stability of societies. However, achieving good governance often requires effective leadership and emotional intelligence, both of which can be fostered through education. As such, for an individual to be emotionally intelligent with good leadership quality, he/she needs to be educated, to prepare for life by means of gearing up to the emerging needs of society. Emotions are intense feelings that influence people's state of mind such as, anger, happiness, perseverance, anxiety, worry, sadness, enthusiasm, hope, persistence, fear and creativity, etc., which are both positive and negative. Any action, if not accompanied by the right level of emotions, can fall flat. Mangal (2013) stated that emotion would prove to be helpful or harmful depending on its intensity/frequency, situation and type. Whether emotion is helpful or harmful depends on one's experience that could either develop or damage it. Hence, we need to manage not only our negative emotions but also learn to put our positive emotions to work for us.

The concept of "emotional intelligence" emerged in psychology during the early 1990s and gained popularity through the work of psychologists Peter Salovey and John Mayer. Mayer and Salovey (1995), defined emotional intelligence as a type of intelligence that includes the skills to identify emotion, to incorporate it in thought, to comprehend it and to manage it. Salovey and Mayer's proposal emphasized the importance of accurately recognizing and interpreting emotions in oneself and others, as well as the ability to skillfully manage and express emotions in ways that are adaptive and beneficial. Emotional intelligence plays a crucial role in leadership development as it enables leaders to effectively navigate social interactions, make informed decisions, inspire and motivate their teams.

Governance is the process by which rulers take a stand about public affairs and the process by which such stand are implemented or not. Good governance is the process of measuring extend to which government conduct public affairs and manage the economy and assure the accomplishment of human rights that is corruption free and free of abuse with regard for the rule of law United Nations Economic and Social Commission for Asia and the Pacific (UNISCAP, 2009). Major characteristic of good governance includes participatory, transparent, equitable, consensus effective and efficient, oriented, accountable, responsive, and inclusive. Leadership is a process where actors who are in charge of the affair of the public, create, implement or interpret the rules that are compulsory on existing social institutions and play the state roles (Dagaci 2009). Developing, and effectively applying good leadership is a key part of any leaders' job and success. Leadership development is the process of developing and refining those key proficiencies. Sustainable development is development that meets the needs of the present, without compromising the ability of future generations to meet their own needs. For a development to be sustainable it must look to balance different, and competing, needs against an awareness of the environmental, social and economic limitations we face as a society.

### **Importance of emotional intelligence**

Emotional Intelligence impacts both mental and physical wellbeing of an individual as highlighted by Jayashree et al. (2017).

**Health** – Managing our stress have direct impact on our physical health which is greatly influenced by our emotional intelligent. By recognizing our emotional state and our responses to trauma in our lives we can then manage to control stress and preserve good health.

**Mental Well-Being** – Emotional intelligence upsets our attitude and viewpoint towards life. It can also help to improve psychological trauma such as anxiety, depression and mood swings. A high level of emotional intelligence is directly connected to a positive attitude and happier viewpoint towards life.

**Relationships** – Having a good understanding and control of our emotions, can help us makes effectively communicate of our feelings and to understand and relate with whom we are in relationships. Stronger and more fulfilling relationships could be achieved from understanding the needs, feelings, and responses of those around us.

**Conflict Resolution** – Communication is key to avoid and resolve conflicts. By communication, we can to understand the needs and desires of others and offer effective negotiation can be put in place before conflicts even start. Hence, it is easier to give people what they want if we can perceive what it is.

**Success** – Higher emotional intelligence helps to increase self-confidence and improve our ability to focus on a goal. Which in turn help us to overcome setbacks and have high resilient outlook.

**Leadership** – Persons with higher emotional intelligence will understand what makes other people happy. They relate with free mind and builds stronger bonds with them. Thus, increased work satisfaction and achievement of the organizational goals. An emotionally intelligent leader is also able to build stronger teams by strategically utilizing the emotional diversity of their team members achievement a goal for all.

### **Component of EI and its influence on Leadership, and Sustainable Development**

Jayashree et al. (2017), highlighted the major components of emotional intelligent which have influence on leadership and development as summarized.

- 1. Self-awareness and Empathy:** Emotional intelligence involves self-awareness, understanding one's emotions, strengths, and weaknesses. Leaders with high emotional intelligence are better equipped to understand the needs and concerns of their constituents, fostering empathy and compassion. This empathy enables leaders to make informed decisions that consider the social and environmental impacts, ensuring sustainable development that benefits all stakeholders.
- 2. Relationship Management and Collaboration:** Emotional intelligence encompasses relationship management skills, such as effective communication, conflict resolution, and collaboration. Sustainable development necessitates collaboration among various stakeholders, including government agencies, businesses, communities, and

civil society organizations. Leaders with strong emotional intelligence can build trust, establish fruitful partnerships, and facilitate cooperation, leading to more effective implementation of sustainable development initiatives.

- 3. Resilience and Adaptability:** Emotional intelligence equips leaders with resilience and adaptability, essential qualities for navigating the complexities and challenges of sustainable development. Leaders who possess emotional intelligence can handle setbacks, overcome obstacles, and adapt their strategies in the face of changing circumstances. This flexibility ensures that sustainable development efforts remain agile and responsive to evolving needs and circumstances.

### **Contribution of Emotional Intelligence and Leadership Development in Promoting Sustainable Development**

In Nigeria, where the pursuit of good governance and sustainable development is crucial, the role of emotional intelligence in shaping leaders and fostering positive change cannot be overstated. Several scholars have explored the connection between emotional intelligence, leadership development, and its impact on governance and sustainable development. Research supports the relevance of emotional intelligence in the context of good governance and sustainable development in Nigeria. According to Agwu and Agbaeze (2020), "emotional intelligence is a key determinant of leadership effectiveness in the public sector." Aina and Salami (2019) argue that emotional intelligence is a pathway to good governance and sustainable development, emphasizing its role in ethical leadership.

In the Nigerian education system, emotional intelligence and leadership development have been recognized as essential components for promoting good governance and sustainable development. Umar and Abdulwahab (2021) highlighted that emotional intelligence fosters effective leadership within educational institutions, contributing to overall governance and development. Ikegwuonu and Idike (2020) propose a conceptual framework linking emotional intelligence and good governance in Nigeria.

Studies have shown the positive impact of emotional intelligence and leadership development on sustainable development. Oluwatobi, Gbadeyan, and Ighodalo (2018) found evidence supporting the relationship between emotional intelligence, leadership effectiveness, and sustainable development in Nigeria. Adeyemo, and Adeoye (2021) emphasized emotional intelligence and leadership development as catalysts for good governance. Overall, these studies highlight the importance of emotional intelligence and leadership development in Nigeria's pursuit of good governance and sustainable development, emphasizing the need for their integration within the education system.

### **The Role of Emotional Intelligence in Good Governance**

Emotional intelligence plays a crucial role in good governance by enhancing decision-making, relationship building, conflict management, and consensus building. Several studies have examined the relationship between emotional intelligence and good governance, particularly in the context of sustainable development in Nigeria (Osibanjo *et al.*, 2017; Okpala & Onyekwelu, 2018; Onwuzo, 2020; Edem & Nyor, 2021). These studies provide valuable insights into the impact of emotional intelligence on various aspects of governance.

One area where emotional intelligence contributes to good governance is decision-making.

Emotional intelligence involves the ability to recognize, understand, and manage one's emotions and those of others. Leaders with high emotional intelligence are more likely to make informed decisions that take into account the emotions and needs of individuals and communities. They can consider different perspectives, empathize with stakeholders, and anticipate the potential consequences of their decisions (Osibanjo *et al.*, 2017). By incorporating emotional intelligence into decision-making processes, leaders can promote fairness, inclusiveness, and long-term sustainability.

Moreover, emotional intelligence plays a vital role in relationship building within governance structures. Effective governance requires strong relationships between leaders, citizens, and various stakeholders. Leaders who possess emotional intelligence can establish rapport, trust, and mutual understanding with others. They are skilled in active listening, empathy, and effective communication, which fosters positive relationships and enhances cooperation (Okpala & Onyekwelu, 2018). By nurturing healthy relationships, leaders can build consensus, encourage participation, and gain support for their governance initiatives.

In the realm of conflict management, emotional intelligence is invaluable. Conflicts often arise within governance systems due to differing interests, perspectives, and values. Leaders who possess emotional intelligence are equipped with the skills to manage conflicts constructively. They can regulate their emotions, remain calm under pressure, and approach conflicts with empathy and understanding (Onwuzo, 2020). Emotional intelligence enables leaders to facilitate dialogue, resolve disputes, and find win-win solutions that address the underlying concerns of all parties involved.

Consensus building is another crucial aspect of good governance that is influenced by emotional intelligence. Effective governance requires collaboration and cooperation among diverse stakeholders to achieve common goals. Leaders with high emotional intelligence can navigate complex relationships, identify shared interests, and create an inclusive and participatory decision-making process (Edem & Nyor, 2021). By actively engaging stakeholders, considering their emotions and perspectives, and fostering a sense of ownership, leaders can build consensus and promote sustainable development.

### **Emotional Intelligence and educational leadership**

Emotional intelligence plays a vital role in educational leadership, offering numerous benefits to educational institutions. Research has shown that emotionally intelligent leaders have a positive impact on the overall school climate, student outcomes, teacher satisfaction, and organizational effectiveness (Beghetto & Plucker, 2006; Brackett *et al.*, 2009; Hargreaves, 2005).

One significant benefit of emotionally intelligent leaders in educational institutions is the creation of a positive school climate. These leaders are skilled in understanding and managing their own emotions as well as the emotions of others, including students, teachers, and staff. They foster an environment of empathy, respect, and trust, which contributes to a positive and supportive school culture (Hargreaves, 2005). Students and teachers feel valued and motivated, leading to increased engagement and better overall well-being within the school community.



Furthermore, emotionally intelligent leaders possess strong interpersonal skills that enhance relationships and collaboration within the educational setting. They are effective communicators, active listeners, and empathetic individuals. These leaders create open lines of communication, encourage feedback, and promote a culture of collaboration among all stakeholders (Brackett *et al.*, 2009). By building strong relationships, educational leaders can better understand the needs and concerns of their teachers and students, leading to improved teamwork, teacher-student relationships, and overall school performance.

In the context of Nigeria, it is essential to emphasize the need for developing emotional intelligence skills among educational leaders. Nigeria's education system faces various challenges, including limited resources, high student-to-teacher ratios, and socio-economic disparities (Olojo & Adedeji, 2016). Developing emotional intelligence skills among educational leaders can help address these challenges and promote positive change. To develop emotional intelligence skills among educational leaders in Nigeria, training programs and professional development opportunities should be provided. These programs can focus on self-awareness, self-management, social awareness, and relationship management, which are key components of emotional intelligence (Olojo & Adedeji, 2016). Through training and ongoing support, educational leaders can enhance their emotional intelligence competencies and apply them to their leadership practices, positively influencing the entire educational institution.

### **Nurturing Emotional Intelligence and leadership Development in Nigeria's Education System**

By nurturing individuals equipped with the skills necessary for personal and professional success, challenges such as lack of awareness, limited resources, and exam-centric approaches can be limited. Also, by adopting strategies like teacher training, curriculum integration, effective counselling, collaborative partnerships, student-centered approaches, and parental involvement, we can pave the way for a brighter future for our students and our nation as a whole. Leadership development programs for educators in Nigeria should be designed and implemented with a focus on building effective leadership skills and incorporating emotional intelligence training. Several studies emphasize the importance of emotional intelligence in leadership effectiveness, good governance, and sustainable development in Nigeria (Oluwatobi *et al.*, 2018; Aina & Salami, 2019; Afolabi, 2019; Agwu & Agbaeze, 2020; Ikegwuonu & Idike, 2020; Umar & Abdulwahab, 2021; Adeyemo *et al.*, 2021).

To design an effective leadership development program, it is essential to consider the specific needs and challenges faced by educators in Nigeria. The program should include a combination of theoretical knowledge, practical skills, and experiential learning opportunities. It should aim to enhance the leadership capabilities of educators, enabling them to inspire and motivate their students, make informed decisions, and drive positive change in their schools and communities. Incorporating emotional intelligence enhance educators to create a positive and supportive learning environment, fostering student success and overall school improvement.

Research supports the integration of emotional intelligence training into leadership development programs in Nigeria. For example, a study by Agwu and Agbaeze (2020), found a positive relationship between emotional intelligence and leadership effectiveness among

Nigerian public sector employees. Another study by Umar and Abdulwahab (2021) emphasized the role of emotional intelligence in leadership development within educational institutions, highlighting its potential for good governance and sustainable development. These findings are further supported by studies such as those conducted by Aina and Salami (2019), Ikegwuonu and Idike (2020), Oluwatobi *et al.* (2018), Adeyemo *et al.* (2021), and Afolabi (2019). These studies provide evidence of the positive impact of emotional intelligence on leadership effectiveness and its potential to contribute to good governance and sustainable development in Nigeria. By implementing emotional intelligence training, Nigeria can nurture a new generation of educators who possess the skills and qualities needed to lead effectively, inspire others, and promote positive change in the education system.

### **Integration of EI into the Curriculum**

Emotional intelligence and leadership development should be integrated into the national educational curriculum as a core subject across all grade levels. This integration can be achieved through the development of specific learning objectives, lesson plans, and assessments aligned with these skills. It is essential to emphasize their importance and demonstrate how they can be applied in real-life situations. Such as acquiring all the necessary skills and knowledge needed to recognize, understand, and manage emotions effectively in oneself and others. Student with high emotional intelligence can build strong relationships, resolve conflicts, and communicate empathetically with other students, teachers, and parents.

Including emotional intelligence in the Nigerian curriculum can have a profound impact on the student leadership style, help them become more self-aware, develop better interpersonal skills, and navigate complex social dynamics.

### **Strategies for Implementation**

- 1. Teacher training and Professional Development:** Implementing emotional intelligence and leadership development requires well-trained educators. Providing comprehensive training programs and workshops for teachers will enhance their understanding of these skills and enable them to effectively impart them to their students.
- 2. Collaborative Partnerships:** Collaboration among various stakeholders, including schools, universities, NGOs, and government agencies, is crucial for successful implementation. By forming partnerships, sharing resources, and exchanging best practices, we can create a supportive ecosystem that fosters emotional intelligence and leadership development in Nigerian education.
- 3. Student-centered Approach:** Promoting student involvement and active participation is key to the implementation of emotional intelligence and leadership development initiatives. Encourage students to engage in activities such as group discussions, projects, and experiential learning, which will enhance their interpersonal skills, self-awareness, and decision-making abilities.
- 4. Parental Involvement and Awareness:** Engaging parents in the process is vital for the success of these initiatives. Conduct workshops and seminars for parents to raise awareness about emotional intelligence and leadership development and provide guidance on how they can support their children's growth in these areas at home.
- 5. Assessment and Evaluation:** Develop appropriate assessment tools to measure

students' progress in emotional intelligence and leadership development. These assessments should go beyond traditional examinations and focus on evaluating students' practical application of these skills in real-life scenarios.

### **Emotional Intelligence and Sustainable Development**

Emotional intelligence (EI) and effective leadership play pivotal roles in achieving sustainable development goals (SDGs) in Nigeria. Sustainable development encompasses economic, social, and environmental dimensions, and the successful implementation of policies and decisions. And these areas require leaders who possess strong emotional intelligence. Examples of Emotional Intelligence in Sustainable Development in education includes;

**Social inclusion and equity:** Emotional intelligence promotes social inclusion and equity among the students, an essential component of sustainable development in education. Trainers with strong emotional intelligence can recognize low performing students and design a strategy to address these social inequalities, ensuring that that such designed promotes equal opportunities. By fostering empathy and understanding, these teachers can create environments where diverse voices are heard and valued, resulting in more inclusive and sustainable outcomes.

**Conflict resolution and peace building:** Nigeria faces various socio-political and ethnic conflicts that hinder sustainable development efforts. If students are trained to have emotional intelligence it will help them to navigate these conflicts by fostering understanding, promoting dialogue, and finding mutually beneficial solutions. Students who possess emotional intelligence can effectively mediate disputes and build sustainable peace, creating an enabling learning environment for development initiatives to thrive.

Overall, the sustainability of emotional intelligence and leadership development initiatives in Nigeria depends on adapting to the cultural context, leveraging available resources, integrating these concepts into the education system, and addressing resistance through effective change management. By implementing these strategies, Nigeria can foster the growth of emotionally intelligent and effective leaders, leading to positive societal impact and development.

### **Conclusion**

In a democratic society, the school's basic purpose is the education and development of all students towards individual fulfilment. This important responsibility can be achieved through organization and administration of guidance programme and services by the various school Counsellors, such as providing personal, social and career counselling to promote students' emotional intelligence, good leadership skills, health and adjustment in school and intelligent career decisions and plans. Providing individual \ group counselling in the classroom settings, assembly ground, and setting a day aside for career day to discuss issues like emotional intelligence, self - discipline, responsibility, value clarification, sex education, qualities of leaderships etc.

The strategic employment of trained guidance counselors in the Nigeria educational sectors emerges as a brilliant solution to combat the detrimental effects of underdeveloped emotional intelligence, while simultaneously propelling good governance and driving sustainable

development in the country. By infusing the educational landscape with the expertise and trained guidance counselors, Nigeria can nurture a generation of emotionally intelligent individuals equipped with the vital skills needed to navigate life's complexities. These professionals will provide essential support, assisting students in understanding and managing their emotions, fostering healthy relationships, and cultivating resilience in the face of challenges. Through guidance counselling interventions, they will empower students to become self – aware, empathetic, and socially responsible individuals, capable of making sound decisions and contributing positively to their communities. By addressing emotional intelligence deficits, these professionals will play a vital role in enhancing mental health outcomes, reducing social problems, and fostering a safe and inclusive learning environment which in turn will foster a generation of emotionally and mentally resilient citizens, paving the way for a healthier, happier, and more productive society. As students develop emotional intelligence and leadership skills under guidance counsellors, they will be equipped to assume roles of responsibility and contribute meaningfully to the nation's progress. These emerging leaders will possess the ability to navigate complexities, foster collaboration, and make informed decisions that drive positive change. Through their ethical leadership, they will steer Nigeria towards a future characterized by good governance, transparency, accountability, and sustainable development.

To realize the brilliance of employing trained guidance counsellors, Nigeria must prioritize their recruitment, training, and ongoing professional development. Adequate resource must be allocated to ensure a robust support system that empowers counsellors to excel in their roles. By investing in their expertise, the nation invests in the transformative potential of its youth, thereby fortifying the pillars of national progress and prosperity.

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## FISCAL EQUALIZATION, CONFLICTS AND ECONOMIC DEVELOPMENT IN NIGERIA

<sup>1</sup>Ishaku, Rimamtanung Nyiputen <sup>2</sup>Uwaeke, George Uchechukwu  
<sup>3</sup>Magaji Ibrahim Yakubu & <sup>4</sup>Abu Maji

<sup>1,3&4</sup>Department of Economics, Federal University Wukari, Taraba State, Nigeria  
<sup>2</sup>Department of Economics, Ebonyi State University, Nigeria

### **Abstract**

*Over the years, different revenue sharing formulas have been adopted from reports of different commissions established by Nigerian governments to address the problems of revenue sharing and resource control. One means of containing these conflicts was the introduction of fiscal equalization payments into revenue sharing. In spite of these governments' efforts, the impact of fiscal equalization and conflicts on economic development in Nigeria has received little consideration from researchers. Hence, this study investigates the impact of fiscal equalization and conflicts on economic development in Nigeria. A panel pool is dynamic. The ordinary least squares estimation technique was employed with Granger causality to determine both the long-run and the direction of causality among the variables. Individual States impacts were examined using least squares dummy variable. Data were carefully collected from selected twenty-two States for the period 2010–2020. Results indicated that Fiscal equalization had a negative and significant impact of 11.18 per cent on conflicts in Nigeria in the long run, and Fiscal equalization did not cause conflicts in Nigeria at  $\alpha = 0.05$ , as expected, but 8 States results showed a negative relationship between Fiscal Equalization and conflicts, while in 14 states there was a positive relationship between Conflicts and Fiscal equalization. Results also showed that Fiscal equalization had a positive and significant impact of 11.91 per cent on economic development in Nigeria in the long run, and Fiscal equalization helped cause economic development in Nigeria. However, results for four (4) States showed a positive relationship between Fiscal equalization and economic development, while results for eighteen (18) states showed a negative relationship between Fiscal equalization and economic development. Findings also indicated that Conflicts had a negative and significant impact of 19.17 per cent on economic development in Nigeria in the long run, and the Granger causality result showed that conflict does not cause economic development in Nigeria. The study therefore recommended that the government establish a sub-unit in the federal ministry of finance charged with the responsibility of working out an acceptable percentage for*

*fiscal equalization payments that can address resource allocation Conflicts and bring about the desired economic development in Nigeria.*

**Keywords:** Fiscal Equalization, Conflicts, Economic Development.  
JEL Code: H39, H12, and F63.

### **Background to the Study**

A federation's ability to manage and distribute its revenue resources among its constituent parts is crucial for political and economic reasons. Particularly in the 1970s, the discovery, exploration, and eventual realization of enormous profits from the sale of oil in Nigeria gave rise to high tension, controversy, unfavorable politics, unhealthy rivalry, and disputes among the constituent parts of Nigeria's federation and peoples. The state government and the federal government have had disagreements over resource control and revenue sharing formulae. As an illustration, between 2003 and 2007, the government of Akwa Ibom State, led by His Excellency Art. Obong Victor Attah, sued the Federal Government over the shore-offshore dichotomy based on oil revenue to the State under the Obasanjo administration. This difference between onshore and offshore indicates that the state can benefit more from natural resources on land, such as oil, than from those at sea. Given that the oil in Akwa Ibom State's water or sea does not belong to the State but to the federal government, how can this not be considered cheating in Akwa Ibom State? In the end, the State prevailed, and the Federal Government satisfied all of the State's demands. The 1999 Constitution, however, mandates the creation of a State Joint Local Government Account (SJLGA) in each of the federation's States, where money from the Federal Account are deposited before being distributed to the local government councils in the State. State governments have seized control of this structure, though, and are depriving local governments under their control of the money they require to carry out projects and promote rural development. In the name of a joint account, these are the issues that local government councils are dealing with. Since only the State governors are signatories to the joint account and the local government chairman does not have access to it, local government councils are unable to pay their staff members' salaries for months or even years as a result of this one act. Another difficulty between the three tiers of government is pay discrepancies. There is a claim that employees of the federal, state, and local governments who possess the same credentials, such as a B.Sc. (Degree), are paid very differently from one another. What justification exists for this discrepancy?

How to achieve extensive and equal revenue sharing and resource control among its parts is one of the major difficulties linked with Nigerian federalism. The mechanism for allocating revenues has never been the subject of broad consensus in Nigeria. The conflict has thus become intense and has been a recurrent subject in both federalism and politics in the nation. As an illustration, the Philipson Commission lowered the discrepancy in the income sharing formula before independence from 100% to 50% in 1951; the Raiseman Commission established it at 50% in 1958; it remained at 50% in 1960; Gowon reduced it to 45% in 1970; and finally, it was cut to 20% in 1975. The Obasanjo/Yar'Adua administration increased it to 25%; Shehu Shagaria lowered it to 5% in 1981; General Buhari subsequently lowered it to 1.5%; General Babangida raised it to 3%; and Ken Saro Wiwa's lobbying forced the government to elevate it to 13% as it is in the current Nigerian constitution (Offiong, 2012). From the foregoing, we can infer that there is still dispute about the income distribution formula despite government efforts through multiple commissions to address the issues.



Conflict and turmoil have been caused in Nigeria by the pursuit for true federalism itself. The debate over the revenue distribution formula and the need for resource control are clear examples of true federalism. Additionally, the construction of other states has been demanded in order to provide equal geographic and economic strength and soothe the anxieties of minority groups due to state inequality and the marginalization of minority groups inside the State.

Both internationally and domestically, several research investigations have been done. As one example, (see Stewart 2010, Gurr, 1993, and Tilly, 1999). However, Nigerians continue to lose their lives in wars. However, this research paper seeks to diverge from the earlier work in that it examines resource control and revenue allocation sharing formula-related conflicts rather than violent conflicts generally. It also seeks to determine whether fiscal equalization has any effect on conflicts and economic development in Nigeria. The study makes an effort to address the following particular queries in accordance with the investigation: Does fiscal equalization have any effect on Nigerian conflicts? How has fiscal equalization impacted Nigeria's economic growth? Does Nigeria's economic growth in any way suffer as a result of conflict? The following precise study goals are necessary in order to respond to the research issues raised above: (i) Analyze how fiscal equalization affects the conflict in Nigeria. (ii) Assess how fiscal equalization has affected Nigeria's economic growth. (iii) Evaluate how conflicts have affected Nigeria's economic growth.

The time frame covered by the study is from 2010 to 2020. This is due to the numerous violent conflicts that Nigeria had during this time in all six geopolitical zones. Federal and state governments are covered by the study. There were 36 states total, and 22 were chosen, with at least one from each geopolitical region. The following states are included in this group: Anambra, Akwa-Ibom, Bauchi, Bayelsa, Cross River, Delta, Ebonyi, Edo, Ekiti, Gombe, Jigawa, Kano, Kogi, Lagos, Niger, Ondo, Ogun, Osun, Oyo, River, and Zamfara. The aforementioned states were utilized to analyze how fiscal equalization, conflicts, and economic growth in Nigeria relate to one another. The state information is necessary because fiscal equalization, a key variable for this study that addresses horizontal sharing across the States, provides the basis for the state data. In order to determine how fiscal equality might affect conflicts and economic growth in Nigeria, we chose the aforementioned States. State per capita gross domestic product (SPCGDP) and equalization payment to 36 States from the federation account (EQP), which serve as proxies for fiscal equalization, as well as other control variables like internally generated revenue (IGR) and total debt owed by the States (DEB), were used as variables in the analysis.

## **Literature Review and Theoretical Framework**

### **Literature Review**

This chapter focuses on three essential aspects of literature review namely, the conceptual issues or review, the theoretical review and the empirical literature review.

### **Conceptual Issues**

Under conceptual issues, fiscal equalization, conflicts, and economic development are discussed.

### **Fiscal Equalization**

Transferring financial resources between jurisdictions with the goal of balancing off inequalities in the ability to raise taxes or the cost of providing public services is known as fiscal equalization. Inter-jurisdictional redistribution is the goal of fiscal equalization, and the primary policy concerns are making sure that redistribution plans minimize trade-offs and distortions. This suggests that redistribution should be carried out in a way that prevents politicians from using resources intended for one region for their own personal gain, which could lead to issues.

Since not all of the states are endowed with mineral or natural resources, there is an imbalance in terms of capacity for internally generated revenues, and federal allocation to the States also varies, fiscal equalization can be understood in the context of this work as the forty (40) percent of the federal allocation to the States that is shared equally among the 36 States of the federation, irrespective of population, landmass, and internally generated revenue, etc.

### **Conflicts**

Conflict is a natural and unavoidable part of being human. However, both a violent confrontation and an abnormality can be avoided. Francis (2007), for instance, defines conflict as "the pursuit of incompatible interests and goals by different groups". He claims that using force and armed violence to further opposing and specific interests and purposes constitutes engaging in an armed conflict. The researcher goes on to define conflict as an altercation or disagreement between two opposed organizations or individuals that is frequently violent. Conflict results from perceived or actual injustice, just as peace does from justice. Conflict in this work can be understood as discontent brought on by regional or community inequities in economic status. For example, competition for natural resources, oil money, or the distribution of revenue formulae throughout the regions has fueled violence between numerous ethnic groups. Additionally, conflict in this context refers to the upheaval or discontent of the areas, towns, or places where mineral resources are found but where such resources are not under their control. The frequency of many violent conflicts that take place in the nation throughout time, such as militia attacks in the Niger Delta, deadly Boko Haram protests, political conflicts, banditry, Fulani herders, etc., serves as the measure of conflict for this study.

### **Economic Development**

In order to increase quality of life, including a cleaner environment, better education, good health care delivery, and nutrition, economic development must go beyond eliminating poverty, inequality, and unemployment. Walter Rodney argues that development equals the ability for self-sustaining expansion to support this claim.

However, for the purposes of this study, the concept of economic development views the general welfare of the populace as the ultimate goal of development, in which case we must determine whether poverty and unemployment are declining and how the distribution of increases in gross national product or national income is changing. The Human Development Index (HDI), household per capita spending, unemployment, poverty, and GDP per capita are only a few examples of the various indicators of economic development. However, this study employed the gross domestic product (GDP) per capita (SPCGDP) of the States as a stand-in for economic development.

### **Theoretical Issues**

The sharing formula for the financial resources generated and jointly owned by the federating units is one of the biggest obstacles in a federating system. When three levels of government—federal, state, and local—share fiscal resources, like in Nigeria, public finance departments are typically involved. In this regard, the study of how well the fundamental concepts of horizontal justice and effective resource allocation are met in the setting of fiscal federalism has been the focus of public finance specialists. The following theories can be examined, though: Theory of Fiscal Federalism, Theory of Conflicts, Endogenous Growth Theory, and Buchan Fiscal Residuum Theory.

### **Buchan Fiscal Residuum Theory**

In 1982, Buchan's Fiscal Residuum Theory was introduced. According to the theory, one should consider the whole fiscal demands on an individual as a more relevant method to solving the issues with fiscal federalism. The theory's basic argument is that the government should treat all regions equally, regardless of their ability to pay taxes, because each one contributes to the federation's advancement. The equalization payout in question is this. Due to this, Buchan agreed to a less desirable intergovernmental fiscal adjustment method known as "Unconditional Equalization Grants". This theory's applicability to the study can be illustrated in the example of Nigeria, where some States have weak national income production. At the same time, some are quite successful at bringing in money for the country, particularly the States that produce oil as well as the industrial and commercial States. According to residual viewpoints, it can be noted that some of the poorer States in the nation may have a high tax burden. However, in order to share equally in budgetary federalism and promote equitable growth among the States, all the federating States will adhere to the unconditional equalization theory.

### **Conflict Theory**

Conflict theory, first postulated by Karl Marx in 1848, States that society is in a state of perpetual conflict because of competition for limited resources. Conflict theory holds that social order is maintained by dominance and power rather than by consensus and conformity. According to the theory, those with wealth and power try to hold on to it by any means possible, chiefly by suppressing the poor and the powerless. The Central tenets of conflict theory are social inequality, the division of resources, and the conflicts between different socio-economic classes, namely the bourgeoisie and the proletariat. These imply that conflict is a function of limited resources.

### **Theory of Fiscal Federalism**

An economist from Germany and the United States named Richard Musgrave first proposed the Theory of Fiscal Federalism in 1959. According to the theory, in order to ensure economic stability across the board for the federation, the federal government should address the disparities in wealth distribution across the States. The key message here is that the State governments should be in charge of allocating resources to particular sectors, like education and others, while the federal government should take the lead in resource redistribution. According to this theory, the government sector has three roles. These include eradicating income disparity, ensuring macroeconomic stability, and addressing different aspects of market failure. The maintenance of macroeconomic stability and the rectification of market failures fall under the purview of the central government. In contrast, addressing income

disparity is a joint responsibility of the federal government, state governments, and local governments (Ozon-Eson 2005)

### **Empirical Literature**

#### **Fiscal Equalization and Conflicts**

Asadu and Nwofia (2018), investigated Nigeria's fiscal federalism and disparities in revenue distribution. The results demonstrate how vulnerable Nigeria is to outside shocks because it is a consumptive mono-economy. Additionally, research conducted in the Nigerian Niger Delta region by Adangor (2015), looked at the distributive justice movement and the derivation principle. In light of this, the study suggests raising the derivative principle from 13 percent to 30 percent, with a further advancement to 50 percent by 2023. Barrios and Martinez-López (2016) investigated state government borrowing in Canada, Germany, and Spain in relation to fiscal equalization schemes. Ordinary Least Squares (OLS) were used to assess the link between the gross domestic product per capita and the internal revenue generated by state governments. The findings indicate that States with higher average borrowing might be either wealthy or impoverished. This outcome provides a solid foundation for the implementation of current fiscal equalization schemes. According to the study, fiscal equalization assisted in lowering state or regional differences in public borrowing. Ewetan, Ike, and Ige (2015), looked into a few pertinent fiscal federalism-related concerns in Nigeria. The study comes to the conclusion that if the nation established efficient structures that enable decentralization to function reasonably well. Decentralization, however, has the potential to be a useful strategy for resolving vertical disputes across levels of government. Panel analysis is used by Guillem and Joan (2014) to investigate the Fiscal Imbalance in Asymmetric Federal Regimes in Spain. The outcome showed that the best way to resolve the dispute and refocus the fiscal-territorial discussion in Spain is through transparency. Issues related to fiscal equalization that are universal were examined by Hansjrg and Claire (2008). The analysis made use of primary data. The outcome demonstrates that, on average, equalization greatly reduces differences in fiscal ability by a third. Additionally, the outcome demonstrates that revenue equalization can lessen taxation and development efforts, particularly in states or regions with higher rates of poverty.

#### **Fiscal Equalization and Economic Development**

Adeleke (2013) investigates Nigeria's issues with revenue allocation and resource control and their implications for national peace. Data from 1985 to 2019 were analyzed using Ordinary Least Squares (OLS). The extent of human casualties in the continuous conflict in the oil-producing areas is incalculable, aside from monetary and tangible damages. In order to achieve this, a way must be found to put an end to the current hostilities and allow Nigeria to experience peace and development. According to true fiscal federalism, the study suggested that the federal government let the oil-producing regions manage their own resources. 50% of the profits from the resources within their jurisdiction should go to the regions that produce oil, at the very least. There will be peace and economic prosperity as a result of doing so. The Slovak Republic's fiscal equalization and regional growth were studied by Sona (2014). Utilizing OLS, the study's conclusion demonstrates how fiscal equalization contributes to economic development by bridging the gap between some local authorities' fiscal capacity and spending demands and by reducing fiscal inequities. Dibua (2004) went on to emphasize other issues that the Niger Delta is dealing with, such as on-going gas flaring and oil spills, all of

which have a negative impact on the environment. Before oil was discovered, these villages' main sources of income were farming and fishing. As a result, these activities were severely restricted, leaving the majority of Niger Delta residents in extreme poverty and hardship. Ikeji (2011), claims that the fight for control of the country's resources has been entwined with political strife and has its roots in the regional divide. Governance over resources has therefore been linked to political factors that affect how wealth is distributed from the federation account. Using two regional models of endogenous growth, Ogawa and Yakita (2009) investigate the relationship between fiscal decentralization, fiscal equalization transfer, and economic growth. According to the findings, fiscal equalization has no effect on how quickly interregional growth converges. This suggests that state or regional economic growth is not stimulated by budgetary equalization.

### **Conflict and Economic Development**

Abul-Azad, Emil, and Heidi (2018), looked at conflicts and violence in Nigeria. The study employed a telephone survey to gather data from 2010 to 2017. The findings indicated that there was more conflict in all three zones in 2016 compared to 2010. This implies that Nigeria's economic growth is negatively impacted by conflicts. Ijeoma (2014) used a field survey approach to collect data in order to assess the cost of war on Nigeria's economic development. The findings indicate that conflicts have a negative and significant impact on the country's economic development. Clifford and Christopher (2020) investigate how conflict affects economic expansion. The Uppsala Conflicts Data Program provided time series data for the study, which covered the years 1975 to 1995 (UCDP). As the outcome demonstrates, business cannot prosper in a conflict. This indicates that, in addition to causing death and damage to material and human capital, war has a detrimental impact on economic activity. As a measure of economic development, war lowers GDP per capita. The causes and effects of ethnic conflicts in Nigeria were studied by Ali and Yahaya (2019). OLS, or ordinary least squares, were used in the investigation. According to the report, politicians and the political class created ethnic conflict in order to further their own agendas. Ordinary least squares (OLS) were used by Achimugu et al. (2013) to examine some of these crises in Nigeria. According to the report, ethnicity is still the primary cause of conflict in Nigeria. Poverty is one of its multiplier effects, which ultimately has an impact on the country's economic development and progress. Pieter and Marijke (2012) explored the evidence from Rwanda about the effect of military wars on economic performance (2012). The study, which used multiple regression analysis, found that the economic activity of households and places experiencing high levels of conflict is falling behind. This indicates that Rwanda's economic performance is adversely affected by conflict.

### **Research Methodology**

#### **Research Design**

The study uses an ex post facto (after the fact) design to investigate how fiscal equalization, conflict, and economic progress are related in Nigeria. This is due to the fact that before the investigation was done, the events had already occurred. Inferences about the connection or relationship between fiscal equalization, conflicts, and economic development in Nigeria are made without a current interaction between the dependent and independent variables because the researcher has no direct control over the independent variables (Ndiyo, 2005). The design is based on different econometric techniques, including trend analysis of stylized facts on

some of the indicator variables of interest and panel unit root tests, panel cointegration tests, and so forth.

Because a single theory was unable to adequately explain the linkages between fiscal equalization, conflicts, and economic progress in Nigeria, the study utilized an eclectic theoretical approach in order to characterize this model. Buchan's Fiscal Residuum Theory, Conflict Theory, and Endogenous Growth Models are the theories that were embraced. The study used Dynamic Ordinary Least Square (DOLS) because it can regress any I(1) variable on other I(1) or I(0) variables as well as lead and lag the first differences of any I(1) variable, which makes it better suited to deal with endogeneity or simultaneity bias in a model. As a result, the study used the panel DOLS (PDOLS) and Granger causality test, and the estimation of individual states used the least squares dummy variable (LSDV). The study modeled two equations using the theoretical and empirical materials that were reviewed. Based on the postulation of theories about the roles of government intervention in the system to provide the desired economic development in Nigeria, the first equation explained the impact of fiscal equalization on conflicts in Nigeria, and the second equation explained the impact of fiscal equalization and conflicts on economic development in Nigeria.

Fiscal equalization and conflicts equation can be functionally presented as:

$$\text{CONF} = F(\text{FEQ}, \text{DEBT}, \text{DTH}, \text{IGR}) \quad 1$$

Where:

CONF= Conflict and violence attacks, (over the years. It is the sum of frequency of conflicts attack ranging from conflicts arising from revenue sharing formula, religious conflict, terrorism and communal conflicts etc.)

DTH= total number of death due to conflict attacks.

FEQ= Fiscal Equalization Payment to the 36 states from the federation account.

DEBT= Total debts owed by the State.

IGR=Internally Generated Revenue of the State.

Fiscal equalization, conflicts and economic development equation will functionally presented below

$$\text{SPCGDP} = F(\text{FEQ}, \text{CONF}, \text{SCEXP}, \text{IGR}, \text{DEBT}) \quad 2$$

Where:

SPCGDP=States Per capita Gross Domestic Product is a proxy for economic development. It is arrived at by dividing the states' nominal gross domestic products by the states' projected population over the years.

SCEXP= State capital expenditure is a proxy for investment. Since investment is a component of growth and development.

All other variables still remain as earlier defined.

### Data

The dataset for this study is drawn from different sources such as the Armed Conflicts Location and event data (ACLED) 2020 publication, Uppsala Violence and Conflicts Data publication 2020 edition, Budgeting ([www.budgit.com](http://www.budgit.com)) on States publication, National Bureau for Statistics (NBS), demographic statistic Bulletin 2019 publication, Office of the Accountant General of the Federation and Central Bank of Nigeria (CBN) Annual Report

publication.

### Model Estimation Procedure

Several procedures were followed systematically when estimating the specified panel dynamic Ordinary Least Square regression equations for the study. The procedures were panel unit root test, panel cointegration test, panel dynamic ordinary least square, Granger causality test and Least Square dummy variables estimation.

### Panel dynamic ordinary least square estimation procedures for the three equations

Equation 3.1 written in the econometrics form thus

$$LogCONF_{it} = \alpha_0 + \alpha_1 LogFEQ_{it} + \alpha_2 LogDEBT_{it} + \alpha_3 LogDTH_{it} + \alpha_4 LogIGR_{it} + \mu_{it} \quad 3$$

Where:

$i$  = different cross sectional (various States)

$t$  = time covered for the study

$a_0$  = Constant parameter/Intercept

$a_1 - a_4$  = Coefficients of independent variables

$\mu_i$  = Error term

Where:  $a_0$  to  $a_4$  are parameters to be estimated and  $\mu_i$  is the error term.  $i, t$  represents conflicts at state  $i$  at time  $t$

The signs of the coefficients of the parameters as theoretically expected are as follows.

$$a_0 > 0, a_1 < 0, a_2 > 0, a_3 > 0, a_4 < 0,$$

Therefore, equation 3.3 transformed into panels dynamic Ordinary Least Square Model for equation one as follows:

$$conf_{it} = \alpha_i + \alpha_{1i} feq_{i,t} + \alpha_{2i} debt_{i,t} + \alpha_{3i} dth_{i,t} + \alpha_{4i} igr_{i,t} + \sum_{k=-K_i}^{K_i} \gamma_{i,t} \Delta feq_{i,t-k} + \sum_{k=-K_i}^{K_i} \delta_{i,t} \Delta debt_{i,t-k} + \sum_{k=-K_i}^{K_i} \tau_{i,t} \Delta dth_{i,t-k} + \sum_{k=-K_i}^{K_i} \otimes_{i,t} \Delta igr_{i,t-k} + \epsilon_{i,t}$$

where all variables remain as previously defined with lags lead as denoted respectively. The PDOLS estimation for each regressor can be built up as follows:

Where,

$\alpha_{1i}, \alpha_{2i}, \alpha_{3i}$ , and  $\alpha_{4i}$ , are coefficient of the long run model

$\gamma_i, \delta_i, \tau_i, \otimes$  are the short run coefficient of the model.

$$\hat{\beta}_{brrptDOLS} = I^{-1} \sum_{i=1}^I \hat{\beta}_{DOLS,i} \quad 5$$

Where  $\hat{\beta}_{DOLS,i}$  is the DOLS estimator applied to cross-section

Equation 3.2 written in the econometrics form thus

$$LogSPCGDP_{it} = \beta_0 + \beta_1 i LogFEQ_{it} + \beta_2 LogCONF_{it} + \beta_3 LogSCEXP_{it} + \beta_4 LogDEBT_{it} + \beta_5 LogIGR_{it} + \mu_{2it} \quad 6$$

Where:

$i$  = different cross sectional (various States)

t = time covered for the study

$\beta_0$  = Constant parameter/Intercept

$\beta_1 - \beta_4$  = Coefficients of independent variables

$\mu_2$  = Error term

Where:  $\beta_0$  to  $\beta_5$  are parameters to be estimated and  $\mu_2$  is the error term.  $i, t$  represent conflicts at state  $i$  at time  $t$

The signs of the coefficients of the parameters as theoretically expected are as follows.

$\beta_0 > 0, \beta_1 > 0, \beta_2 < 0, \beta_3 > 0, \beta_4 < 0$ , and  $\beta_5 > 0$

Equation 3.6 was transformed into panel dynamic OLS Model for equation two as below

$$spcgdp_{i,t} = \alpha_i + \beta_{1i} feq_{i,t} + \beta_{2i} conf_{i,t} + \beta_{3i} igr_{i,t} + \beta_{4i} debt_{i,t} + \beta_{5i} scexp_{i,t} + \sum_{k=-K_i}^{K_i} \lambda_{i,t} feq_{i,t-k} + \sum_{k=-K_i}^{K_i} \eta_{i,t} \Delta conf_{i,t-k} + \sum_{k=-K_i}^{K_i} \phi_{i,t} \Delta igr_{i,t-k} + \sum_{k=-K_i}^{K_i} \rho_{i,t} \Delta debt_{i,t-k} + \sum_{k=-K_i}^{K_i} \Omega_{i,t} \Delta scexp_{i,t-k} + \varepsilon_{i,t}$$

Where all variables remain as previously defined and denoted the lags and lead respectively; while the PDOLS estimation for each regressor can be built up as follows:

While

$\beta_1, \beta_2, \beta_3, \beta_4$ , and  $\beta_5$ , are coefficient of the long run model  
 $\lambda_i, \eta_i, \phi_i, \rho_i$ , and  $\Omega_i$  are short run coefficient of the model.

$$\hat{\theta}_{brptDOLS} = I^{-1} \sum_{i=1}^I \hat{\theta}_{DOLS,i} \quad 7$$

Where  $\hat{\theta}_{DOLS,i}$  is the DOLS estimator applied to cross-section  $i$

Equation 3.1 written in the econometrics form thus

$$\text{LogSPCGDP}_{i,t} = \lambda_{0i} + \lambda_{1i} \text{LogCONF}_{i,t} + \lambda_{2i} \text{LogSCEXP}_{i,t} + \lambda_{3i} \text{LogDEBT}_{i,t} + \lambda_{4i} \text{LogIGR}_{i,t} + \mu_{3it} \quad 8$$

Where:

$i$  = different cross sectional (various States)

$t$  = time covered for the study

$\lambda_0$  = Constant parameter/Intercept

$\lambda_1 - \lambda_4$  = Coefficients of independent variables

$\mu_j$  = Error term

Where:  $\lambda_0$  to  $\lambda_4$  are parameters to be estimated and  $\mu_j$  is the error term.  $i, t$  represent conflicts at state  $i$  at time  $t$

The signs of the coefficients of the parameters as theoretically expected are as follows.

$\lambda_0 > 0, \lambda_1 > 0, \lambda_2 > 0, \lambda_3 < 0, \lambda_4 > 0$ ,

Therefore, equation 3.1 transformed into panels dynamic OLS Model for equation three as follows:

$$spcgdp_{i,t} = \alpha_i + \tau_{1i} conf\_feq_{i,t} + \tau_{2i} scexp_{i,t} + \tau_{3i} debt_{i,t} + \tau_{4i} igr_{i,t} + \sum_{k=-K_i}^{K_i} \eta_{i,t} \Delta conf\_feq_{i,t-k} + \sum_{k=-K_i}^{K_i} \phi_{i,t} \Delta scexp_{i,t-k} + \sum_{k=-K_i}^{K_i} \sigma_{i,t} \Delta debt_{i,t-k} + \sum_{k=-K_i}^{K_i} \psi_{i,t} \Delta igr_{i,t-k} + \varepsilon_{i,t} \quad 9$$



where all variables remain as previously defined with lags lead as denoted respectively. The PDOLS estimation for each regressor can be built up as follows:

Where:

$\tau_{1i}, \tau_{2i}, \tau_{3i}$ , and  $\tau_{4i}$ , are coefficient of the long run model

$\eta_i, \phi_i, \sigma_i, \psi$  are the short run coefficient of the model.

$$\hat{Y}_{brptDOLS} = I^{-1} \sum_{i=1}^I \hat{Y}_{DOLS,i}$$

10

Where  $\hat{Y}_{DOLS,i}$  is the DOLS estimator applied to cross-section  $i$

### Data Presentation, Analysis and Discussion of Findings

#### Panel Unit Root Tests

**Table 1: Panel Unit Root Test results at Levels and at first difference**

Variable	Levin, Lin and Chu Test Stat.	Prob.	Im-Pesaran & Shin W-Test Stat	Prob.	ADF-Fisher Test Stat.	Prob.	PP-Fisher Chi-Square Test Stat.	Prob.	Overall Test Decision
SPCGDP	-4.74395	0.0000	-2.72206	0.0032	68.5023	0.0104	73.4926	0.0003	Reject
CONF	-5.22536	0.0000	-3.08534	0.0010	77.1031	0.0015	161.151	0.0000	Reject
FEQ	-19.1316	0.0000	-9.01957	0.0000	170.312	0.0000	64.0287	0.0259	Reject
DEBT	-2.96050	0.0015	1.26808	0.8976	29.7659	0.9503	37.9048	0.7292	Accept
DTH	-1.5096	0.0656	-1.11914	0.1315	53.9404	0.1448	132.209	0.0000	Accept
IGR	-10.4322	0.0000	0.90282	0.8167	51.4582	0.2049	51.5463	0.2025	Accept
<b>SCEXP</b>	<b>-4.84941</b>	<b>0.0000</b>	<b>-2.24466</b>	<b>0.0124</b>	<b>64.8962</b>	<b>0.0218</b>	<b>94.2283</b>	<b>0.0000</b>	Reject
<b>First difference</b>									
SPCGDP	-4.27043	0.0000	-1.69001	0.0455	56.0612	0.1050	144.088	0.0000	Reject
CONF	-11.0294	0.0000	-6.58939	0.0000	133.312	0.0000	306.671	0.0000	Reject
FEQ	-16.0514	0.0000	-6.26054	0.0000	131.345	0.0000	62.4492	0.0349	Reject
DEBT	-7.24744	0.0000	-2.42534	0.0076	68.5662	0.0103	118.740	0.0000	Reject
DTH	-4.35793	0.0000	-4.41812	0.0000	100.501	0.0000	341.629	0.0000	Reject
IGR	-10.4322	0.0000	-4.94652	0.0000	96.8576	0.0000	183.281	0.0000	Reject
SCEXP	-3.7763	0.0001	-3.38335	0.0004	82.2770	0.0002	212.173	0.0000	Reject

**Source:** Author's computation 2023 using eview 10

The panel unit root test displayed in Table 1 shows that four of the variables except the DEBT, DTH, and IGR were stationary at levels using the common unit root process as reported by Levin, Lin, and Chu, Im-pesaran & Shin, ADF-Fisher, and PP-Fisher probabilities. DEBT, DTH, and IGR were not stationary at level using the above criteria. Using individual unit root processes at levels as reported by Im-Pesaran and Shin probability values, ADF-Fisher Chi-Square test probability values, and PP-Fisher Chi-Square test probability values, again, all the

variables except DEBT, DTH, and IGR were stationary at level. On the overall test results putting the Levin, Lin, and Chu common unit root process and Im-Pesaran and Shin, ADF-Fisher Chi-Square, and PP-Fisher Chi-Square individual unit root tests together, only the DEBT, DTH, and IGR were not stationary at levels. The disagreement between the common unit root process and the individual unit root process prompted the panel unit root test at first. The result shows that all the series became stationary at the first difference. From the Levin, Lin, and Chu common unit root process, all the variables became stationary at the first difference, even at the one (1) percent level of significance. Using the individual unit root process at first difference, both the Im-Pesaran and Shin, ADF-Fisher Chi-Square p-values, and PP-Fisher Chi-Square p-values have unanimously agreed with the stationarity of the variables in the model even at the one (1) percent level of significance.

### Panel Co-integration Tests results (Pedroni's Co-integration)

To examine the existence of long run relationship among the variables, a panel co-integration test in the panel framework was carried out and the result from eleven main different test statistics as explained in the methodology is presented in the table 2 below:

**Table 2: Pedroni's Co-integration Test results**

Test Statistic	No Deterministic Trend	Deterministic Intercept and Trend	No Deterministic Intercept or Trend
Panel V-Statistic (Prob) (0.9771)	-2.718827 (0.9967)	-4.531177 (1.0000)	-1.997744
Panel rho-Statistic (Prob) (0.9136)	2.399947 (0.9918)	3.906920 (1.0000)	1.363059
Panel PP-Statistic (Prob) (0.0000)	-11.07134 (0.0000)	-16.27956 (0.0000)	-7.831154
Panel ADF-Statistic (Prob) (0.0012)	-4.693876 (0.0000)	-5.726784 (0.0000)	-3.048041
Panel V-Weighted Stat (Prob) (0.9952)	-3.331589 (0.9996)	-5.121867 (1.0000)	-2.592509
Panel rho -Weighted Stat (Prob) 1.617545(0.9471)	2.512357 (0.9940)	4.085796 (1.0000)	
Panel PP-Weighted Stat (Prob) (0.0000)	-10.45898 (0.0000)	-15.89959 (0.0000)	-6.399519
Panel ADF-Weighted Stat (Prob) (0.0611)	-2.804726 (0.0025)	-4.325409 (0.0000)	-1.545674
Group rho-Statistic (Prob) (0.9999)	4.526588 (1.0000)	5.432321 (1.0000)	-3.797387
Group PP-Statistic (Prob) (0.0000)	-17.07060 (0.0000)	-26.17812 (0.0000)	-10.15472
Group ADF-Statistic (Prob) (0.0003)	-5.077080 (0.0000)	-4.498223(0.0000)	-3.298085

**Source:** Author's computation (2023) using eview 10  
*N.B (Probability values are in parenthesis)*

The results of no deterministic trend from Table 2 indicates that out of the eleven test statistics, six out of eleven have significant probabilities at 5per cent level. Pedroni's co-integration test thus confirms the existence of at least six co-integrating equations in the three models. The result thus confirms the existence of long run relationship among the variables of the study.

Pedroni's co-integration test with a deterministic trend and intercept which serves a confirmatory test to the test without trend again, six out of eleven have significant probabilities at 5per cent level. Pedroni's co-integration test thus confirms the existence of at least six co-integrating equations in the model. The result thus confirms the existence of long run relationship in the models. Finally, Pedroni's co-integration test with no deterministic trend or intercept shows that five out of eleven have significant probabilities at 5per cent. Pedroni's co-integration test thus confirms the existence of at least five co-integrating equations in the model. The result thus confirms the existence of long run relationship in the models. The Pedroni's co-integration test is supported by the Kao co-integration test for equation one and two presented in table 2 and 3 below respectively.

**Table 3: Panel Kao residual Cointegration Test for Fiscal equalization and conflicts**  
**Series: Log(Conf) log(Feq) log(debt) Dth IGR**

	t-Statistic	Prob.
ADF	-1.339928	0.0301
Residual variance	0.931595	
HAC variance	0.524017	

**Sources:** Author's computation (2023) using eview 10

**Table 4: Panel Kao Residual Cointegration Test for fiscal equalization, conflicts and economic development**  
**Series: SPCGDP Log (Conf) log (Feq) SCEXP log(debt) IGR**

	t-Statistic	Prob.
ADF	-1.900222	0.0287
Residual variance	41.25005	
HAC variance	45.86368	

**Sources:** Author's computation (2023) using eview 10

The Kao residual co-integration is based on whether or not there exists a long run relationship among variables in a model. The null hypothesis states that, there is no long run relationship among the variables in the models. It was test at 5 per cent level of significant. The Kao test which depends on the ADF, t-statistic and probability value shows that a long run relationship existed between the variables in the two equations of the panel model. Since the two tests, Pedroni and Kao tests have unanimously justified co-integration; panel co-integration test has given additional credence and validity to the long run relationship existing between the variables in the panel regression model for the selected twenty-two States.

**Estimated Results of fiscal equalization and conflicts in Nigeria**

The results in table 4 shows that all the variables such as death rate as a result of conflicts attack (DTH), debts owed by government, (DEBT), Internally generated revenue (IGR) were positive and statistically significant in explaining their impact on conflicts (CONF) in the selected States in Nigeria in the long run. Fiscal equalization has negative and significant

impact on conflicts in Nigeria. These means that an increase in fiscal equalization by one unit, conflicts in Nigeria would reduce by 1.117955 units. In another word, one per cent increase in fiscal equalization payments in Nigeria, resources-based conflicts would decrease approximately by 11.18 per cent. The positive signs on the coefficient variables such as internally generated revenue (IGR) and debt are not in tandem with a priori expectations of a negative sign. It was only the coefficient of death that is in line with a priori expectation which implies that increase in conflicts will result in increase in numbers of death. Given that the incidence of serious conflict in the country, economic activities will be low which will affect IGR. This implies that the coefficient of IGR is supposed to be negative instead of positive. This means that in real term, one per cent increase in debt, conflicts would increase by 73.63 per cent. This result might be as a result of high-income inequality among the twenty-two States which encourages increase in borrowing which make some of the States to be highly indebted. Since the money borrowed are not been invested into productive venture rather it was used to pay staff salary and other miscellaneous. FEQ has about 11.18 per cent ability to reduce resources-based conflict in Nigeria approximately. Furthermore, from the estimated results it is evident that the model is a good model based on the analysis of some diagnostic checks. R-squared of 0.6002 indicate that about 60% of the total variations in the dependent variable (CONF) have been explained by the independent variables. About 40% of the total variation is left unexplained and attributed to other variables not captured by the model but represented by the error term ( $\mu$ ). The model therefore has a good fit and a high predictive power.

**Table 5: Long run result for equation one**  
**Dependent Variables: CONF**  
**Method: Panel Dynamic Least Square (DOLS)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(FEQ)	-1.117955	0.316481	-3.532457	0.0005
LOG(DEBT)	0.736251	0.112441	6.547903	0.0000
DTH	0.003370	0.000687	4.902077	0.0000
IGR	0.007197	0.003669	1.961451	0.0511
R-squared	0.600242	Mean dependent var	2.131086	
Adjusted R-squared	0.553974	S.D. dependent var	1.359571	
S.E. of regression	0.907992	Sum squared resid	178.0809	
Long-run variance	0.957960			

**Sources:** Author's computation (2021) using eview 10

#### **VAR Granger Causality result for fiscal equalization and conflicts in Nigeria**

In other to confirm the impact of fiscal equalization on conflicts in Nigeria, granger causality test was conducted to ascertain the direction of causality between the variables of study. From Table 5 below, the first section where conflicts (CONF) is the dependent variable, debt (DEBT) have positive and significant causative impact on conflicts in Nigeria individually while death (DTH), internally generated revenue (IGR) and fiscal equalization (FEQ) have positive but not significant causative impact on conflicts in Nigeria individually. But the joint causation of the explanatory variables on conflicts shows a positive and significant level of causation.

In the second section of the table 5 it was discovered that CONF, IGR and DTH have no significant causative impact on FEQ individually but only DEBT that individually causes FEQ. When the causative impacts of the variables are jointly considered on FEQ, the result indicates positive and significant level of causation. From the result of the third section, four and five section shows that when DEBT was the dependent variable, all the variables such as CONF, FEQ, DTH and IGR do not individually and jointly granger causes DEBT in Nigeria. Also when death was the dependent variable only CONF that has positive and significant causative impact on death in Nigeria individually while other variables such as FEQ, DEBT and IGR individually do not have significant causative impact on DTH. When the causative impacts of the variables are jointly considered on DTH, result revealed positive but no significant level of causation. Finally, when IGR was dependent variable, all the variable individually and jointly have positive but no causative impact on IGR in Nigeria.

**Table 6: Granger Causality Tests Results for fiscal equalization and conflicts in Nigeria**

Dependent variable: LOG(CONF)			
Excluded	Chi-sq	df	Prob
LOG(FEQ)	29.78883	2	0.3497
LOG(DEBT)	19.54233	2	0.0001
DTH	3.605232	2	0.1649
IGR	0.006079	2	0.9970
All	51.13701	8	0.0000
Dependent variable: LOG(FEQ)			
Excluded	Chi-sq	df	Prob
LOG(CONF)	8.089761	2	0.3175
LOG(DEBT)	9.405832	2	0.0091
DTH	2.764933	2	0.2510
IGR	0.722380	2	0.6968
All	25.23847	8	0.0014
Dependent variable: LOG(DEBT)			
Excluded	Chi-sq	df	Prob.
LOG(CONF)	0.503110	2	0.7776
LOG(FEQ)	2.276893	2	0.3203
DTH	1.085357	2	0.5812
IGR	4.921224	2	0.0854
All	11.10937	8	0.1956
Dependent variable: DTH			
Excluded	Chi-sq	df	Prob.
LOG(CONF)	5.768651	2	0.0559
LOG(FEQ)	5.209613	2	0.0739
LOG(DEBT)	0.277971	2	0.8702
IGR	4.263916	2	0.1186
All	14.76430	8	0.0639
Dependent variable: IGR			
Excluded	Chi-sq	df	Prob.
LOG(CONF)	4.828789	2	0.0894
LOG(FEQ)	3.876857	2	0.1439
LOG(DEBT)	0.666603	2	0.7166
DTH	0.778226	2	0.6777
All	10.94005	8	0.2051

Source: Author's computation (2023) using eview 10

**Estimated Results of fiscal equalization, conflicts and economic development in Nigeria**

Table 6 shows the estimated panel dynamic ordinary least squares result for equations two, which aim at achieving objectives two and three of this study. The coefficient of fiscal equalization (FEQ) shows a positive and statistically significant value given its p-value of 0.0041. This means that with a 1 percent increase in fiscal equalization, economic development would increase by 1.19 percent in the long run, *ceteris paribus*. In the real world, an increase in fiscal equalization will in turn increase economic development in Nigeria in the long run. However, these results show that fiscal equalization payments would lead to economic development in Nigeria in the long run.

Also, state capital expenditure (SCEXP), a proxy for state investment and internally generated revenues (IGR), has a negative and significant impact on economic development in Nigeria in the long run. These are inconsistent with the relevant *a priori* expectations. These might be the results of the fact that some States are not investing the money that is allocated for capital investment but rather misuse the money, which might affect economic development in the long run. Also, the negative impact of IGR on economic development might be the result of the attitudes of some state governments towards revenue generation. Some States in Nigeria fall into the trap of waiting for fiscal equalization payments or federal allocations without working out a modality for increasing their IGR.

However, the co-efficient of conflicts had a negative and significant effect on economic development given its p-value of 0.0046. This is consistent with *a priori* expectations, showing that with a one per cent increase in conflicts, economic development would decrease by 19.17 per cent. In the long run, conflicts hamper the level of economic development in Nigeria. The coefficient of debt is negative and significant, with a p-value of 0.0001. This result is consistent with *a priori* expectations and indicates that with a one per cent increase in debts, economic development would decrease by 24.05 per cent. However, an adjusted R-squared of 0.9435 indicates that about 94.4 per cent of the total variations in the dependent variable (SPCGDP) have been explained by the independent variables. About 5.6 per cent of the total variation is left unexplained and attributed to other variables not captured by the model but represented by the error term. The model therefore has a good fit and strong predictive power.

**Table 7: Long run result for equation two**

Dependent Variable: SPCGDP

Method: Panel Dynamic Least Squares (DOLS)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(CONF)	-0.191719	0.143983	-1.331541	0.0046
LOG(FEQ)	1.946584	0.670172	2.904602	0.0041
SCEXP	-0.009175	0.002420	-3.791581	0.0002
LOG(DEBT)	-2.404759	0.614162	-3.915512	0.0001
IGR	-0.020326	0.010334	-1.966987	0.0506
SPCGDP(-1)	0.566356	0.047807	11.84670	0.0000
R-squared	0.943592	Mean dependent var	51.97670	
Adjusted R-squared	0.935660	S.D. dependent var	237.5744	
S.E. of regression	60.26148	Sum squared resid	697237.6	
Long-run variance	1.567963			

**Source:** Author's computation (2021) using *eview* 10

### Granger Causality result for fiscal equalization, conflicts and economic development in Nigeria

From Table 7 SPCGDP as the dependent variable shows that Conflicts (CONF) and Debt do not individually and significantly cause economic development in Nigeria; while States capital expenditure (SCEXP) proxy for investment, internally generated revenue (IGR) and fiscal equalization have positive and significant causative impact on economic development in Nigeria individually. But when the causation of the explanatory variables was observed jointly on SPCGDP, the result showed a positive significant level of causation. Also, when CONF is the dependent variable, it can be seen that IGR, SPCGDP and FEQ do not cause CONF individually, but only SCEXP and DEBT that individually have positive causative impact on CONF. But when all the explanatory variables are jointly considered on CONF, the result indicates positive significant level of causation. From the result of the third section of table 8, causality flows from explanatory variables jointly to the dependent variable FEQ is positive and significant, also when consider the causality individually IGR, SCEXP, SPCGDP and CONF does not cause or impact on FEQ but only DEBT has positive and significant casualty impact on FEQ.

**Table8: Granger Causality for equation two**

Dependent variable: SPCGDP			
Excluded	Chi-sq	df	Prob
LOG(CONF)	2.429695	2	0.2968
LOG(FEQ)	0.671566	2	0.0148
SCEXP	10.80716	2	0.0045
LOG(DEBT)	1.976937	2	0.3721
IGR	89.61531	2	0.0000
All	102.9628	10	0.0000
Dependent variable: LOG(CONF)			
Excluded	Chi-sq	df	Prob
SPCGDP	0.871896	2	0.6467
LOG(FEQ)	28.72663	2	0.3479
SCEXP	8.080823	2	0.0176
LOG(DEBT)	18.98413	2	0.0001
IGR	1.126790	2	0.5693
All	57.58419	10	0.0000
Dependent variable: LOG(FEQ)			
Excluded	Chi-sq	df	Prob.
SPCGDP	4.939279	2	0.0846
LOG(CONF)	8.809253	2	0.2122
SCEXP	3.364261	2	0.1860
LOG(DEBT)	11.34413	2	0.0034
IGR	0.845680	2	0.6552
All	31.37250	10	0.0005
Dependent variable: SCEXP			
Excluded	Chi-sq	df	Prob.
SPCGDP	0.040509	2	0.9799
LOG(CONF)	0.546211	2	0.7610
LOG(FEQ)	0.605848	2	0.7387

LOG(DEBT)	0.482004	2	0.7858
IGR	4.395191	2	0.1111
All	17.71077	10	0.0600
Dependent variable: LOG(DEBT)			
Excluded	Chi-sq	df	Prob.
SPCGDP	1.091816	2	0.5793
LOG(CONF)	1.555665	2	0.4594
LOG(FEQ)	0.933806	2	0.6269
SCEXP	3.992195	2	0.1359
IGR	2.991259	2	0.2241
All	15.15212	10	0.1266
Dependent variable: IGR			
Excluded	Chi-sq	df	Prob.
SPCGDP	1.144226	2	0.5643
LOG(CONF)	5.286221	2	0.0711
LOG(FEQ)	3.250589	2	0.1969
SCEXP	1.577801	2	0.4543
LOG(DEBT)	0.776891	2	0.6781
All	12.92177	10	0.2281

**Sources:** Author's computation (2023) using eview 10

Equation one Fixed Effects Cross Sectional Dummy Variable Regression Results for the various States.

According to the estimated fixed effects model below, there are around eight (8) state fiscal equalizations that have a negative conflict coefficient. It indicates that a rise in fiscal equalization payments in the chosen States would lead to fewer conflicts in the following states: Bauchi (17.13%), Bayelsa (19.91%), Jigawa (15.63%), Kano (54.88%), Osun (16.98%), Oyo (18.52%), Rivers (21.59%), and Zamfara State (19.83%). But as evidenced by the coefficients of States like Akwa Ibom, Anambra, CRS, Delta, Ebonyi, Edo, Ekiti, Gombe, Kaduna, Kogi, Niger, Ondo, and Ogun States, budgetary equality reduces conflict. These findings suggested that the conflicts in those States would worsen if fiscal equalization payments increased. The disparities in culture/religion views, economic policies, people's living standards within the States, governance, and political systems, which were presumed constant in the FEM, may be the fundamental causes of these differences in the individual States.

Kano State concluded from the fixed effects model results that budgetary equalization significantly and negatively affects disputes in the state. While other states, like Bauchi, Bayelsa, Jigawa, Osun, Oyo, Rivers, and Zamfara, have negative, but not particularly substantial, effects on conflicts in their individual states. The calculated random effects model below demonstrates that fiscal equality in all States has a negative correlation to conflict, nonetheless. This is consistent with the relevant economic theories, which suggest that a percentage increase in equalization payments in some States will lead to a reduction in conflict ratios in Akwa Ibom (33.072), Anambra (35.219), Bauchi (29.658), Bayelsa (31.582), Cross-River (35.359), Delta (34.948), Ebonyi (35.378), Edo (36.548), Ekiti (38.705), Gombe (35.292), The random effect model is the proper model for this problem, according to the Housman test. The Probability value greater than 5% level of significance (1.0000) makes this clear. The detailed outcome is available in Appendix 6. The panel dynamic regression results obtained earlier, which showed that fiscal equalization had an adverse long-term effect on



conflicts in Nigeria, are confirmed by the individual state results of the least squares dummy variable (LSDV).

**Table 9: LSDV Model with Individuality Intercepts and Heterogeneity Coefficients of the States for equation one.**

States	Fixed effect model		Random effects model	
	Coefficient	probability	Coefficient	probability
Akwa-Ibom	2.179023	0.065	3.307227	0.000
Anambra	2.995436	0.824	3.5219195	0.580
Bauchi	1.7133182	0.189	2.965869	0.354
Bayelsa	1.991764	0.587	3.158219	0.669
Cross Rivers	2.399077	0.505	3.5359559	0.491
Delta	2.4344883	0.468	3.4948296	0.603
Ebonyi	2.30335	0.730	3.5785935	0.482
Edo	2.514237	0.316	3.6548568	0.302
Ekiti	2.6191103	0.222	3.8705283	0.139
Gombe	2.2360798	0.878	3.5292887	0.580
Jigawa	1.5639454	0.112	2.887192	0.323
Kaduna	2.4369747	0.438	3.5851056	0.407
Kano	0.548813	0.000	1.74647	0.000
Kogi	2.1913294	0.972	3.4405256	0.718
Lagos	2.4837101	0.498	3.3773906	0.889
Niger	2.26374	0.817	3.5506271	0.537
Ogun	2.1823378	0.992	3.3084234	0.997
Ondo	2.2337362	0.873	3.4421184	0.701
Osun	1.698673	0.167	2.909101	0.267
Oyo	1.8522133	0.340	3.0078154	0.386
Rivers	2.1598749	0.960	3.1974915	0.779
Zamfara	1.983396	0.594	3.265978	0.917

Sources: Author's Computation (2023) using Stata version14

#### Equation two Fixed Effects Cross Sectional Dummy Variable Regression Results for the various States

Fiscal equalization has negative effects on economic development in all States except Lagos, Bayelsa, Delta, and Rivers States, as shown by the state coefficient in Appendix 6. However, fiscal equalization has positive but insignificant effects on economic development in Lagos, Bayelsa, Delta, and Rivers States. Only Lagos State stands out statistically. Fiscal equalization has a detrimental effect on Nigeria's economic growth in the other 18 States. Only Bauchi (0.002), Ebonyi (0.049), Gome (0.010), Jigawa (0.002), Kano (0.007), Kaduna (0.083), Kogi (0.049), Nigeria (0.054), Osun (0.023), and Zamfara (0.002) are statistically significant at 5% and 10%.

The state coefficient in Appendix 9 of the estimated fixed effects model of equation two, which was developed to achieve study objective three below, demonstrates that conflicts have a detrimental influence on economic development in every State. The size of the influence, however, differs from state to state. This outcome is consistent with the empirical findings of Leonce (2001) regarding the consequences of racial wars in Burundi and Rwanda. Their research demonstrates how the economies were harmed by the war. In other words, their findings indicate that conflicts have a detrimental effect on Burundi's and Rwanda's economic

development. The findings indicate that whereas disputes have a negative but not statistically significant influence on economic development in eight states, they have a negative but not statistically significant impact in 12 states. This finding supports the empirical research of Ejaz and Lakshni (2010), Pirter & Mrijke (2012), Clifford & Christopher (2020), and others who have found that conflicts hinder economic growth in Nigeria and Southeast Asia, among other places.

The Hausman test's outcome demonstrates that the random effects model is a suitable model for this study's equation 2. The intersection of the intercept and the state-specific dummy coefficients is shown in Table 9 below. The results for random factors show that conflicts have a detrimental influence on economic growth in all the states. Additionally, the outcome demonstrates that fiscal equalization has a detrimental effect on economic development in all states, with the exception of Lagos, Delta, Rivers, and Bayelsa. This suggests that states like Akwa-Ibom, Anambra, Bauchi, Cross River, Ebonyi, Edo, Ekiti, Gombe, Jigawa, Kaduna, Kano, Kogi, Nigeria, Ogun, Osun, Ondo, Oyo, and Zamfara will have less economic growth as fiscal equalization increased. However, states like Lagos, Delta, Bayelsa, and River show that further fiscal equality will result in greater economic growth in the states.

The impact of state capital expenditures (SCEXP) and internally generated income (IGR) on economic development differs throughout the twenty-two selected States in Nigeria, as shown in Table 9 and Appendix 6. Only a few of the twenty-two chosen states—Lagos, Rivers, Bayelsa, and Delta—showed that SCEXP and IGR have a favorable impact on economic growth. Other states revealed that SCEXP and IGR have a negative impact on economic growth in the chosen states. These might be primarily ascribed to the state government's inability to diversify its revenue sources and the improper prioritization of state capital expenditures. Lagos State ranks top in the 2020 States Fiscal Sustainability Index, according to NBS statistics, which are supported by the results of Lagos and Rivers' economic progress. Lagos State earned N516.62 billion in total revenue in 2019, of which N398.73 billion came from IGR.

**Table 10: LSDV Model with Individuality Intercepts and Heterogeneity Coefficients of the States for equation two.**

States	Fixed Effect Model		Random Effects Model	
	Coefficient	probability	Coefficient	probability
Akwa-Ibom	2.0463989	0.035	64.89595	0.244
Anambra	1.14059517	0.176	64.1402348	0.123
Bauchi	0.665097	0.004	63.403461	0.002
Bayelsa	2.2098387	0.701	65.0153611	0.788
Cross Rivers	1.4548701	0.158	64.3012844	0.171
Delta	2.2336183	0.669	65.1684788	0.550
Ebonyi	1.2280527	0.085	63.9324324	0.049
Edo	1.8038167	0.564	64.6525948	0.578
Ekiti	1.9187493	0.786	64.6338731	0.591
Gombe	0.901197	0.021	63.586204	0.010
Jigawa	0.570644	0.005	63.249472	0.002

Kaduna	1.3013805	0.075	64.1422544	0.083
Kano	0.763538	0.006	63.588925	0.007
Kogi	1.2189296	0.074	63.9541681	0.049
Lagos	4.166504	0.000	71.372759	0.000
Niger	1.1961935	0.092	63.894768	0.054
Ogun	1.7214094	0.473	64.6004068	0.530
Ondo	1.6880411	0.423	64.4733035	0.363
Osun	1.0902508	0.031	63.85841	0.023
Oyo	1.3244044	0.106	64.1761212	0.120
Rivers	2.2959973	0.597	65.2603302	0.458
Zamfara	0.591691	0.003	63.292289	0.002

**Sources:** Author's computation 2023 using Stata version 14

### Discussion of Findings

The results obtained from the two equations aim at achieving the three specific objectives of this study. The two equations indicated that the variables under investigation are cointegrated, which implies the existence of long-run relationships among fiscal equalization, conflicts, and economic development in Nigeria for the period of study. The results of equation one indicates that almost all the variables have a positive but significant impact on conflicts in Nigeria. Only fiscal equalization has a negative and significant impact on conflicts in Nigeria. These mean that if fiscal equalization goes up by one unit, conflicts in Nigeria would decrease by 1.117955 units. In other words, with a one percent increase in fiscal equalization payments in Nigeria, resource-based conflicts would decrease approximately by 11.18 percent in the long run. Since most of the resource-based conflicts are caused by disparities in the revenue sharing formula that yield inequality in income sharing, this result is in conformity with Musgrave's fiscal federalism theory, which states that the federal government should address the inequality in the distribution of wealth among the States in order to achieve economic stability in the entire federation. This means that equality or equalization in wealth sharing would reduce conflicts and bring about the desired economic development. The result has further given credence to the empirical study of Hansjrg & Claire (2008). The implication is that fiscal equalization payments have a significant ability to resolve resource base conflicts in Nigeria so as to foster economic development.

The results for the Granger causality test from Table 10 show that in the first section where CONF is the dependent variable, only DEBT has a positive and significant causative impact on conflicts in Nigeria individually, while DTH, IGR, and FEQ have a positive but not significant causative impact on conflicts in Nigeria individually. But the joint causation of the explanatory variables on conflicts shows a positive and significant level of causation. This implies that fiscal equalization did not cause conflicts in Nigeria in the short run; it was only debt that individually and significantly had a causative impact on conflicts in Nigeria. In other words, the result implies that fiscal equalization does not cause conflicts in Nigeria but rather helps reduce them.

The result for individual state effects shows that about eight (8) of the State's fiscal equalizations have a negative coefficient with regards to conflicts. This result gives credence to

the empirical work of Hansjrg & Claire (2018) on fiscal equalization issues that are common to all countries. It means an increase in fiscal equalization payments in the selected States would result in a decrease in conflicts, while in fourteen (14) states, the result shows that fiscal equalization has a positive impact on conflicts. This means that an increase in fiscal equalization payments will escalate conflicts in 14 States. The reasons for these differentials in the individual States might be accounted for by the differences coming mainly from culture/religion beliefs, economic policies, the living standards of the people in the States, governance, and political systems, which were assumed constant in the FEM.

From table 4.10, the estimated panel dynamic ordinary least squares result for equations two, which aimed at achieving objectives two and three of this study, The coefficient of fiscal equalization (FEQ) shows a positive and statistically significant value given its p-value of 0.0041. This means that with a 1 per cent increase in fiscal equalization, economic development would increase by 1.1917 per cent, *ceteris paribus*. In the real world, an increase in fiscal equalization will in turn increase economic development in Nigeria in the long run. However, these results show that fiscal equalization payments would lead to economic development in Nigeria in the long run.

The result for Granger causality from table 4.11 indicated that when SPCGDP is considered as a dependent variable, Conflicts (CONF) and Debt do not individually and significantly cause economic development in Nigeria, while States capital expenditure (SCEXP) is a proxy for investment, internally generated revenue (IGR), and fiscal equalization (FEQ) have a positive and significant causative impact on economic development in Nigeria individually. But when the causation of the explanatory variables was observed jointly on the SPCGDP, the result showed a significant positive level of causation. The economic implication of this result is that fiscal equalization has a positive and significant impact on economic development in Nigeria individually, and when combined with other independent variables such as CONF, DEBT, SCEXP, and IGR, the result shows a positive and significant impact. This means that there are other variables outside the model that cause economic development in Nigeria.

Looking at the impact of fiscal equalization on economic development in individual states, the result indicated that out of twenty-two States, the 18-state coefficient shows that fiscal equalization has negative impacts on economic development, which is evidenced in the States coefficient in Appendix 9, while Lagos, Bayelsa, Delta, and Rivers States have positive but no significant impact on economic development. Only Lagos State is statistically significant. Among the other 18 States that have a negative impact on economic development in Nigeria, only the following are statistically significant at the 5% and 10% levels: Bauch (0.002), Ebonyi (0.049), Genome (0.010), Jigawa (0.002), Kano (0.007), Kaduna (0.083), Kogi (0.049), Nigeria (0.054), Osun (0.023), and Zamfara (0.002). The economic implication of this result is that there are factors that are responsible for the variation or differences in the impact of fiscal equalization on economic development in Nigeria since equalization payments were equal irrespective of size, population, IGR, Land mass, etc. The four States whose coefficients show that fiscal equalization has a positive impact on economic development in Nigeria are: three are oil-producing states, while Lagos is an industrial State. There are a lot of lessons to be learned from Lagos State as the Benchmark State for the individual state analysis. From the results, it was only Lagos that had a positive and significant impact on economic development in Nigeria, while in Rivers, Delta, and Bayelsa States, fiscal equalization had a positive but not

significant impact on economic development in Nigeria. This means that for fiscal equalization to achieve its primary objectives, it must be combined with individual States efforts on revenue generation, or IGR, so as to foster the desired economic development. The result for the 18 States indicated that fiscal equalization has a negative impact on economic development, which is in conformity with the empirical results of Hansjrg & Claire (2018). The 18 states results, such as Akwa-Ibom, Anambra, Bauchi, CRS, Ebonyi, Edo, Ekiti, Gombe, Jigawa, Kaduna, Kano, Kogi, Niger, Ogun, Ondo, Osun, Oyo, and Zamfara States, showed that fiscal equalization can reduce tax and developmental efforts, thereby hampering economic development in the States. Also, the negative impact of fiscal equalization on economic development in those States might be a result of low internally generated revenue (IGR) from 18 states. However, the co-efficient of conflicts had a negative and significant effect on economic development given its p-value of 0.0046. This implies that for a one per cent increase in the intensity of conflicts, economic development would decrease by 19.17 per cent. In the real world, conflicts hamper the level of economic development in Nigeria. This is consistent with a priori expectations and also gives further credence to the empirical work of Ijeoma (2014) on the impact of the cost of conflicts on economic development in Nigeria. Checking for the direction of causality in objective three, when CONF is the dependent variable, it can be seen that IGR, SPCGDP, and FEQ do not cause CONF individually, but only SCEXP and DEBT individually have a positive causative impact on CONF. But when all the explanatory variables are jointly considered on CONF, the result indicates a positive and significant level of causation. The economic implication of this result is that conflicts do not cause economic development in Nigeria. In other words, conflict has a negative impact on economic development in Nigeria.

## **Summary, Conclusion and Recommendations**

### **Summary of Major Finding**

The main aim of this study was to evaluate the relationships among fiscal equalization, conflicts, and economic development in Nigeria, while the specific objectives were (i) to examine the impact of fiscal equalization on conflict in Nigeria and (ii) to evaluate the effects of fiscal equalization on economic development in Nigeria. (iii) to determine the impact of conflicts on economic development in Nigeria. In order to achieve the objectives, time series data for selected States were collected and used for the analyses on the Basis of the availability of state GDP per capita (as a proxy for economic development). Twenty-two States were selected for the analysis, at least two from each geopolitical zone. The study adopted Panel dynamic Ordinary Least Squares (PDOLS) regression as the estimation technique to examine the long-run relationship among fiscal equalization, conflicts, and economic development in Nigeria. VAR Granger Causality was also adopted to evaluate the direction of causality and the immediate impact between the variables, while Least Squares Dummy Variables (LSDV) under the panel framework was also used to examine the individual state impacts of the variables under study.

Pre-estimation tests indicated that some of the series were integrated into order zero (1, 0), while others were integrated into order one (1, 1). This means that some of the variables have a unit root, but after the first difference they become stationary, while others do not have a unit root but are stationary at levels. Both Pedroni and Kao cointegrated tests were adopted to check for the presence of cointegration in the model. However, Pedroni's results indicated that out of the eleven test statistics, six out of eleven—Panel PP-Statistic, Panel ADF-Statistic,

Group PP-Statistic, Group ADF-Statistic, Weighted Panel PP-Statistic, and Weighted Panel ADF-Statistic—have significant probabilities at the 5 percent level. Pedroni's co-integration test thus confirms the existence of at least six co-integrating equations in the two models. The result thus confirms the existence of a long-term relationship among the variables of the study. Also, the Kao cointegration test confirms the existence of a long-term relationship among the variables of the study evidenced by the p-value less than 5% level of significance.

The estimated Panel dynamic model results for equation one showed that fiscal equalization had negative and significant impacts on conflicts in Nigeria in the long run. However, the Granger causality test result shows that fiscal equalization does not cause conflicts in Nigeria, which is a confirmation of the panel dynamic model result. This implies that fiscal equalization has a negative impact on conflict in the short and long run. From the above results, we can deduce that fiscal equalization has the ability to resolve conflicts in Nigeria if properly utilized. The results for the individual States show that eight (8) States out of the twenty-two indicated that fiscal equalization has negative impacts on conflicts in the States. While fourteen (14) States show that fiscal equalization has a positive impact on conflicts in the states, this means that an increase in fiscal equalization would escalate conflicts in the fourteen States. The reasons for these conflicting results might be that these States do not utilize their potential so as to support the equalization payments to resolve conflicts and bring about the desired development.

The result of objective two from the Panel dynamic model shows that fiscal equalization had a positive and significant impact on economic development in Nigeria in the long run. The Granger causality test result shows that fiscal equalization causes economic development in Nigeria. This means that fiscal equalization has a positive impact on economic development in Nigeria. However, the individual States analysis shows that eighteen (18) out of the twenty-two States coefficient showed that fiscal equalization have negative impacts on economic development in Nigeria while four States such as Lagos, Delta, Rivers and Bayelsa States coefficient showed that fiscal equalization has positive impact on economic development in Nigeria. The reasons for the disparity in the individual state results would be a suggestion for further studies.

### **Conclusion**

The main aim of this study was to evaluate the relationships among fiscal equalization, conflicts, and economic development in Nigeria, while the specific objectives were (i) to examine the impact of fiscal equalization on conflict in Nigeria and (ii) to evaluate the effects of fiscal equalization on economic development in Nigeria. (iii) to determine the impact of conflicts on economic development in Nigeria. In order to achieve the objectives, time series data for selected States were collected and used for the analyses on the Basis of the availability of state GDP per capita (as a proxy for economic development). Twenty-two States were selected for the analysis, at least two from each geopolitical zone. The study adopted Panel dynamic Ordinary Least Squares (PDOLS) regression as the estimation technique to examine the long-run relationship among fiscal equalization, conflicts, and economic development in Nigeria. VAR Granger Causality was also adopted to evaluate the direction of causality and the immediate impact between the variables, while Least Squares Dummy Variables (LSDV) under the panel framework was also used to examine the individual state impacts of the variables under study.

Pre-estimation tests indicated that some of the series were integrated into order zero (1, 0), while others were integrated into order one (1, 1). This means that some of the variables have a unit root, but after the first difference they become stationary, while others do not have a unit root but are stationary at levels. Both Pedroni and Kao cointegration tests were adopted to check for the presence of cointegration in the model. However, Pedroni's results indicated that out of the eleven test statistics, six out of eleven—Panel PP-Statistic, Panel ADF-Statistic, Group PP-Statistic, Group ADF-Statistic, Weighted Panel PP-Statistic, and Weighted Panel ADF-Statistic—have significant probabilities at the 5 percent level. Pedroni's co-integration test thus confirms the existence of at least six co-integrating equations in the two models. The result thus confirms the existence of a long-term relationship among the variables in the study. Also, the Kao cointegration test confirms the existence of a long-term relationship among the variables of the study, as evidenced by the p-value below the 5% level of significance.

The estimated Panel dynamic model results for equation one showed that fiscal equalization had negative and significant impacts on conflicts in Nigeria in the long run. However, the Granger causality test result shows that fiscal equalization does not cause conflicts in Nigeria, which is a confirmation of the panel dynamic model result. This implies that fiscal equalization has a negative impact on conflict in the short and long run. From the above results, we can deduce that fiscal equalization has the ability to resolve conflicts in Nigeria if properly utilized. The results for the individual States show that eight (8) States out of the twenty-two indicated that fiscal equalization has negative impacts on conflicts in the States. While fourteen (14) States show that fiscal equalization has a positive impact on conflicts in the states, This means that an increase in fiscal equalization would escalate conflicts in the fourteen States. The reasons for these conflicting results might be that these States do not utilize their potential so as to support the equalization payments to resolve conflicts and bring about the desired development.

The result of objective two from the Panel dynamic model shows that fiscal equalization had a positive and significant impact on economic development in Nigeria in the long run. The Granger causality test result shows that fiscal equalization causes economic development in Nigeria. This means that fiscal equalization has a positive impact on economic development in Nigeria. However, the individual States analysis shows that eighteen (18) out of the twenty-two States coefficient showed that fiscal equalization have negative impacts on economic development in Nigeria while four States such as Lagos, Delta, Rivers and Bayelsa States coefficient showed that fiscal equalization has positive impact on economic development in Nigeria. The reasons for the disparity in the individual state results would be a suggestion for further studies.

### **Recommendations**

In line with the findings of the study, the following recommendations were made:-

1. Knowing the importance of fiscal equalization on resolving natural resources-based conflicts in Nigeria, government should increase the percentage of equalization payments so as to reduce resources-based conflicts to the barest minimum.
2. To the extent that fiscal equalization has a positive impact on economic development in Nigeria, both in short and long run. The federal government should set a minimum target of IGR for each State of the federation to generate before receiving equalization payments. Consequently, government should establish a sub-unit in the federal

ministry of finance to be charged with the responsibility of working out, from time to time an acceptable percentages for fiscal equalization payments that can resolve resources-based conflicts and bring about the desired economic development in Nigeria.

3. Also the study recommends Federal government to encourage less developing States to work or diversify their internally generating revenue (IGR) sources so as to bring even development among the States in Nigeria.
4. Capital expenditure as a proxy for public investment in the State has positive, though insignificant, impacts on economic development in Nigeria. This shows that, the States governments are not investing resources in appropriate channels that can bring the desired growth and development in the economy. The federal government should interact with the States from time to time to ensure proper accountability for the State resources. This would help to check-mate mismanagement of resources in the States.

### **Contribution to knowledge**

This work would contribute to literature and also served as reference material. Reasons being that, to the best of the researcher knowledge it is the first in Nigeria to examine the impact of fiscal equalization payments on resources- based conflicts and its impact on economic development. The measure of fiscal equalization used in this work is a value added to knowledge. The measure for fiscal equalization is the 40 per cent of the federal allocation to the States government that is to be shared equally among the 36 States of the federation irrespective of population, landmass, and IGR etc. This work would help government of the day to know that the effectiveness of fiscal equalization on resolving conflicts depends on States IGR. It is on this effect that the study recommends that federal government should set a minimum target of IGR for each State of the federation to generate before receiving equalization payments. A look at the work of Ijeoma (2014) only examines the impact of cost of conflicts on economic development in Nigeria. The study only examines the impact of the cost of conflict on economic development without looking at the solution to conflicts. However, this study departed from the existing literature by examine the role of fiscal equalization in resolving conflicts so as to bring the desired economic development in Nigeria.

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## ASSESSMENT OF TRANSIT CRIME IN ADO-ODO/OTA LOCAL GOVERNMENT AREA, OGUN STATE, NIGERIA

<sup>1</sup>Esuabanga, William E., <sup>2</sup>Osuorji, Gideon C., <sup>3</sup>Abimbola, Jonathan A &  
<sup>4</sup>Alade, Olumide T.

<sup>1,2,3&4</sup> Nigerian Building and ROAD Research Institute (NBRRI),  
KM 10 Idiroko Road, Ota-Ogun State

### Abstract

*This study was aimed at assessing transit crime within Ado Odo/Ota Local Government Area, Ogun State, Nigeria. The Objectives were: examine the types of transit crime within the area; assess the modes of public transportation mostly associated with transit crime and to determine the degree of relationship between types of transit crime and the modes of public transportation. The hypothesis used for the study was stated in null format (H<sub>0</sub>): there is no significant relationship between types of transit crime and the modes of public transportation system within the area. The population needed for the study was obtained from 2006 Population figure of 527,242 and this was projected to date bringing the figure to 896,700(3.4% growth rate). Taro Yamene sampling formula was used to generate 400 sampled population needed to carry out the study. Structured questionnaire was used as primary source of data to elicit information from victims and witnesses of transit crime within the 16 wards. However, 392 were successfully retrieved representing 98 percent. Data were analyzed using descriptive statistical tools (tables, percentage and relative important index-RII) while Spearman ranked Correlation (RS) was used as an inferential statistical tool in analyzing the stated hypothesis. The result showed that robbery/theft, fraud/scams, and ritual attempt with RII mean value of 4.66, 4.55 and 4.54 respectively were the most prevalent type's transit crime within the study area. Also, the leading modes of public transportation mostly affected by transit crime were buses, tricycles and motorcycles with RII mean value of 4.77, 4.57 and 4.52 respectively. Furthermore, the RS coefficient value of 0.167 revealed that there was no significant relationship between the stated variables leading to the acceptance of the H<sub>0</sub>. The paper recommended adequate lighting system, installation of closed-circuit television (CCTV), improve emergency communication system as well as better coordination among stakeholders in public transport system and relevant security agencies be put in place to reduce this menace.*

**Keywords:** *Transit, Crime, Security, Co-ordination and Modes*

### **Background to the Study**

Transit crimes are those criminal activities which are carried out within public transportation facilities such as buses, trains, taxis, and other modes of transportation. According to Ceccato, Gaudalet and Graf (2021), transit offences and /or safety are disturbing behaviours against public transportation users, personnel and property. Transit crimes can occur both on board public transportation while the vehicle is still on transit or within transit stations or at a stopping point or spots. The victims or witness of these categories of crime are mostly passengers who board these public transportation facilities. Over the years, there has been an upsurge in this type of criminalities across the world impacting negatively on passengers either directly or indirectly ranging from loss of lives and properties, delay travel, distortion of business schedules, psychological trauma, and other nasty experiences. In Nigeria, concern for adequate security and safety of passengers at any time of the day has become a cause of concern. On a daily basis, the incidence of transit crime is a recurring decimal threatening lives and properties as well as peaceful conduct of businesses and other schedules. Unfortunately, the challenge looks like a monster with our intra-city and inter-city transportation facilities that have become so difficult to be dealt with by concern stakeholders. In spite all this, little or no attention has been made towards addressing this menace in our society. According to vanguard news paper (2022), 65 % of assassinations and kidnappings were done when the vehicles is on transit route. Public transportation facilities and the passengers have become soft spots and targets for criminal activities due to inadequate security measures put in place to address this negative trend. Despite numerous road transport challenges posed by transit crime in Nigeria, the issue has become hydra-headed and even sophisticated to control (Balogun, 2022). This therefore calls for a more relevant study and assessment in order to generate a better and deeper understanding that are needed to adopt a more better preventive approaches so as to reverse this negative trend.

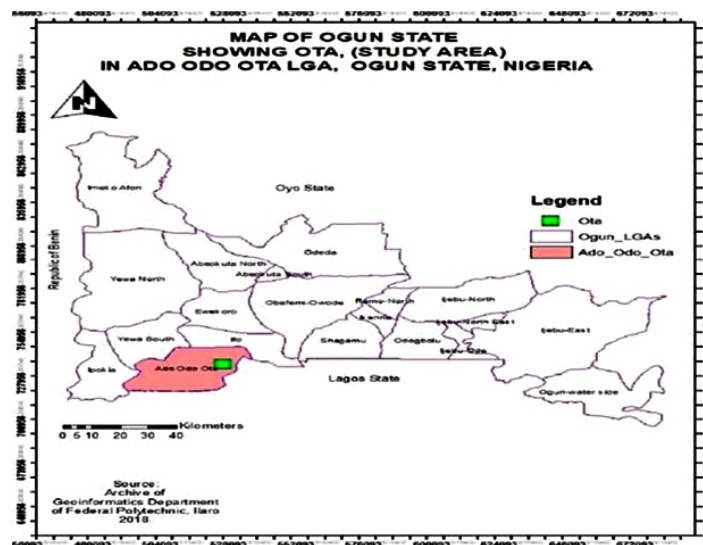
### **Literature Review**

Studies on transit crime and other attacks on other transportation system have received widespread investigation. Ojedekun and Adeotit (2022) investigated criminality and crime measures in selected train stations in Lagos, Nigeria using in-depth interviews and key informant interview methods. The result showed that vandalism, pilfering of train station equipments, roof top riding and ticket evasion was leading forms of crime with the train station in Lagos. Odufuwa and Fasina (2012) examined the relationship between quality of public transport and crime incidents with the view to establishing the sustainability of public transport in African Mega city Lagos, Nigeria using correlation and regression analysis. The result showed that there is a significant relationship in the volume of crime incidence in public transport and the quality of public transport system. Omidiji and Ibitoye (2010) investigated crime and road crashes prevention in transportation system in Nigeria using participants that cut across drivers from commercial transport and government owned corporations. The result revealed that 91% respondents agreed that armed robber frequently strike on their routes during journeys to cause road traffic crashes. Badiora, Ojewala and Okunola (2015) examined perceived risk and fear of crime in Nigeria transit environment with a view to providing strategies needed to prevent crime in public transit systems. It was discovered that gender and age were the major factors that influence commuters fear towards transit crime while perception of transit crime was rated at 0.732 relative importance index (RII) mean value. Ceccato, Gaudalet and Graf (2021), in their review of crime and safety in transit environment based on the English and French literature from 1970 – 2022 discovered that the main focus of

transit crime study is to improve on the actual and perceived safety for public transportation users. They also investigated variation in safety perceptions in transit crime environment of university students in 18 cities on six continents using 45-question survey within six continents. The findings revealed that student's mobility was affected by avoidance strategies which prompted some transit riders to travel at a particular time as well as on some travel route and settings that deemed especially risky, or even avoiding the route of transit completely. Furthermore, Liggett, Loukaitou-Sideris and Iseki (2004) highlighted the two major strategies needed to investigate crime such as ecological and compositional approaches. They noted that ecological strategy should focus on the physical and environmental attributes while compositional strategy should focus on the socio-demographic attributes of offenders and victims of transit crime. However, despite all these studies and investigations in the field of transit crime, no effort has been made to identify the linkage or relationship between transit crime and the mode of public transportation, hence this forms the basis of this study.

### Study Area

Ado-Odo/Ota is one of the most populated local government areas (LGA) among the 20 LGAs in Ogun state, Nigeria. Its major towns are Ado-Odo, Agbara, Igbesa, Iju, Atan, Itele, Kooko, Ebiye, Owode, Sango Ota etc. the 2006 population figure is 527,242 and if it is projected to date, it is estimated to be 896,700 using 3.4% growth rate (National Population Commission and National Bureau of Statistics, 2022). Due to its proximity to Lagos mega-polis, it has become one of the fastest growing urban settlements within the state. It has attracted notable institutions and agencies and organizations such as Faith Tabernacle world Headquarters (Winners Chapel), Covenant University, Bells university of technology, Honda car assembling plant, International Distillers Company Plc (Chelsea) National laboratory complex of Nigerian Building and Road Research Institute (NBRRI) and other notable agencies. It has a total land area of 878km<sup>2</sup> which lies within latitude 6° 41'N and 3° 68'E. It is bounded by Lagos mega-polis at East and South, Yewa South and Ifo LGAs in the North and Ipokia LGA in the West. The major food and cash crops are cocoa, kola nuts, palm oil, cassava, timber, maize, vegetables etc.



### Methodology

Reconnaissance survey was conducted with the use of GPS and maps to have a good understanding of the major transit routes of the study area. Based population was extracted from the 2006 population figure of 527,242 and this was projected to 896,700 as of date with 3.4% growth (National Population commission and National Bureau of Statistics, 2022). Taro Yamene population sampling formula was adopted to arrive at the sampled population of 400 required for the study. Structured questionnaires were used to elicit information from victims and witnesses of transit crime within the 16 wards that made up the LGAs. 392 questionnaires were successfully retrieved representing 98%. Data were analyzed using descriptive statistical tools (tables, percentage and relative importance index (RII) while spearman ranked correlations (rs) was used as an inferential statistical tool in analyzing the stated hypothesis.

Taro yamene sample formula is given as  $n = \frac{N}{1} + N(\epsilon)^2$

Where n = sample size of the population under study, N= whole population, e = precision @ 0.08

$RS = 1 - \frac{6\sum d^2}{N^3 - N}$  where RS = spearman's ranked correlation, d = differences between the ranks,

N= sample size

Relative importance index (RII) =  $\frac{\sum fx}{5(\sum f)}$  where fx = weight given to each performance,  
 $\sum fx$  = total number of sample.

**Table 1: Sampled population based on wards**

S/N	Ward	Sample Population	Percentage
1.	Ado-Odo I	25	6.25
2	Ado-Odo II	25	6.25
3.	Agbara ward I	25	6.25
4.	Agbara (Ejila awori ward)	25	6.25
5.	Alapoti ward	25	6.25
6.	Atan ward	25	6.25
7.	Ere ward	25	6.25
8.	Igbesa ward	25	6.25
9.	Ijoko ward	25	6.25
10.	Iju ward	25	6.25

11.	Ilogbo ward	25	6.25
12.	Ketu-adie-owe ward	25	6.25
13.	Ota I ward	25	6.25
14.	Ota II ward	25	6.25
15.	Ota III ward	25	6.25
16.	Sango ward	25	6,25
	Total	400	100

**Source:** Author's computational analysis, 2023

### **Aims and Objectives of the Study**

The study was aimed at assessing transit crime within Ado-Odo/Ota LGA in Ogun state. The following were the specific objectives set for the study:

1. To examine the types of transit crime within the study area
2. To assess the modes of public transportation mostly associated with transit crime.
3. To determine the degree of relationship between the types of transit crimes and the mode of public transportation system within the area.

Hypothesis of the study was stated in null format (H<sub>0</sub>) as follows.

There is no significant relationship between types of transit crime and the modes of public transportation system.

### **Data Presentation, Analysis and Discussion of Findings**

**Table 2:** Socio-economic characteristics of respondents

<b>Sex</b>	<b>Number of Respondents</b>	<b>Percentage</b>
Male	201	51.28
Female	191	48.72
<b>Total</b>	<b>381</b>	<b>100</b>

<b>Marital Status</b>		
Single	197	50.25
Married	138	35.20
Divorced	25	6.35
Widowed	32	8.16
<b>Total</b>	<b>392</b>	<b>100</b>
<b>Age Categories</b>	<b>Number of Respondents</b>	<b>Percentage</b>
Under 25 years	99	25.26
26 – 35 years	130	33.16
36 – 55 years	124	31.63
56 years above	39	9.95
<b>Total</b>	<b>392</b>	<b>100</b>
<b>Education</b>		

The above socio-economic characteristics presented in table 2 shows that greater number of respondents were males representing 51.28% of the entire population used for the study while 48.72% were females. This means that male formed the dominant population affected by transit crime. The table above also revealed that 50.25% were single while 35.20% were married leading in terms of those affected by the crime. It was also observed that the age category most affected were those within the 26 – 35 years representing 33.16% and 36 – 55 years representing 31.63% respectively.

In terms of education qualification, the study revealed that the leading populations most affected by transit crime were those with WAEC and those without formal education with 21.94% and 20.66% respectively. This means that education has a way of reducing transit crime by giving the needed exposures and awareness needed to prevent transit crime.



**Table 3: Types of transit crime**

S/N	Variables	5	4	3	2	1	$\sum f_j$	$\sum fx$	Mean	Rank
1	Robbery/Theft	282	88	13	9	8	392	1827	4.66	1
2	Kidnapping	240	102	23	16	11	392	1720	4.39	4
3	Assault/Harassment	156	79	58	66	33	392	1435	3.66	6
4	Fraud and Scam	121	80	19	39	133	392	1193	3.04	9
5	Vandalism/Destruction	156	79	58	66	33	392	1435	3.66	6
6	Pick pocketing	271	82	27	8	4	392	1784	4.55	2
7	Ritual attempt	273	74	33	6	6	392	1778	4.54	3
8	Vehicle snatching	191	73	77	33	18	392	1562	3.98	5
9	Others	97	88	151	42	14	392	1388	3.54	8

Strongly agree (5); Agree (4); Neutral (3); disagree (2); strongly disagree (1)

**Source:** Author's Field computational analysis, 2023

Table 3 above showed the different types of transit crime within the study area. It revealed that the top –three transit crime prevalent were robbery/theft, pick pocketing, and ritual attempt with RII values of 4.66, 4.55 and 4.54 respectively.

**Table 4: Transport mode**

S/N	MODES	5	4	3	2	1	$\sum f_j$	$\sum fx$	Mean	Rank
1	Pedestrian	238	105	23	16	10	392	1601	4.08	5
2	Pickup/Vans	192	71	78	34	19	392	1565	3,99	6
3	Motorcycles	272	73	34	7	6	392	1774	4.52	3
4	Tricycles	273	83	25	8	4	392	1792	4.57	2
5	Bicycles	171	66	59	32	27	392	1387	3.53	9
6	Buses	292	87	14	7	7	392	1871	4.77	1
7	Lorries/Trucks	195	66	73	37	21	392	1553	3.96	7
8	SUV/Private cars	185	71	69	38	28	392	1520	3.88	8
9	Others	241	103	22	17	12	392	1729	4.41	4

Strongly agree (5); Agree (4); Neutral (3); disagree (2); strongly disagree (1)

**Source:** Author's Field computational analysis, 2023

Table 4 above shows different types of transport modes associated with transit crime. It revealed that the three leading mode associated with transit crime were buses, tricycles and motorcycles with the RII mean value of 4.77, 4.57 and 4.52 respectively. This therefore shows that focus should be on these major modes of transport and should be given due attention and priority in an effort to reduce this crime by stakeholders and concern security agencies such as the police, Civil defense, and other military and paramilitary agencies.

**Table 5:** Spearman Rank Correlation table

X: transport mode	Y: type of crime transit	D	D <sup>2</sup>
5	1	4	16
6	4	2	4
3	6	-3	9
2	2	0	0
9	7	2	4
1	5	-4	16
7	8	-1	1
8	3	5	25
4	9	-5	25
			100

**Source:** Author's statistical analysis (2023)

$$RS = 1 - \frac{6 \sum d^2}{N^3 - N} = 1 - \frac{6 \times 100}{9^3 - 9} = 1 - \frac{600}{729 - 9} = 1 - \frac{600}{720} = 1 - 0.833 = 0.167$$

From table 5 above, spearman rank correlation was used to analyze the relationship between transport mode as independent variable (X) and transit crime as dependent variable (Y). The result showed that there is no strong relationship between transport mode and type of transit crime with a very low coefficient value of 0.167. This therefore means that transit crime can occur with the use of any form of transit mode. It also means that the need to fight transit crime should be holistic and focus should not only be on commercial vehicles alone. Security agencies should beam their search light on all modes of transportation. Furthermore, the null hypothesis raised (H<sub>0</sub>) raised, was upheld that there is no significant relationship between the two variables- transport mode and transit crime.

## CONCLUSION AND RECOMMENDATION

It can be concluded that different types of transit crime exist within the major routes of the study area which negatively impact the free flow of transportation. The study revealed that the most prevalent types of transit crime based on the RII rating were armed robbery/theft, pick pocketing and ritual crimes. Also, it was discovered that buses, tricycles and motorcycles were the commonest mode of transport affected by transit crime. Furthermore, it can be inferred that there is no significant relationship between types of transit crime and transit mode. This therefore means that transit crime can take place within and around any mode of transport used by commuters at any point in time. On the basis of the findings, the following recommendations were put forward

1. Fight against transit crime should not be narrowed down to few modes of transport, but rather be holistic and targeted at all modes of transport and routes
2. Adequate lighting system within different transit corridors of the study area
3. Installation of closed circuit television (CCTV) at strategic routes for better monitoring and investigation
4. Improvement in emergency communication system and better coordination among stakeholders within the stakeholders such as commuters, drivers and relevant security agencies be put in place.

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# OPERATIONAL ANALYSIS OF THE MAINTENANCE STRUCTURE OF SPECIAL PUBLIC SERVICES IN NIGERIA

**Opata J. O.C.**

*Federal University Otuoke, Bayelsa State*

## ***Abstract***

*Basically, Maintenance culture is one of the key indices in any institution. While the operational activities determine the range of institutional activities, the framework, personnel and productivity are crucial towards attaining the set vision of the institution concerned. This work is to discuss the maintenance services of the Nigerian public service, with special emphasis on the Nigerian Air force activities. It is imperative to understand that this will review and analyze the Air force maintenance operation between the year 2015 and 2023.*

***Keywords:*** Risk, Maintenance, Integrity and Efficiency

## **Background to the Study**

The Institute of Risk Management (IRM) defines risk as the combination of the probability of an event and its consequence. Consequences can range from positive to negative. This is a widely applicable and practical definition that can be easily applied. While, the international guide to risk-related definitions is ISO Guide 73 and it defines risk as 'effect of uncertainty on objectives'. Guide 73 also notes that an effect may be positive, negative, or a deviation from the expected. These three types of events can be related to risks as opportunity, hazard or uncertainty. The guide notes that risk is often described by an event, a change in circumstances, a consequence, or a combination of these and how they may affect the achievement of objectives. Also, the Institute of Internal Auditors (IIA) defines risk as the uncertainty of an event occurring that could have an impact on the achievement of objectives. The IIA adds that risk is measured in terms of consequences and likelihood.

Hopkin (2010) states that, Risk in an organizational context is usually defined as anything that can impact the fulfilment of corporate objectives. However, corporate objectives are usually not fully stated by most organizations. Costard (2008) defines Risk as the likelihood of occurrence and the magnitude of consequences of a specified hazard being realized. In addition, Holton (2004) in a paper on defining risk, argues that there are two ingredients that

are needed for risk to exist. The first is uncertainty about the potential outcomes from an experiment and the other is that the outcomes have to matter in terms of providing utility. Although, in 1921, a scholar Frank Knight established the difference between Risk and Uncertainty. His views states as follows “risk that is measurable is easier to insure but we do care about all uncertainty, whether measurable or not”.

Furthermore, Risk is incorporated into so many different disciplines from insurance to engineering to portfolio theory that it should come as no surprise that it is defined in different ways by each one. It is worth looking at some of the distinctions:

1. Risk versus Probability: While some definitions of risk focus only on the probability of an event occurring, more comprehensive definitions incorporate both the probability of the event occurring and the consequences of the event. Thus, the probability of a severe earthquake may be very small but the consequences are so catastrophic that it would be categorized as a high-risk event.
2. Risk versus Threat: In some disciplines, a contrast is drawn between risk and a threat. A threat is a low probability event with very large negative consequences, where analysts may be unable to assess the probability. A risk, on the other hand, is defined to be a higher probability event, where there is enough information to make assessments of both the probability and the consequences.
3. All outcomes versus Negative outcomes: Some definitions of risk tend to focus only on the downside scenarios, whereas others are more expansive and consider all variability as risk. The engineering definition of risk is defined as the product of the probability of an event occurring, that is viewed as undesirable, and an assessment of the expected harm from the event occurring.

### **Risk Identification**

How can you identify the causes and effects of the risks in your company?

What can happen?

- i. In this first stage of the methodology, the possible specific causes of business risks are identified in a systematic manner, together with the range and possible effects thereof, which an entrepreneur must confront.
- ii. The proper identification of risks calls for a detailed knowledge of the company, of the market in which it operates, of the legal, social, political and cultural environment in which it is set.
- iii. Risk identification must be systematic and begin by identifying the key objectives of success and the threats that could upset the achievement of these objectives.

However, according to Association for Manufacturing Technology (AMT) Maintenance Can Improve Asset Reliability. This happens when improving reliability boils down to minimizing the frequency of unplanned downtime events. Organizations use a range of maintenance techniques to reduce the frequency of unplanned downtime including:

- i. Planned corrective maintenance (CM)
- ii. Preventive maintenance (PM)
- iii. Condition-based maintenance (CbM)
- iv. Predictive maintenance (PdM)

While ISO55000, defines an asset as an item that has potential or actual value to a company. These assets may fall into different classes. They may tangible, which are the products you

produce and the equipment you use, or intangible, which encompasses your reputation, image, social conscience, etc., or financial concerns, such as costs, investment and performance. However, according to Optimal's Asset-Reliability-as-a-Service ie ARAS, (2023), asset integrity management is an attempt to reduce or eliminate unplanned downtime. Since corrosion is a major cause of these costly incidents, asset integrity management includes corrosion management as a key component.

According to an online asset integrity management firm, arcweb, Asset Integrity Management (AIM) is a term used to describe the practice of managing an asset (power plant, oil rig, refinery, etc) to ensure its ability to perform its function effectively and efficiently is maintained. Well run AIM strategies ensure that the people, systems, processes and resources that enable an asset to deliver its function are in place over the life cycle of the asset, while simultaneously maintaining health and safety and environmental legislation. AIM applies to the entirety of an asset's operation, from its design phase to its decommissioning and replacement.

In addition, oil and gas IQ, an asset integrity management firm, explains Asset integrity, or asset integrity management systems (AIMS) as the term for an asset's capacity to run effectively and accurately, whilst also protecting the wellbeing of all personnel and equipment with which it interacts – as well as the measures in place to assure the asset's life cycle. Asset integrity applies to the entirety of an assets operation, from its design phase to its decommissioning and replacement.

This entails the constant business challenge for asset integrity managers on how to balance the designing, maintenance, and replacement of assets throughout their life cycle with the costs to business – in terms of finance, time, and resources. At its heart, it is the managing of the degradation of assets.

Furthermore, oil and gas IQ, explained that there are elements that affect asset integrity management. It itemized these elements as follows below:

Human element, asset integrity is built on a belief that the majority of people within the institution will do things properly, and however optimistic that may sound, most of the time maintenance, inspection, and data management is conducted with the best of intentions. Thus, signs that things may not all be well in the world of asset integrity management and inspection can include:

- i. Team members feel like any concerns they have about health and safety, or the state of equipment are not being taken seriously, leading to an environment in which faults are not even reported.
- ii. Any changes made to asset integrity plans, or even basic running of the facility, only occur after a large-scale incident.
- iii. A lack of understanding around how to find root causes from simple fault reports, often resulting in people being lulled into a false sense of security and overstating the level to which the facility is safe and operational.
- iv. There is a reliance on tacit understanding, rather than a tangible and easily accessible set of rules surrounding AIM and reporting faults.

- v. There is a lowest-bidder attitude surrounding maintenance contractors, and knowledge of and enthusiasm for asset integrity isn't valued particularly highly.

Risk Based Inspection (RBI), RBI, or risk-based inspection is one such method – whereby one must balance risk reduction with the minimum amount of effort required to streamline the process and free up more time. However, there are a near-infinite number of ways in which to carry our maintenance – and with many risks (such as calibration uncertainty or equipment accessibility) quantification is simply not possible. Therefore, each company must decide how far along the quantitative/qualitative scale it sits; whether to rely more heavily on experts, or statistics. Hence, for every easily-identifiable symptom of corrosion or asset instability, there are dozens of hidden issues: hydrogen attack, high-temperature tempering, thermal fatigue, metallurgy issues, internal system corrosion, and so on – and without dedicated and experienced professionals, implementing damage mitigation techniques is next to impossible. Once one has identified the need for thorough inspection, the next step is to enact it.

Identifying damage conditions and the factors that alter them. Here, issues such as temperatures increases or decreases in operating environment with regards to rate of degradation, contaminations of any kind or source, basic strain that is evaluating stress inherent to the operation.

According to Centre for Chemical Process Safety of American Institute of Chemical Engineers (AIChE), asset integrity is the systematic implementation of activities, such as inspections and tests necessary to ensure that important equipment will be suitable for its intended application throughout its life. Where work activities related to this focuses on two area namely:

Preventing a catastrophic release of a hazardous material or a sudden release of energy. Ensuring high availability (or dependability) of critical safety or utility systems that prevent or mitigate the effects of these types of events.

It explained that maintaining containment of hazardous materials and ensuring that safety systems work when needed are two of the primary responsibilities of any facility. While it is imperative to note that, asset integrity activities range from technical meetings involving experts seeking to advance the state-of-the art in equipment design, inspection, testing, or reliability, to a plant operator on routine rounds spotting leaks, unusual noises or odors, or detecting other abnormal conditions.

However, asset integrity activities involve the following mainly. They are:

1. Inspections, tests, preventive maintenance, predictive maintenance, and repair activities that are performed by maintenance and contractor personnel at operating facilities.
2. Quality assurance processes, including procedures and training, which underpin these activities.

Although, at an operating facility, the asset integrity element activities are an integral part of day-to-day operation involving operators, maintenance employees, inspectors, contractors, engineers, and others involved in designing, specifying, installing, operating, or maintaining

equipment.

In addition, asset integrity operations are expected to produce the following outputs. They are:

1. Reports and data from initial inspections, tests, and other activities to verify that equipment is fabricated and installed in accordance with design specifications and is fit for service at startup.
2. Results from ongoing ITPM tasks, performed by trained or certified personnel and based on written procedures that conform to generally accepted standards, that help ensure that equipment remains fit for service.
3. Controlled repairs and adjustments to equipment by trained personnel using appropriate written procedures and instructions.
4. A system to control maintenance work, repair parts, and maintenance materials needed for the work to help ensure that equipment remains fit for service.
5. A quality assurance program that helps prevent equipment failures that could result from I. Use of faulty parts/materials.

**Improper fabrication, installation, or repair methods.**

The main objective of asset integrity is to help ensure reliable performance of equipment designed to contain, prevent, or mitigate the consequences of a release of hazardous materials or energy. While a proper execution of asset integrity activities requires a high level of human performance, with the ultimate work output being in reliable and predictable equipment operation.

However, AIChE, states that an effective asset integrity depends on management ensuring the following. They are:

1. Equipment and systems are properly designed, fabricated, and installed.
2. The unit is operated within the design limits of the equipment.
3. ITPM tasks are conducted by trained and qualified individuals using approved procedures and completed as scheduled.
4. Repair work conforms to design codes, engineering standards, and manufacturer's recommendations.
5. Appropriate actions are taken to address deficiencies, regardless of how they are discovered.

According to Openlearningworld.com, an online educational review site, the performance of a system can be measured by two factors, viz., the efficiency and the effectiveness. The efficiency indicates the manner in which the inputs are used by the system. Being efficient means the system uses inputs in a 'right' way. If the input-output ratio is adverse, we say that the system is inefficient though it produces the desired output. Thus, its effectiveness is the measure for deciding whether the system provides the desired output or not. On the overall, a system has to be effective and efficient for the highest utility to the user of the system.

Banton (2022), defined efficiency as a measurable concept that can be determined using the ratio of useful output to total input. Increased efficiency minimizes the waste of resources such as physical materials, energy, and time while accomplishing the desired output. Which is



measurable and can be expressed as a ratio or percentage. Thus expressed mathematically below as

$$Efficiency = \frac{Output}{Input} \quad \text{known as equation (1)}$$

It went further to note the types of efficiency. They are listed below as follows:

1. Economic efficiency, which refers to the optimization of resources to best serve each person in that economic state.
2. Market efficiency, which describes how well prices integrate available information. This means that markets are efficient when all information is already incorporated into prices.
3. Operational efficiency, which measures how well profits are earned as a function of operating costs. The greater the operational efficiency, the more profitable the firm or investment.

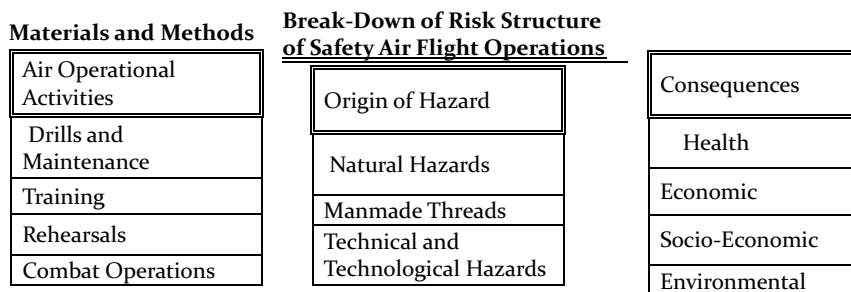
In addition, it described the impacts of efficiency as is an important attribute because all inputs are scarce. Hence, an efficient society is better able to serve its citizens and function competitively. Efficiency reduces hunger and malnutrition because goods are transported farther and quicker. Advances in efficiency also allow greater productivity in a shorter amount of time.

Dincer and Bincer (2020) defined efficiency as a measure of performance and effectiveness of a system or component. The main approach to define efficiency is the ratio of useful output per required input. Thus, efficiency assessment is critical for energy systems and it is broadly utilized for any systems and processes. As a result, if the efficiency definition is based on the first law of thermodynamics, it is termed energy efficiency. While, if the efficiency definition is based on the second law of thermodynamics, then it is termed exergy efficiency.

This mathematically expressed as the following below:

$$\eta_{en} = \frac{\Sigma E_{useful}}{\Sigma E_{input}} \quad \text{known as Equation (2)}$$

Wills and Finch (2016) defined efficiency as a measure of performance and effectiveness of a system or component. The main approach to define efficiency is the ratio of useful output per required input. If the efficiency definition is based on the first law of thermodynamics, it is termed energy efficiency.



Basically, every operations have its own structure. Thus for the purpose of this work, this risk structure of air safety flight operations will be adopted to do the analysis and review as a mini-Risk –informed case model.. This segments flight operation activities into three categories namely:

1. Air operational activities
2. Origin of hazard
3. Consequences

## Results and Discussions

### Summary of Nigerian air force Operational Incidents between 2015 and 2023

REF	Facility	Number Of Causalities	Type of Hazard Witnessed
3. 01	Airport Emergency Landing at Lagos airport	None	One of their jets lost its tyre
3. 02	Airport crash shortly after take- off from the Nnamdi Azikwe International Airport	7 NAF personnel	Death and Equipment wreckage
3. 03	Airport crash involving two pilots	Two pilots	Human disappearance and Equipment wreckage
3. 04	Military Beachcraft 350 aircraft crashed at the Kaduna, International airport.	Eleven people	Death and Equipment wreckage
3. 05	Alpha Jet Aircraft crashed in Zamfara	Unknown	Human disappearance and Equipment wreckage
3. 06	A trainer aircraft crashed in Kaduna	Two pilots	Death and Equipment wreckage
3. 07	Air force plane crash in Kaduna	Seven persons	Death and Equipment wreckage
3. 08	An F-7NI jet crashed	One person	Death and Equipment wreckage
3. 09	Augusta Westland 101 Helicopter crashed in Makurdi	Unknown	Equipment wreckage
3. 10	NAF Augusta 109 Light Utility Helicopter crashed in Borno River	None	Equipment wreckage
3. 11	Two F-7Ni aircraft crashed in abuja	One person	Death and Equipment wreckage
3. 12	NAF Mi-35M crashed near Damasak, Borno State.	Five persons	Death and Equipment wreckage
3. 13	NAF helicopter crashed while landing in Katsina State	None	Equipment wreckage
3. 14	NAF aircraft RV -6A Air Beetle crashed near Kaduna	Two persons (Pilot and Instructor)	Death and Equipment wreckage
3. 15	A Helicopter of the NAF crashed at the Enugu NAF base	None	Equipment wreckage

From the above, it clearly shows that between 2015 and 2023, the Nigerian air force witnessed fifteen key incidents. Whereby four incidents had no causality during occurrence. Five pilots were lost during this period in operational activities. While one instructor's life was claimed during the period under review. Seven personnel staff of the Nigerian air force lost their lives during this period. While fifteen people of different categories also lost their lives. Although, two operation are still under exhaustive review process with unknown number of causality. On the part of Asset and human management, the operations witnessed eight incidents of both human death and equipment wreckage. Though, with four incidents of equipment wreckage only. While it had two incidents of human disappearance and equipment wreckage, and one incident of tyre break-down and loss.

### Analytical Review of the Break-Down of Risk Structure Safety Air Operations

S/N	Risk Structure Analysis	Number of Incidents
1	Drills and Maintenance	Four
2	Training	Three
3	Rehearsals	One
4	Combat Operations	Seven
1	Natural Hazards	Two
2	Manmade Threads	Six
3	Technical and Technological Hazards	Seven
1	Health	At least eight
2	Economic	Fifteen
3	Socio- Economic	Fifteen
4	Environmental	Fourteen

From the method adopted earlier in materials and method, the risk structure analysis of Nigerian air force activities between 2015 and 2023 shows that during air safety operation, drills and maintenance recorded four safety hazardous incidents. Three safety hazardous incident were observed during training activities. Rehearsals witnessed one incident while combat operations recorded seven incidents.

On the origin of the hazard incidents, natural hazards were responsible for two incidents. While manmade threads were responsible for six incidents. Just as Technical and technological hazards were responsible for seven incidents. On the consequence of the operational incidents, the health issues that were involved were in eight incidents of air flight operations. While economic concerns were in all fifteen incidents. Just as the socio-economic details were raised in all fifteen incidents. While environmental concerns were in fourteen incidents only.

## Conclusions

Finally, from the review of the break-down of the risk air operations structure and flight operational incidents of the Nigerian air force between 2015 and 2023. It shows that Nigerian air force operations, observed some basic safety principles during operational activities. Although there is the need for integration of more elements into key components of the management facilities on asset integrity and maintenance to enhance reliability and efficiency in its operations. The institution can assess the AIChE principles of asset integrity, while integrating more RBI to enhance asset reliability and efficiency. This will not only sustain a global practice of asset maintenance and reliability but will set a standard in its overall operational activities thereby increasing productivity and quality service delivery.

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## AGRICULTURAL OUTPUT-FOOD PRICE NEXUS AND HOUSEHOLDS' WELFARE IN NIGERIA

<sup>1</sup>Ojiya, Emmanuel Ameh, <sup>2</sup>Asom, Simeon Terwuah, <sup>3</sup>Abe Maggai,  
<sup>4</sup>Gwadzang, Charity Isa, <sup>5</sup>Okoh, Abo Sunday,  
<sup>6</sup>Gisaor, Vincent Iorja & <sup>7</sup>Mohammed, Sekuru Abdullahi

<sup>1</sup>Food Economics, Centre for Food Technology and Research (CEFTER),  
Benue State University, Makurdi, Nigeria

<sup>2</sup>Department of Economics, Benue State University, Makurdi-Nigeria

<sup>3,4,5&6</sup>Department of Economics, Federal University, Wukari-Nigeria

<sup>7</sup>Department of Management, Nigeria Army University, Biu-Nigeria

### **Abstract**

*This paper evaluates agricultural output-food price nexus and the welfare of households in Nigeria. The study is essentially secondary data based and utilized the Autogressive Distributed Lags (ARDL) approach for its analysis. Findings revealed that agricultural output had no significant impact on households' welfare in Nigeria. It was also shown that government spending on agriculture was unable to significantly boost food production and hence food security in Nigeria during the time under reference. This portends grave concerns for the future, and in light of this, the government should reassess its current insignificant allocation to the sector. The study also recommends that government should provide funding to enhance technology in food production through the acquisition of sophisticated farm tools (harvesters, tractors, herbicides, and fertilizer) and the construction of irrigation / storage facilities, as well as the establishment of food processing industries throughout the country, in order to enable farmers to increase productivity, leading to reduced food prices and enhanced welfare for the citizenry.*

**Keywords:** Agriculture, Food prices, Welfare, ARDL and Nigeria

### **Background to the Study**

Despite the fact that agriculture accounts for only approximately a fifth of Africa's GDP and half of its export value, more than two-thirds of the population lives in rural areas and rely on agriculture for their livelihood (World Bank, 2014). Smallholder farming, productivity, profitability and sustainability are thus seen as the primary means of escaping poverty in the region. Agricultural research and development initiatives focusing on agricultural

intensification and modernization can contribute to increased agricultural productivity, reducing poverty and meeting rising food demand. Lower food prices may boost the purchasing power of low-income people (Olsson and Hibbs, 2005; Ravallion and Datt, 1998). Though agriculture is not a panacea for poverty reduction, but because the majority of impoverished people in Sub-Saharan African countries rely on it for their livelihoods, it can have a significant impact on poverty (Foster and Rosenzweig, 2005). Price changes, drought, pests, and illnesses are all common economic and ecological risks in agriculture. These dangers affect especially the impoverished and small-scale farmers. Global economic shocks can also have a negative impact on a country that relies on agricultural exports (Winters et al., 2004; Easterly and Kraay, 2000). Correspondingly, a sudden decrease in the prices of agricultural outputs can quickly push small net sellers into losses and poverty. Besides, poor smallholders face a slew of obstacles that limit their output, hence households are unable to intensify agriculture and produce high-value commodities due to a lack of information regarding production methods and market opportunities, particularly for novel crops and types.

One of the major determinants of welfare in Nigeria is an excessive reliance on subsistence farming, along with restricted access to profitable off-farm work and income-generating activities, which has retarded any meaningful growth. Several scholars have agreed that there is a strong link between agricultural output, government expenditure on agriculture, credit available to farmers, security of farmers and farming communities, unemployment, exchange rate fluctuations, and household welfare, particularly in developing countries. Nonetheless, the country's high poverty rate, geometric population growth, worsening insecurity as manifested in attacks by bandits, herders and Boko-Horamists as well as a low government expenditure on agriculture, and a pervasive culture of corruption have all had a detrimental effect on food production, resulting in higher food prices and thus reduced household welfare. Given that Nigeria is a food deficient nation amidst growing demand for food, market forces naturally influence price setting, resulting in many low-middle-income households spending the greater share of their income on food. Due to the fact that households' welfare is mostly determined by their purchasing power, numerous households suffer welfare losses as their purchasing power continues to decline.

Thus, Nigeria's enormous natural and human resources have not resulted in increased welfare, since poverty, youth unemployment; growing insecurity, official corruption, core inflation as well as food inflation have all remained elevated. It is also to this connection that household incomes and hence welfare have continued to nosedive, as a result of the country's low purchasing power, which has exacerbated the country's misery index, impoverishing more people daily. The likely leading effects of these distortions, manifested in decreased food production, accessibility and utilization, are the adoption of a variety of food coping strategies, culminating in food rationing, hunger, and malnutrition, and thus calorie deficiency among households. In essence, poor income results in excessive carbohydrate and other low-quality food intake, leading to welfare loss, health issues, and more poverty. Hence to this connection, the problematic of this study is to examine agricultural output, food prices and households' welfare in Nigeria using Nigerian data. While the paper's main objective is to examine agricultural output-food price nexus and the welfare of households in Nigeria; the specific objectives are as follows: (i) to investigate the effect of agricultural productivity on households' welfare in Nigeria; (ii) to examine the impact of food prices on households'

welfare in Nigeria; (iii) to determine the effect of government agricultural expenditure on households' welfare in Nigeria.

The study on agricultural output-food price nexus and households' welfare in Nigeria is carried out using quarterly data from 1999: Q1-2020:Q4. One important justification for the adoption of quarterly data is hinged on the fact that due to the frequency of occurrence of most economic variables, they are better measured or estimated in quarters. Furthermore, the choice of 1999 coincides with the period when Nigeria, upon transiting from military rule to democracy experienced several changes in the structure of the economy, leading to improved investment in the agricultural sector of the economy, as the return to democracy with less dictatorial tendencies signified investor's confidence in the economic potentialities of the country.

## **Literature Review**

### **Conceptual Clarification**

#### **Agricultural Productivity and Production in Nigeria**

Nigeria is Africa's most populous country (210 million people) and one of the largest in terms of land area (910,770 km<sup>2</sup>). It has the world's 27th largest economy, with a gross domestic product (GDP) of \$523 billion dollars and a per capita GDP of \$3,010 dollars in 2013 (World Bank, 2020). Although the agricultural industry employs 60% of Nigeria's working population and generates over 40% of the country's GDP, households whose primary source of income is agriculture have a higher rate of poverty (World Bank, 2014). Crop production, which accounts for 88 percent of overall agricultural GDP is the most important subsector (Mogues et al., 2014). From 2002 to 2012, the agricultural industry in Nigeria grew at a 5.9 percent annual rate, but it is suggested that this expansion is primarily due to population growth and the cropping of bigger tracts of land, most likely by commercial farmers (Oseni et al., 2014). Nigerian agriculture is predominantly rain-fed, with low productivity, little technology, and a high-labor intensity. This low agricultural production has been attributed to low fertilizer use, soil fertility degradation, and traditional tools, low technology, rain-fed farming practices. According to the literature, Nigerian farmers in all regions are below their production boundaries, indicating that there is room to boost agricultural productivity above present levels even without changing their current levels.

Low agricultural output in Nigeria is due to a variety of factors, including low input, inadequate use of farm technology such as improved seed and fertilizer, as well as increased insecurity across the country. More than 80% of Nigerian households attribute their poverty to agricultural issues, with lack of agricultural inputs and inability to afford inputs (such as fertilizers and seeds) accounting for 44% (Oseni and Winters, 2009). The large disparity in fertilizer use relative to prescribed fertilizer levels is frequently cited as one of the primary causes of Nigeria's low agricultural production. It has long been argued that among other constraints to improving fertilizer use in Nigeria are limited access of framers to extension services, an outdated land tenure system, climatic factors, an imperfect credit and capital market, spatial inequality distribution of fertilizer, high prices of other non-fertilizer inputs, and an insufficient fertilizer supply (Philip et al., 2009; Oseni et al., 2014).



### **Food Inflation and Food Accessibility in Nigeria**

Scholars are divided on the definition of inflation. While Gordon (1984) and Barro (1997) viewed inflation as a negative condition caused by a lack of monetary regulation, leading to higher prices in markets and reduces the purchasing power and hence the standard of living of average households, Barro (1997) on the other hand defined inflation as the gradual increase in the general level of prices for goods and services within an economy over time as a result of a shortage of either aggregate demand or aggregate supply, or both. Food inflation on the other hand is a term that refers to an increase in the average price of food goods in a country over a specified time period. According to Shankar (2019), food inflation is defined as an increase in the wholesale price index of a particular food item in comparison to the overall index or the consumer price index (CPI). More precisely, it is the increase in the cost of a staple food commodity relative to its previous price during a specified time period. Food inflation has a different meaning in affluent countries than it does in underdeveloped/developing countries. In rich countries such as the United States of America, Italy and Germany, an increase in food costs brings minor inconvenience to households and consumers, while in underdeveloped economies, an increase in food prices has severe repercussions for individual households' consumption patterns, since people may go hungry due to a lack of food. Although food grains are mostly viewed as commodities on the global market, they are the staple food of the poor in the majority of developing countries, which have a population of roughly two billion people (Kalkuhl, Matthias, von Braun, Joachim, and Torero, Maxim) (2016).

### **Households' Welfare**

The term "household" refers to the fundamental residential unit in which economic output, consumption, inheritance, child-raising, and housing are structured and conducted. From the 14<sup>th</sup> century, welfare was frequently used to refer to a condition of happiness, prosperity, or merriment. In economics, it relates especially to the utility received through the acquisition of tangible things and services. While Pigou (1920) and Moratti et al (2012) defined welfare as an individual's consumption resulting from income (money), they argued that household welfare is generally defined as the amount of money required or expended to sustain a consistent level of utility. As a result, this researcher defines household welfare as the aggregate happiness or value that individuals, households, or communities obtain from the consumption of certain bundles of products (food) or services, given their available financial resources. It is a state of well-being, pleasure, and comfort, or the degree of prosperity and standard of living achievable by an individual or a group of individuals as a result of the satisfaction gained from their income and consumption of certain bundles of commodities (food inclusive). An excellent example of welfare is having access to the food combinations necessary to maintain a healthy lifestyle for a person or household, given the purchasing power available at the time.

A prevalent theme in contemporary economic research is the quest to identify and quantify true welfare or well-being. Historically, economists utilized financial indices to assess welfare, including household income, consumption spending, gross domestic product (GDP) and consumer confidence (Slesnick, 1998). However, while other scholars adopt real income or expenditure as a proxy for household welfare, this research study utilizes final household consumption expenditure as a proxy for household welfare. This was justified by the notion that the amount of income spent by a customer on utility maximization is what in reality generates welfare. It encompasses all purchases made by resident households for daily necessities such as food, clothes, electricity, and transportation.

## **Theoretical Review**

### **Sen's Poverty and Famine Theory: An Entitlement Approach**

This theory propounded by Sen (1981) tied its arguments to the fact that hunger and famine for a very long time have been largely rooted in postulations made by Thomas Malthus' food availability approach. Sen did not contribute to challenging Malthus (1798)'s stance on food security until the early 1980s, when attention was shifted from national food availability to people's access to food in a dissertation on "entitlement and deprivation". The emphasis on food security in the entitlement discourse was an insistence on each individual's entitlements to commodity bundles, including food, by viewing famine as a result of households' failure to be entitled to the bundle(s) that assures them of sufficient food to improve their welfare (Sen 1981). Sen's Poverty and Famine Hypothesis is adopted for this study *as it best provides answers to the discourse on food security and households' welfare in developing countries, particularly Nigeria.*

## **Empirical Review**

In a cross-sectional survey, using Foster–Greer–Thorbecke and probit regression model, Ogunniyi, Omotoso, Salman, Omotayo, Olagunju and Aremu, (2021) investigated the factors determining households' maize production in Nigeria and found that the value of output sold, education, credit access and participation in government safety nets programme significantly influenced food security among maize farmers in the study area. Deriving from the findings, it was recommended that efforts should be intensified to enhance the productivity of land through improved production practices.

Similarly, in a study on food insecurity in conflict affected regions in Nigeria's North-East, North-Central, and South-South zones, the World Bank (2017) using data from emergency response survey conducted via telephone calls among households in three affected regions between August-September 2017 conducted a research and found that the mean household in all the three regions is "highly food insecure"; North-East of Nigeria is the most food insecure of the three regions; reducing meals or portion size is the most important coping strategy in all three regions; food prices are the most important source of food insecurity in all three regions. The study recommended that, attention should be paid to increased food productivity, particularly in the Northeast and North Central, which rely heavily on agriculture as their main source of livelihood.

Furthermore, utilizing a point-analysis survey, Onwusiribe, Nto, Oteh and Agwu (2021) through the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) and Auto-Regressive Distributed Lag (ARDL) models examined the dynamics of food price volatility and households' welfare in Nigeria: implications for post-COVID-19 recovery: Data for the study which was sourced from FAO and the World Bank revealed that food prices, depth of food deficiency, food import, and food production index had a significant short-run impact on households' welfare in Nigeria. Policy recommendations were aimed at focusing on the short-term benefits while formulating policies aimed at households' welfare in the longrun.

In another study using a Random Sampling Technique with Quadratic Almost Ideal Demand System (QUAIDS) technique and the Compensated Variation model, Olubokun and Agbede (2018) studied the effects of food price inflation on households in Ondo State and found that apart from plantain, all other estimated expenditure elasticities were all positive and

statistically significant, indicating that all the food items are normal goods. The scholars concluded that since all households in Ondo State suffered welfare losses from hike in food prices during the referenced period, government should as much as possible try to subsidize the prices of foodstuffs to make it easily accessible to households in Ondo State for improved welfare.

Additionally, in using time series analysis, Egwuma, Ojeleye and Adeola (2017) employed econometrics techniques of cointegration and error correction mechanism to empirically examine the relationship between food price inflation and key demand and supply variables including real gross domestic product, food import and crude oil price for the case of Nigeria between 1988 and 2017. Findings indicated that real GDP, food import, and crude oil price were positively related to food price inflation in the long-run. The coefficient of the error correction term was found to be statistically significant and showed that the dynamics of food price inflation in Nigeria is characterized by a relatively sluggish process of adjustment to the long-run equilibrium. The study recommended for the adoption of appropriate policies and creation of an enabling environment that significantly encourages increased domestic food production.

### Study Methodology

#### Data, Sources and Method of Data Analysis

The variable used for empirical testing includes Agricultural output (Ag-output), Agricultural Expenditure (AGX), Food prices (Fprice), Population Growth (POPGR), as the core independent variables while Security (SEC) served as the control variable to avoid the challenge of variable omission. The data are sourced from the National Bureau for Statistics (NBS) database, Central Bank of Nigeria (CBN) Statistical bulletin and World Bank Development Indicators (WBDI) respectively. The Autoregressive Distributed Lags (ARDL) Regression, the Augmented Dickey Fuller (ADF) Unit Root Test and the ARDL Bounds Test to Cointegration were adopted as the main analytical tools of analysis in this study, using E-views 9.0 econometric software.

#### Model Specification

The method of estimation employed for this study is based on Auto-regressive Distributed Lag (ARDL) Model approach and Error Correction Mechanism (ECM) model. The ARDL modeling approach popularized by Pesaran and Pesaran (1997), Pesaran and Smith (1998), Pesaran and Shin (1999), and Pesaran et al. (2001) has numerous advantages. The main advantage of this approach lies in the fact that it can be applied irrespective of whether the variables are I(0) or I(1) and that none of the variables is stationary at 1(2) and beyond (Pesaran and Pesaran 1997). This study illustrates the ARDL modelling approach by considering the following equation:

$$\text{Ln(Hwfare)} = \lambda_0 + \lambda_1 \text{Ln(Agoutput)} + \lambda_2 \text{Ln(AGX)} + \lambda_3 \text{Ln(Fprices)} + \lambda_4 (\text{POPGR}) + \lambda_5 (\text{SEC}) + \mu_t \quad (\text{eqtn 1})$$

Where:

Hwfare	=	Households' welfare
Agoutput	=	Agricultural output (productivity)
AGX	=	Government Expenditure on Agriculture
Fprices	=	Food prices (proxy for food inflation)

POPGR	=	Population growth rate
SEC	=	Security of lives and properties across the federation
Ln	=	The natural log
$\mu_t$	=	Stochastic error term

Moreover,  $\lambda_0, \lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5$  are the respective parameters.

The equation of ARDL is as follows:

$$\Delta \text{Ln(Hwfare)}_t = \beta_0 + \beta_1 \text{Ln(Agoutput)}_{t-1} + \beta_2 \text{Ln(AGX)}_{t-1} + \beta_3 \text{Ln(Fprices)}_{t-1} + \beta_4 (\text{POPGR})_{t-1} + \beta_5 (\text{SEC})_{t-1} +$$

$$\sum_{i=1}^n \alpha_1 \text{Agoutput}_{t-i} + \theta_2 \text{AGX}_{t-i} + \sum_{i=1}^n \delta_3 \text{Fprices}_{t-i} + \sum_{i=1}^n \delta_3 \text{POPGR}_{t-i} + \sum_{i=1}^n \lambda_4 \text{SEC}_{t-i} + \mu_t \dots \text{ (eqtn 2)}$$

If the existence of a long-term relationship between the variables is borne out, the second stage in the analysis consists in estimating the short- and long-term parameters, using the ARDL approach. Once the long-term relationship between the variables is determined, then the estimates of the long-term ARDL can be obtained. If a long-term relationship between the variables exists, then there also exists an error-correction representation. Consequently, the error correction model is estimated in the third step; it indicates the speed of adjustment to long-term equilibrium following a short-term shock. A general error-correction representation of equation is formulated as follows:

$$\Delta \text{Ln(Hwfare)}_t = \beta_0 +$$

$$\sum_{i=1}^n \alpha_1 \Delta \text{Agoutput}_{t-i} + \sum_{i=1}^n \theta_2 \Delta \text{AGX}_{t-i} + \sum_{i=1}^n \delta_3 \Delta \text{Fprices}_{t-i} + \sum_{i=1}^n \Omega_4 \Delta \text{POPGR}_{t-i} + \sum_{i=1}^n \lambda_5 \Delta \text{SEC}_{t-i} + \varphi_1 \text{ECM}_{t-1} + \mu_t \text{ (eqtn 3)}$$

Where

$\varphi$  = Speed or rate of adjustment;  $\alpha_1, \theta_2, \delta_3, \Omega_4, \lambda_5$  represents the coefficients of the variables respectively;  $\Delta$  is the difference operator,  $n$  is the lag length of the variables;  $ect_{t-1}$  denotes the residual from the cointegration equation (the error correction term), and  $\mu_t$  is the uncorrelated white noise residuals.

### Apriori Expectation

An *a priori* expectation is a theoretical statement or criteria set by economic theory. The study evaluates agricultural output-food prices nexus and households' welfare in Nigeria. Ordinarily, on a priori, some parameters in the model such as agricultural output, government expenditure on agriculture, population growth and security of lives and properties, all things being equal are expected to turn out positive, as an increase in any of these variables connotes higher agricultural output and hence improved households' welfare. Similarly, excepting food prices, the coefficients values of security of lives and properties is expected to come out positive, implying that improved security among farmers and farming communities, all things remaining equal would translate to more food production, thus leading to reduced food prices for the various households.

### Results and Discussion

#### ADF Unit Root Test

Table 1 summarizes the findings of the Augmented Dickey-Fuller (ADF) test which was

employed to determine the stationarity properties of the series in the model. This was aimed at establishing whether the series are stationary and exhibit random walk in tandem with the stochastic process.

**Table 1: Augmented Dickey Fuller (ADF) Unit Root Test**

Variable	Level t-statistic value	1 <sup>st</sup> Difference -t-statistic value	5% critical value	Order of Integration
Hwfare	-4.589590	****	-2.897223	I(0)
AGAX	-2.899619	****	-2.899619	I(0)
FPRICES	-3.109868	****	-2.895512	I(0)
POPGR	****	-3.204429	-2.895512	I(1)
SEC	-3.800537	****	-2.898623	I(0)

**Source:** Extracts from E-views version 10

The unit root test indicates that the variables in the models are integrated of order zero I(0) or I(1) i.e. first difference stationary respectively. However, since all the variables are not integrated of the same order but having revealed a mix order of integration, that is, combination of I(0) and I(1) as shown above, the use of Johansen co-integration test becomes untenable, hence the appropriate technique is the application of the popular Autoregressive Distributed Lags (ARDL) bound for co-integration to determine the existence of long-run relationship amongst the variables in the model. But to achieve this, a suitable lag selection criterion was determined.

### Lag Selection Criteria

Before delving into the complexities of the cointegration test, it is crucial to choose a suitable lag length. Estimating the lag length is a critical step in many econometric analyses. To determine the appropriate number of lags to be selected during model estimation, the lag length is selected using explicit statistical information criteria obtained through unrestricted VAR estimate. The study employed the Akaike Information Criterion as the suitable lag selection criteria. See appendix page. The maximum number of lags that could be taken in this study was determined to be seven, utilizing Akaike Information Criterion (AIC), and this was selected for the estimation of a parsimonious model.

### ARDL Bounds Testing

Since all variables are not integrated of the same order, but a combination of I(0) and I(1), the ARDL bounds testing method to cointegration (Pesaran & Shin, 1999; Pesaran, Shin, & Smith, 2001) was used to determine if there is cointegration or evidence of long-run relationship between the variables included in the model. The test requires that the F-statistic value be greater and above the upper and lower bound critical values at the chosen level of significance, in this case 5% threshold; otherwise, no long-run relationship exists. Below is the summary of findings from the Bounds testing.

**Table 2: ARDL Bounds Testing**

Level of Significance	F-statistics value (K)	Lower Bound I(0)	Upper Bound I(1)
10%	8.972705 (5)	2.26	3.35
5%		<b>2.62</b>	<b>3.79</b>
2.5%		2.96	4.18
1%		3.41	4.68

**Source:** Extracts from E-views 10

From Table 3 it was revealed that the F-statistic value of 8.9 is greater than the upper bounds value of 3.79 at the 5% level of significance for the ARDL model. This is thus a confirmation of a unique long-run relationship among the variables in Nigeria during the referenced period.

### Longrun and Shortrun (ECM) Analysis

An empirical ARDL model estimated to determine the long-run and shortrun relationship between the regressors and the regressand, revealed the following, as presented in Table 4.

**Table 3(a): Longrun Regression Output**

**Dependent Variable:** Household's welfare (Hwfare)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AGOUTPUT	-0.012016	0.017839	-0.67359	0.5027
AGAX	-0.02382	0.010329	-2.306094	0.0239
FPRICES	0.078073	0.02062	3.786199	0.0003
POPGR	0.067904	0.039239	1.730524	0.0877
SEC	0.002773	0.009312	0.297823	0.7667
C	3.231718	0.119216	27.108131	0.0000

**Table 3(b): Shortrun Regression Output**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(AGOUTPUT)	-0.030023	0.00574	-5.230383	0.0000
D(AGAX)	0.000878	0.002719	0.322931	0.7477
D(FPRICES)	0.011744	0.003409	3.44492	0.0009
D(POPGR)	0.068663	0.033313	2.061131	0.0428
D(SEC)	0.004658	0.00268	1.738256	0.0863
ECM(-1)	-0.150426	0.035728	-4.210323	0.0001

R-squared: 97%

**Source:** Extracts from Eviews version 10

After proving the existence of a long-run relationship between the variables of the model, the second step of the methodology consists in searching for the long and short-term coefficient estimates of the model. Table 3(A) and (B) presents the estimates of long run and short run results respectively. The explanatory power of the regression model with an r-squared of 97% is impressive. This revealed that 97 percent of the variation in households' welfare is explained by the independent variables agricultural output, government spending on the agricultural

sector, food prices, population growth and the level of security prevailing at the time. The remaining 3 percent is explained by the stochastic error term, that is, variables not captured in this model. The model is therefore adjudged to have a good fit and useful for making generalization within this period.

The output from the longrun autoregressive distributed lag above is quite revealing and call for urgent policy review on the part of policymakers. Except for the coefficient values of agricultural output and the level of security prevailing in the country, Table 3(A) revealed that all other variables in the agricultural output-household welfare equation were statistically significant in explaining the model in the long run. However, short-run estimates indicated that, aside the coefficient value of government expenditure on agriculture (AGAX), all other series in the model were statistically significant predictors of households' welfare during the quarters examined. For instance, it was shown that both in the long and short term, a unit decline in the index of agricultural productivity resulted in a corresponding decrease in Nigeria's aggregate food stock, hence households' welfare was negatively affected.

Similarly, evidence from long-run estimates indicated that government expenditure on agriculture had a detrimental effect on food supply in Nigeria during the quarters analyzed. That is, each unit decrease in food production was as a result of a fall or decline in government investment in the agricultural sector. This may be related to the activity of non-state actors who have rendered government investment in the field fruitless. In addition, it was revealed that food prices in the longrun and shortrun revealed statistically significant influence on households' welfare as it clearly showed that increasing food prices translated to reduced welfare for the average Nigerian.

Additionally, the computed coefficients for the longrun and shortrun estimates in Tables 4 indicated that population increase was statistically significant and hence had a considerable impact on agriculture output and thus the welfare of Nigerian households during the referenced periods. The coefficients of 0.067904 and 0.068663 revealed that each additional or upward movement in population growth has a proportionately injurious or negative effect on agricultural productivity and thus households' welfare. Furthermore, Table 4 revealed that the coefficient value of security was positive and exerted statistically significant influence on households' welfare both in the longrun and short-term within the period examined. Specifically, it was revealed that for every percentage rise in the cases of political violence, terrorism, banditry, kidnapping and mindless killing of vulnerable farmers, a proportionate decrease or decline is occasioned in the food production sector of the economy, triggering higher food prices and hence reduced welfare for households.

Finally, the slope coefficient of the error correction term (-0.150426) represented the rate of adjustment and is also consistent with the long-run equilibrium convergence hypothesis when the agricultural output-food prices and household welfare equations are disturbed. Given system innovation, the error correction term suggested that it will take approximately 15 percent, i.e. 6 years, six months, and a nine weeks speed of adjustment to attain equilibrium in the system. Although the rate of adjustment is sluggish, the ultimate convergence to an equilibrium state is contingent on the effectiveness of government initiatives aimed at resolving the incidence of low food output and hence rising prices.

### Post Estimation Analyses

This section examines the usefulness, robustness and reliability of the estimated models by conducting diagnostic tests. Basic diagnostic tests such as serial correlation test, heteroscedasticity test and normality test were conducted. The results are shown in Table 5.

**Table 4: Post Estimation Analysis**

S/N	Test	F-Statistic	P-Value	Decision
1	Breusch-Godfrey Serial Correlation LM Test	1.024030	0.3645	Accepted
2	Heteroskedasticity Test: Breusch-Pagan-Godfrey	1.769128	0.0458	Rejected

**Source:** Author's Computation Using E-views 10

From the Heteroskedasticity Test: Breusch-Pagan-Godfrey test results, the hypothesis of zero homoscedasticity in the residuals were rejected. This was because the probability value of 0.0458 which is less than 5%. However, the Breusch-Godfrey Serial Correlation LM test revealed an insignificant value of 0.3645, which is in excess of 0.05. This leads to the rejection of the presence of serial autocorrelation in the residuals thus concluding that the residuals are serially correlated. It can therefore be deduced that the model is valid and useful for policy making.

### Test of Hypotheses

Three hypotheses are formulated and tested as follows:

Ho<sub>1</sub>: Agricultural output has no significant impact on households' welfare in Nigeria.

Ho<sub>2</sub>: Food prices does not exert any significant effect on the welfare of Nigerian households.

Ho<sub>3</sub>: Government expenditure on agriculture has no significant impact on households' welfare in Nigeria.

To conclude on the three hypotheses above, t-statistic and p-values for the longrun coefficients shall be used. Consequently, in reference to the longrun regression output in Table 3(A&B), it is concluded as follows: Agricultural output has no significant impact on households' welfare in Nigeria; on the other hand, government spending on the sector was found to have a significant, though negative effect on output growth during the period examined, even as, food prices exerted significant adverse effect on households' welfare during the periods examined.

### Concluding Remarks

This paper evaluated agricultural output-food price nexus and the welfare of households in Nigeria. The study is essentially secondary data based and utilized various econometric tools. The study found evidence of a unique longrun relationship between the dependent and independent variables in the model. Similarly, results from the longrun and shortrun regression succinctly revealed that agricultural output had no significant impact on households' welfare in Nigeria; secondly, that, government spending on the sector was found to have a significant, though negative effect on output growth during the period examined, just as, food prices exerted significant but adverse effect on households' welfare within the referenced periods.

In concluding therefore, this study states that the longrun inverse relationship between



government spending on agriculture and food production confirmed the fact that government spending on the sector was unable to significantly boost food production, leading to food insecurity in Nigeria during the referenced period. Consequently, the government should reassess its current meagre budgetary allocation to the agricultural sector. There is no gainsaying the fact that food production is, without a doubt, a serious enterprise that merits all the attention it receives. Given that when food production increases, the likelihood of being unable to access food decreases significantly, thus reduced government spending on agriculture and the risk of misappropriation deny farmers access to agricultural inputs such as pesticides, fertilizers, improved seedlings, tractors, and harvesters, all of which have a detrimental effect on overall agricultural output, leading to an inevitable demand-supply gap and hence higher food prices. Consequently, it is further recommended that the various anticorruption agencies, including the Economic and Financial Crimes Commission (EFCC) and the Independent Corrupt Practices and Other Related Commission (ICPC) should be strengthened to punish all involved in cases of misappropriation of budgeted funds to the agricultural sector.

Finally, to ameliorate citizens' plight in combating the current wave of rising food prices, government should also earn for more sustainable food production and this they can achieve by improving on security. Government and its security agencies should therefore go beyond its present propaganda and grandstanding and provide a peaceful environment for farmers. They should be more proactive and devise workable strategies aimed at de-escalating growing tension across Nigeria's six geopolitical zones including the Federal Capital Territory Abuja, so as to allow farmers to return to more productive farming activities as soon as possible.

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**Appendix I:  
Lag Length Selection Criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-4359.311	NA	3.57e+37	112.0080	112.2799	112.1168
1	-3504.472	1490.489	8.72e+28	92.16595	94.88523	93.25453
2	-3343.816	243.0442	1.22e+28	90.12348	95.29011	92.19178
3	-3288.619	70.76462	2.92e+28	90.78511	98.39909	93.83313
4	-3168.253	126.5384	1.66e+28	89.77573	99.83706	93.80347
5	-2554.669	503.4542	4.47e+22	76.11971	88.62839	81.12716
6	-2369.381	109.2719	1.42e+22	73.44568	88.40171	79.43285
7	-2003.904	131.1971*	1.90e+20*	66.15138*	83.55477*	73.11828*

**Source:** Author's extract from E-views 10;

LR: Sequential Modified Test Statistic

FPE: Final Prediction Error

AIC: Akaike Information Criterion

SC: Schwarz Information Criterion

HQ: Hannan-Quinn Information Criterion

**Note:** \* indicates lag order selected by the criterion.



## ENTREPRENEURSHIP STRATEGIES FOR GOOD GOVERNANCE AND SUSTAINABLE DEVELOPMENT IN NIGERIA

<sup>1</sup>Rufa'i Muhammad Gezawa & <sup>2</sup>Miswaru Bello

<sup>1</sup>Department of Fine and Applied Arts  
Sa'adatu Rimi College of Education Kumbotso, Kano  
<sup>2</sup>Department of Psychology  
Sa'adatu Rimi College of Education Kumbotso, Kano

### *Abstract*

*Nigeria as an independence society and in which is among the developing nations with full of human and natural resources but yet it faces a lot of problems for the growth and sustainable development. The problems are many such as unemployment, insecurity, hunger, sectionalism, poverty and among others which all occur as a result of lack of good governance. The paper gave out conceptual idea of sustainable development, challenges visage toward sustainable development in Nigeria. Survey research was conducted in this study and public views and attitude of good governance were obtained. Based on the findings of study some recommendations were offered among others; the findings showed the strategies of entrepreneurship for good governance and sustainable development in Nigeria. Encouraging entrepreneurship among our youth, entrepreneurs should obtain qualities of leadership as innovators, risk takers with a view to generate more revenue, opportunity recognizers, managers, job providers, to ensure good decision making in order to obtain good leadership for sustainable governance.*

**Keywords:** *Entrepreneurship, sustainable development, governance, leadership, entrepreneur*

### **Background to the Study**

Indeed, in every given society there must be governance under the control of whatever the type of leadership (i.e. political, military, traditional etc) for the purpose to have stable peace and development. People are always needed to have good peaceful environment for their daily activities such as for economics activities, religious, political, social, educational and

commercial among others, which are only achieved successfully as a result of good leadership. Therefore, best leadership is the backbone of good governance that led to results to the sustainable development of every society (UNDP, 1997). The system of governance we are operating goes away differently from where to achieve sustainable development because it involves a lot of irregularities and personal interest which will never bring to the sustainable development rather than downgrading the society. Good governance regarded as government that operates with set of law and order, open policy of administration, with transparency, accountability and treat each citizen equally (Raheem *et al*, 2019)

The structure of three tier of government we are operating is very simple and easy to achieve sustainable development. The structure classified that each tier has its own council that enable them to operate independently in order people to participate administratively, to participate in leadership through political opportunity, to know their rights, to identify law and order and to enjoy other societal development easily (Odigbo, 2013). This indicates that local government is the simplest avenue in which objectives of sustainable development can be easily achieved but presently there is less commitment on all these issues due to personal interest of states government operators. World Bank (1992) highlighted good governance as “it is the means by which power is exercised in the management of a country's economic and social resources for development”. Based on this assertion of World Bank, Nigeria has available resources that enable governments to handle and operate the good governance system which easily to achieve sustainable development successfully. The resources that support our economic capacity to run governance include crude oil, mineral resources such as; coal, gold, iron, and agricultural produce as well as human resources among others that are too numerous to mention.

According to Okibe, (2013) in Potter (2000), Good leadership results to good governance which is seen as “sound development management” especially for the management of the citizens and their resources, rights, involvement in decision making, legal framework, dissemination of information and technology, capacity building, appropriate policy making, accountability and transparency and able to put them into proper practice. Good government is the foundation of sustainable development because such type of government is always engaged in executing projects for economic growth, social development, environmental protection and development, elimination of poverty and hunger for the well-being of its people (Raheem, *et. al*, 2019). Good government is always engaged in providing proper implementation of rules of law, transparency, accountability, allow members participatory in the society in order to obtain peaceful and comfortable environment. Good governance is simply the total commitment of government administratively over the affairs of its citizens and their society especially their legal right and interest without any differences (UNDP, 1997). It is the type of government that listen to its citizens either the poorest or richest in decision making for the benefit of development resources, political, social and economic development. Although social and economic are based on compromise among stakeholders of states, private sector and civil society. According to UNDP, state provides a good political and legal atmosphere, private organization provides jobs and incomes, and civil societies facilitate political and social interaction. In which if these are successfully achieved the tendency of poverty, hunger, unemployment and insecurity will be reduced or eradicated totally in the societies.

### **Sustainable Development**

Citizen always hopes to live comfortably in his present and future life in a Conducive environment as well as for his generation, but never to achieve this goal unless he has a total committed government for this purpose. This makes good governances globally to be engaged in sustainable development program in order to save their citizens from any challenges of life as well as prepare for the wellbeing of their future generation. Best governments take care of societal development, economic development and ecological development for the present people and future generation usage without any afraid of hunger, poverty, unemployment and many among other issues. Brundland, (1989) defined sustainable development as development that “meets the needs of the present without compromising the ability of future generation to meet their own needs.” Therefore, it is clearly understood that sustainable development is the responsible of government to provides all necessary requirement for the better life for both present generation and the future ones (i.e. people centre). This means good leadership try to take care all the available resources and policies into consideration for the benefit of present people and the future generation benefits without any scared especially their economics, ecological and necessary social requirements. Whenever these are achieved, it reflects there is good governance practice which always results to have a sustainable development society. In another perception sustainable development is the government policy where future generations to benefit and enjoy life equally without any compromise with present generation benefits (Todaromand Smith, 2003) and this perception is equally the same with World Commission on Environment and Development (WCED, 1987; Elliot, 1994).

Therefore, sustainable development is the right situation which is provided by good governance for the life of its present people without any concession with the expected coming people in future. In respect of good government, it always committed in providing health, portable and hygienic drinking water, protection and maintenance of all types of forests, improve their financial gain in order to eliminate poverty, enforcement of civil law and order for their right and security, as well as many other engagements for the sustainable development of their society and the nation in general. Government emphasizes human development as part of development by preparing individual with skills and knowledge for self-reliant jobs as well as provide educational programmes which all serves as keys of promoting sustainable development of the society (UNSD, 1992). Presently the strong sustainability is the involvement and support of green economy, environmental protection as well as protection of natural resources which assist in the provision of food security and other financial income (Davies, 2013).

### **Entrepreneurship**

Entrepreneurship simply means total commitment of an individual to be involved into business activity for his financial benefit which if financial benefit is successfully achieved, some key pillars of sustainable development (i.e. economic, society and environment) will also be achieved. Entrepreneurship can be serves as remedy to Nigerians' problems such as unemployment, low productivity, poverty, inequality and many other issues (Devine & Kiggundu, 2016). Entrepreneurship is an essential component of the economic growth and development, encourage innovation and job creation for the human and environmental development (Voda and Florea, 2019).

Report of general assembly of the United Nations Seventy-seventh Session Item 18 of the provisional agenda of Sustainable development of 29<sup>th</sup> July, 2022, agreed that entrepreneurship has very important role in achieving the sustainable development goals. Entrepreneurship is part of sustainable development being it comprises some of sustainability pillars such as economic, ecological and social goals which are integrated into business enterprises activities, encouraging having peaceful environment when identifying and pursuing business opportunity by an entrepreneur as well as avoidance of any harmful thing on that environment (Reijnders, 2021). Sustainable development is agitating peaceful environment for an individual to carry out his activities without any harm, which this serves as pre-requisite requirement of an entrepreneur in carry out his business activities without fear of any risk for the boost of his and societal economy.

Entrepreneurship is the ability in the creation of wealth through establishment of small and medium business enterprises (SMEs) which lead an individual to use his available ecological resources, convert them to useful forms for self-reliant, create other businesses opportunities, innovation, provide jobs to people, boost financial gain within the society, enable government to generate more incomes for execution of projects that support and uplift the standard living of its citizen as part of sustainable development goals (ITC, 2019). Entrepreneurship leads to high rate of investment into micro, small and medium business enterprises and offer them sources of accessing fund which enable us to meet level of productivity, to reduce high number of unemployment and alleviate high level of poverty and hunger among societies for the successful achievement of sustainable development goals in African countries (Brixiova et al., 2020).

### **Methodology**

Survey research was used in this study. Survey research is conducted to access opinions of people, attitude on particular issue such as policy, project or method of doing something. Survey research is employed in my research in order to obtain views of people on role of entrepreneurship education for national security. Simple random sampling technique was used to select the sample of the study from the population of the study. The population of the study is Two hundred (200) and researcher was able to be retrieved one hundred and fifty-four (154) Questionnaires which were used as a sample for the study across students of undergraduate studies who participating entrepreneurial training. Questionnaire was used for the data collections which are divided into Likert type 5. Reliability co-efficient of 0.59 after the test and re-tests was recorded which makes the items to posses' moderate internal consistency for information generation. Descriptive statistic was used to answer research questions.

### **Research Questions**

1. What are sustainable developments goals emphasizing?
2. What kinds of attitudes our leaders are playing in governance toward the sustainable development in Nigeria?
3. What kinds of strategies entrepreneurship consist for good governance and achievement of sustainable development?



**Table 1: Sustainable Development**

ITEMS	N	Mean	Std Deviation	Remark
It emphasizes on human development such as education, health	154	4.3052	.83492	Good
It urges on national resources for both present and future generation benefit	154	3.9675	1.12267	Good
To provide all abilities to eradicate unemployment, poverty and hunger for the standard of living	154	3.8117	1.24075	Good
It purposely to boost economy, social and environmental sustainability	154	4.0584	1.03682	Good
It encourages human right, equal consideration, enforce law and order for secured and peaceful environment	154	3.8377	1.12297	

Table 1 is the result on the main idea of sustainable development suppose be in Nigeria based on 2.5 decisions mean. The result shows a mean of 4.3052 of total respondents (154), indicating that human development is among of the main purpose of sustainable development program at  $sd = 0.83492$ . In the same table, 3.9675 mean of the respondents indicated taking care of national resources for both present and future benefit is main effort governments suppose to exhibit for sustainability development in Nigeria at  $sd = 1.1227$ . The mean 3.8117 of the respondents indicated to set all avenues to eradicate poverty, hunger and unemployment in our society is among of the main aims of sustainable development at  $sd = 1.24075$ . The mean 4.0584 of the respondents agreed sustainable development focused on boost of economic, social and environment development at the  $sd = 1.03682$ . The main 3.8377 of the total respondents indicated that human right, equal consideration, security are also parts of aims of sustainable development at  $sd = 1.12297$

**Table 2: Good governance in Nigeria**

ITEMS	N	Mean	Std	Remarks
The leaders do their best in utilization and preservation of our resources properly	154	2.7403	1.52455	Good
Governments provide all necessary facilities for human capacity such as education, skills, health	154	1.44645	2.6688	Fair
All necessary action are in place for security and equal opportunity across our states	154	1.47539	2.7727	Fair
They provide all necessary support for SMEs in order to create jobs opportunity for economics, environmental growth and employment across the states	154	1.47855	2.9418	Fair
They provide subsidies and empowerment programmes to eradicate poverty and hunger among citizens	154	1.40573	2.8961	Fair

Table 2 is the result of good governance for sustainable development in Nigeria. The main 2.7403 of 154 respondents indicated that the leaders utilize and reserve our resources properly for sustainability at sd = 1.52455. The main 1.44645 of the respondents indicated governments provide all necessary facilities for human capacity in their effort to achieve sustainable development at sd = 2.6688. The main 1.47539 of the respondents indicated governments provide security and equal opportunity across the states for sustainable development at sd = 2.7727. The main 1.47855 of the total respondents indicated that government support small scale and medium business enterprises for the purpose to create jobs opportunities for economic, environmental and development across the states at sd = 2.9416. The main 1.40573 of the total respondents indicated that government provide subsidy and empowerment for eradication of inflation, poverty and hunger among Nigerian citizens at sd = 2.8961

**Table 3: Entrepreneurship Strategies**

ITEMS	N	Mean	Std Deviation	Remarks
Creation of jobs opportunities which reduce unemployment	154	3.8591	1.33053	Good
Enhance income generation which leads to societal and national economic growth	154	3.5390	1.37738	Good
Produce self-reliant and wealth among individual for poverty and hunger eradication	154	3.8831	1.27288	Good
Entrepreneur posse's qualities of leader (i.e. encourage employees' right, motivation, follow of information, transparency, accountability etc) for good governance in order to achieve sustainability in business organization	154	3.7403	1.20893	Good
It enhances innovation and creativity for transforming available resources within an environment to useful form for economy, environmental and societal development as part of good governance and sustainable development	154	3.8247	1.14978	

Table 3 is the result that shows entrepreneurship strategy for good governance and sustainable development in Nigeria. The main 3.8571 of the total respondents of 154 indicated entrepreneurship create jobs opportunity for governance and sustainable development at sd = 1.33053. The main 3.5390 of the respondents indicated entrepreneurship enhance sources of income for societal and economic growth for good governance and sustainable development at sd 1.37738. The main 3.8831 of the respondents indicated entrepreneurship prepare an individual to be self-reliant that enable to do away poverty and hunger for him to have standard of living at sd = 1.27288. The main 3.7403 of the respondents indicated entrepreneurship prepare an individual with qualities of leadership that make him to governing organizations with motivation, transparency, accountability, encourage right for the growth and

sustainable development of at  $sd = 1.20893$ . The main 3.8247 of the total respondents indicated entrepreneurship enhances innovation and creativity for transformation available resources with an environment to useful forms for the economic growth and societal development in order to achieve good governance for sustainable development at  $sd = 1.14978$

### **Recommendations:**

1. Basically sustainable development is much concern in human development and care of available resources for the goodness of present and future generation. Base on the study it is recommended to prepare series of workshops, seminars, conferences on sustainable development for the government officials, politician and enlightenment campaign for others societal stake holders as well as ordinary citizens.
2. In line with this study the good governance for sustainable development in Nigeria is not encouraging and need to be improved. This can only be succeeded through,
  - i. Taking care of citizens' daily needs such as foods, education, shelter etc which will leads to minimize corruption among the society
  - ii. Enforcing law and order among the society
  - iii. Awareness campaign to various categories of Nigerian citizens
  - iv. Establish provision of war against of indiscipline.
3. Good governance for sustainable development program involves a lot of money and entrepreneurship contributes to the growth and sustainable economy development of societies and the nation in general. Therefore, entrepreneurship serves as the source of generating financial income for governments which assist them to execute projects such as sustainable development successfully. In addition, entrepreneurship on itself is part of sustainable development objectives because it can assist governments in creating jobs opportunity for our youth, prepare an individual to be self-employee, alleviate poverty, eradicate hunger and enable to have secured environment as well as encourage innovation for the utilization of our resources into use. Therefore, in order to succeed sustainable development, governments are advice to encourage entrepreneurship at all level of our communities, provide a provision of capital for business start-up and take measures on importing goods and services for the advantage of our entrepreneurs to sell their own products and services.

### **Conclusion**

Entrepreneurship strategy for good governance and sustainable development in Nigeria, the study indicated that entrepreneurship strategy enable our governments to achieve sustainable development because it involves many objectives of sustainable development such as self-employment, creating jobs opportunities, reduce the level of poverty and hunger etc which all of them assist in human development. It serves as sources that enhance financial benefit (i.e. economy growth) of governments which assist them to execute different types of projects including sustainable development. Further finding on sustainable development are hereby recommended for our governments to engage themselves for better leadership practice in order achieve and improve the standard of living of our citizens.

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## INSECURITY, CLIMATE CHANGE AND FOOD SECURITY IN NIGERIA

<sup>1</sup>Ojiya, Emmanuel Ameh, <sup>2</sup>Gwadzang, Charity Isa, <sup>3</sup>Gbaka Solomon, <sup>4</sup>Abu Maji,  
<sup>5</sup>Mohammed, Sekuru Abdullahi, <sup>6</sup>Isa Munkaila; <sup>7</sup>Samuel, Paabu Adda,

<sup>1</sup>Food Economics, Centre for Food Technology and Research (CEFTER),  
Benue State University, Makurdi, Nigeria

<sup>2,4&7</sup>Department of Economics, Federal University, Wukari-Nigeria

<sup>3</sup>Department of Economics, Benue State University, Makurdi, Nigeria

<sup>6</sup>Department of Public Administration, Federal University, Wukari-Nigeria

<sup>5</sup>Department of Management, Nigeria Army University, Biu-Nigeria

### **Abstract**

*Due to the imperativeness of food to man, this study was projected to determine the effect of conflicts (insecurity) and changing climatic conditions on Nigeria's food security aspiration from 1999 to 2021. It based its theoretical stand on Sen's Poverty and Famine theory and utilized econometric techniques for its analysis. The study revealed among others, that conflicts and climate change significantly impacted aggregate food production in Nigeria between the period examined. Thus, it was concluded that conflicts and climate change exerted significant negative influence on households' food security in Nigeria. Deriving from the above, the study recommends that; for enhanced food security, government should aim for more sustainable food production by improving on security. Thus, security agencies should endeavor to provide a peaceful environment for farmers; secondly, to stem the tide of rising sea levels across the major rivers in the country, the government should prioritize the dredging of Rivers Niger and Benue to reduce the effect of overflow which results to flooding that destroys food crops, particularly rice, during the rainy season. Finally, creating formal employment opportunities and income-generating activities for all qualified Nigerians holds the potential for deescalating tensions (insecurity) across the country as well as giving citizens access to nutritious food, thus making them food secured.*

**Keywords:** Insecurity; Climate Change; Food Security; Nigeria; ARDL

### **Background to the Study**

Mankind, faced with the dilemma of food insecurity from time immemorial has continued to strive to achieve food sufficiency for continued survival. Food security is viewed as a condition or state in which every person (households, state and the nation) have unhindered and unobstructed physical, social, and economic access to enough, safe and nutritionally inclined food which guarantees their dietary requirements for an active, energetic and productive life. This implies that food insecurity refers to the absence or lack of access to enough, safe, and nutritionally inclined food which guarantees a household's nutritional needs for an active and healthy living (FAO, 2002; Barrett, 2002). Food security usually is comprised of four important components: food availability, food access, food utilization as well as constant and sustained assurance of access to it. The United Nation's Food and Agricultural Organization (FAO, 2019) estimates revealed that 842 million people globally are still undernourished / malnourished; out of which an estimated 98 percent are said to be living in developing or third world countries, with South Asia presently having the highest total figure of the undernourished, estimated at 295 million hungry persons, whereas the countries of Africa collectively has the biggest concentration of food insecure persons of any region.

Food insecurity affects more than 2 billion people worldwide, with 1.03 billion living in Asia, 675 million spread across the Africa continent, 205 million persons distributed across Latin American countries and the Caribbean, while 88 million of these hungry people are in Northern America and Europe, with 5.9 million in the Oceania. Put succinctly, the vast majority of the world's hungry people are largely residents of poor countries, which as it were, accounts for 12.9 percent of the global population of the malnourished, who are daily in search and yearning for the true definition of food to be actualised in their lifetimes (FAO, IFAD, UNICEF, WFP and WHO (2020). Nigeria's food insecurity challenge is exacerbated by a long-standing gap between food production, a rising population growth and an unsustainable rise in food prices that has led to the multiplicity of more hungry people (Babatunde, Omotesho and Sholotan, 2007). However, the country's food insecurity is linked to the numerous socio-economic and institutional constraints, including the effect of changing climatic conditions, perennial insecurity challenges (banditry, herdsman-farmers conflicts, Boko-Haram terrorist acts, and widespread kidnapping) faced by both large-scale and small-scale agriculturalists who predominate Nigeria's agricultural sector (Nurudeen and Shaufique, 2019). While these conflicts collectively retard sustainable food production, households' food security is further hampered by the reality of climate change, as the frequency of its unpleasant consequences constitute significant threats to both food security and the well-being of human lives across different regions of the world.

The adverse outcome of climate change has necessitated global concerns and efforts at mitigating its effects as well as advocacy for measures that would restrict human actions that induce climate change. Climate change refers to changes in the mean variability properties of the climate, which persists over an extended period of time, typically within decades or longer. The main cause of the climate change experienced in the present time is the human expansion of greenhouse effect (IPCC, 2014). It is to be noted that government efforts at proffering solutions to the twin-debacle of insecurity among farmers and farming communities on the one hand and the effect of climate change has yielded little efforts, given that the crises have remained largely

unresolved, further accentuating Nigeria's food insecurity. The resurgence of conflicts against farmers and farming communities has led to many farmers abandoning the all-important job of food production, resulting in an inevitable incidence of food insecurity as food prices has continued to skyrocket amidst a growing population and an uncontrollable inflationary trend.

Furthermore, several studies have been carried out to investigate the relationship between national insecurity, climate change and food security in Nigeria, with some believing that different socio-economic and political factors are responsible for the country's growing food insecurity. For instance, Agbo (2012) claimed that man-made factors are the fundamental driving forces or triggers of climate change. This is in line with Nzewi (2009), who previously stated that the current literature on the subject suggests that human activities such as altered land use, deforestation, wars, and increased energy consumption, agricultural and industrial activities are responsible for approximately 60% of global warming. These human-climate induced activities are triggers that accentuate the unending conflicts between pastoralists and farmers across the country, with food production being the major culprit. In fact, Nigeria's goal of becoming a food-secure nation has been severely hampered by the growing influence of changing climatic conditions, which has shifted the trajectory of food production throughout the country. As a result, households' expectations of safe, abundant, culturally acceptable, and nutritious food that meets their dietary and nutritional choices for an active and healthy life has been badly harmed (Essien, 2013).

Furthermore, the last two decades (1980s and 90s) were some of Nigeria's worst nightmares in meeting her food security aspirations, thus food insecurity has remained an intractable issue, putting several households and the future of many citizens at risk of starvation. Rainfall is required for the majority of food crop grown in Nigeria; while crops that need a lot of rain, for example, are produced along the coast and up to the middle belt, food crops that do not require as much rain are grown in the country's northern regions. Moreover, excessive flooding across the nation's six geopolitical regions have adversely affected Nigeria's quest for sustainable food production, thus rendering many households food insecure. In addition, the unending conflict between herders and farmers which has defied logic is a consequence of global warming and climate change. The conflict has been spreading to Nigeria's Southern states due to a lack of grazing routes for cattle herders as a result of desert encroachment, which is a regular occurrence in northern Nigeria. Consequently, climate change is shrinking the space available for agricultural activities, as seen by the shrinkage of water formations (lakes), the drying up of grazing routes, and the loss of arable land to desertification. The seasonal movement of herdsmen to the southern part of Nigeria during the dry season is therefore largely due to the effect of climate change-related shrinkage of Lake Chad and desertification in northern Nigeria, with many of them now migrating southwards with the resultant effects being the prolonged conflicts involving herdsmen which affects aggregate food production (Adishi and Oluka, 2018; Onuoha and Ezirim, 2010).

### **Problem Statement**

Despite several food policies articulated by global food agencies such as the International Food Policy Research Institute (IFPRI), the International Institute for Tropical Agriculture (IITA), the International Fund for Agriculture Development (IFAD) and the International



Institute for Sustainable Development (IISD), food insecurity has remained the norm in most developing countries. The effect of these policies and interventions have remained less effective, given that food insecurity in Nigeria has remained high despite billions of naira appropriated each year for agricultural production (Babatunde, Omotesho and Sholotan, 2007). The underlining belief is that no matter the amount of funds invested in the agricultural sector, the gains had remained slim in the face of the type of insecurity posed by the activities of non-state actors such as armed bandits, kidnappers, herders-farmers clashes and other sundry crimes; and where these food policies are deemed effective, food insecurity has remained intractable as households quest to meeting their food security aspirations equally come in conflict with changing climatic conditions which exert adverse effect on aggregate food production.

Several scholars in times past have argued that climate change precipitates food crises in parts of the world as well as serve as triggers for conflicts and other sundry vices in other climes due to resulting friction that arises from the struggle for control of limited agricultural resources between farmers and pastoralists. Nigeria is viewed by some scholars as a place where the crisis associated by climate change are playing out without any significant measures in place to mitigate the effects. Consequently, the Food and Agricultural Organization (FAO) of the United Nations in its various reports titled “The State of Food Security and Nutrition in the World” showed that the underlying factors that induce food insecurity in the world are climate change, the country's economic capability and conflict (FAO, IFAD, UNICEF, WFP and WHO, 2017, 2018, 2019). To this connection, Nigeria has been identified as a country where the three drivers identified by the FAO play very significant role in aggravating food insecurity situation (Kralovec, 2020). Additionally, other researchers such as George, Adelaja and Weatherspoon (2020), Ogbo, Ebele and Ukpere (2013) and Ayinde, Muchie and Olatunji (2011) posited that climate change is the key driver of conflict in several parts of Nigeria which has worsened the food security situation in the country and has reinforced poverty in some communities.

These socio-economic challenges, according to Sen (1981) hinder the attainment of households' food security aspirations, the concomitant effect being a reduction in food production, accessibility, utilization and stability of access which culminates in the adoption of several food coping strategies, climaxing in food rationing, hunger and malnutrition and hence calorie deficiency among several households. Consequently, and in the light of the foregoing, the most pressing economic policy option is to evolve ways to lessen the negative consequences of insecurity (conflicts) and climate change on food security; hence to this connection, the problematic of this research is to evaluate the nexus between conflicts (insecurity), changing climatic conditions and food security in Nigeria. Consequently, this study's main objective is to assess the nexus between conflicts and climate change on food security in Nigeria, with specific objectives as follows: (i) to examine the extent to which insecurity (conflicts) had significantly affected food security in Nigeria (ii) to evaluate the extent to which climate change had significantly impacted food security in Nigeria.

The study examines the effect of conflicts and climate change on food security in Nigeria using quarterly data from 1999:Q1-2021:Q4. One important justification for the adoption of quarterly data is hinged on data availability and the fact that due to the frequency of

occurrence of most economic variables, they are better measured or estimated in quarters. Furthermore, the choice of 1999 coincides with the period when Nigeria, upon transiting from military rule to democracy experienced several changes in the structure of the economy, leading to improved investment in the agricultural sector of the economy, as the return to democracy with less dictatorial tendencies signified investor's confidence in the economic potentialities of the country. It is further justified on the basis that the advent of democratic governance in Nigeria brought in its wake different agitations from non-state actors for resource control, and some of these has remained at the root of the unending cycle of violence on citizens across the federation, which has adversely undermined aggregate food production and hence food security in Nigeria.

### **Conceptual Clarification**

#### **Food Security**

There are two ways to look at food and nutrition security: self-sufficiency and the ability to manage risk and vulnerability in food and nutrition supply. According to (IFPRI, 2004), for a long time in the 1970s and 1980s, the term "food security" referred solely to a country's ability to produce enough food to feed its population. As nutrition security was added to food security in the 1990s and risk management and risk coping became more important in the 2000s, the concepts of food and nutrition security were blended with these other concepts. According to the World Food Summit Report (1996), food security is achieved when all people have continuous economic and physical access to appropriate, safe, and healthy food combinations that meet their nutritional requirements for an active and healthy lifestyle, while also maintaining their cultural traditions. Moreover, in 2001's *The State of Food Insecurity*, this concept was redefined to mean a situation in which all people have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and provides them with food options for leading an active and healthy lifestyle (FAO, 2002). Four fundamental pillars underpin food security: food availability, food access, food consumption, and food stability, which imply removing the potential that any shock may cause any of the first three dimensions or pillars to be disrupted in any way. While food availability is required, it is not a sufficient condition for food accessibility, just as food accessibility alone cannot suffice without consumption.

Food security is mostly determined by two variables. These include guaranteeing enough food supply and, secondly, ensuring that households suffering from undernutrition or malnutrition have the opportunity to access food, either via self-production or by the ability to purchase it. As a result of the disagreements and divergent views expressed by various scholars regarding the definition of food security, this study adopts, as its working definition and hence views food security as a fundamental human right, and the ability and / or capacity of all people, to have unfettered access to a sufficient, safe, and nutritious food combination that satisfies, guarantees, and meets their food preferences and dietary needs for an active and productive life at all times, regardless of their financial means, as they could fall back on food aid.

### **Food Security Dimensions**

#### **Food Availability**

According to Oni and Fashogbon (2013), food availability refers to the amount or stock of food that households, communities, states, geopolitical areas, and nations have at any one moment. It is primarily influenced and guided by domestically produced foods, imported

foods, food aid / assistance, and other demand and supply elements in food production, as well as the underlying causes of each of these aspects (FAO, 1996). Food availability is defined as the availability of sufficient quantities of food to all persons within a given country on a regular and consistent basis. Food availability, according to this study, refers to the accumulation or stock of food accessible in a given home, community, local government, state, or nation, which is attainable through domestic food production activities, food aid from donor organizations, or open importation from overseas. Food availability is sometimes confused with food access, as it can apply to both household and aggregate food supply.

Although it should be noted that food availability is a poor indication of food security because it does not account for disparities in food access, the average daily calorie consumption per person does provide some insight into a country's overall food situation (Kidane, Maetz & Dardel, 2006). To ensure food availability for rural farmers in rural areas, it is necessary to ensure that they have access to sufficient food, whether through self-production or market purchases (given sufficient purchasing power). Cereals, roots, and tubers are the most important sources of calories in Nigeria's diet. Nonetheless, due to a scarcity of suitable processing and storage facilities, the vast majority of rural farmers in the country sell their excess produce during the harvest season and rely on food purchases during the rest of the year. Additionally, this study asserts that food availability in Nigeria is influenced by the following key elements or factors: agricultural inputs/machinery; the effect of climate change; the security of farmers and farming communities; government expenditure on agriculture; poverty, population growth, the level of food imports; the effect of poverty and governmental institutions in place – whether weak or strong.

### **Food Access**

On the other hand, food accessibility refers to an individual (household's), regional or nation's capacity or ability to have easy access to accessible food supplies at all times, given the income at their disposal. Access to food is mostly a demand-driven issue. Consumers' or households' access to food is contingent upon their available money and the cost of the foodstuff in question (FAO, 1996). These elements are influenced by the household's resource endowment, which specifies the range of productive activities available to achieve income and food security objectives (Kidane, Maetz & Dardel, 2006). Food accessibility is governed globally by four critical factors: economic, physical, political and sociocultural influences.

### **Food Utilization**

Food usage is a concept that refers to the quantity and quality of food that a household consumes in order to fulfill its nutritional and/or dietary requirements. A good dietary environment, also referred to as proper food use, connotes the presence of suitable and appropriate food processing and storage systems, acceptable and adequate knowledge of nutrition and child-rearing techniques, and access to suitable public health and sanitation services such as cleanliness and hygiene (FAO, 2000; Food and Nutrition Technical Assistance Project (FANTA), 2006). Food usage extends beyond the quantity of food consumed to the quality of food products consumed, since quantity alone does not equate to well-nourished households. Malnutrition is almost always the result of underutilization of available and accessible dietary combinations. This can manifest as stunting, sickness, or even obesity. However, this research study interprets food utilization differently and so adds that food use, as the end goal of the food production discourse, is the capacity of households to

consume quality food of all categories or types required for their diet and a healthy living. To ensure total food utilization, end users must have access to a variety of processing and storage methods for their food in order to maintain its shelf life and avoid contamination.

### **Stability of Food Access**

Food access stability connotes that households are not at risk of losing access to food due to unforeseen shocks induced by changes in weather conditions or other crises or cyclical occurrences such as seasonal food insecurity (Olarinde, Abass, Abdoulaye, Adepoju, Adio, Fanifosi & Wasiu, 2020). It is expected that causes of food insecurity will grow more frequent in the future, particularly as a result of climate change. This is due to escalating climate change and the impact of global warming, which has resulted in regular temporary food shortages and strains on existing resources, leading to political turmoil. Furthermore, the climate-induced migration of herders and their cattle throughout Nigeria in search of food and feed usually leads to violence. Conflicts over scarce resources such as water and land, as well as migration due to drought, may become more frequent and extreme as a result of climate change, increasing the risk of food poverty and malnutrition (Oni & Fashogbon, 2013).

Additionally, the FAO (2007) stated that irregular access to food caused by climatic change, political instability, or economic crises, such as unemployment, food inflation, and national insecurity, may have a disastrous effect on a household's food security status. However, it is the contention of this study that food stability or access stability refers to the continuous assurance that households, communities, states, and nations have that their food needs will always be met, regardless of external threats such as income loss (unemployment or underemployment), poverty, or political violence. Unfortunately, food security in Nigeria has become a problem for policymakers, given the present degree of insecurity in the country's key farming areas. This is in addition to the growing threats posed by unavoidable changes in climatic conditions as a result of global warming's devastating effects, which have resulted in unstable rains, flooding of agricultural products due to torrential rainfall, and a recurring incidence of excessive heat waves, which are detrimental to the yield of a variety of agricultural products. These undesirable events wreak havoc on food production. It is important to remember that food security objectives can only be achieved when all four elements of food security are met concurrently.

### **Review of Related Literature**

#### **Insecurity: Political Violence, Terrorism and Food Security in Nigeria**

Security is crucial to the social contract between citizens and the state; hence, security of life and property as entrenched in the constitution as a fundamental right and entitlement of every citizen in Nigeria, regardless of the citizen's ethnic or religious affiliation. Insecurity according to some scholars, is a breach of peace and security, whether religious, ethnic, regional, civic, social, economic, or political, that results in recurring wars and wanton destruction of lives and property, impeding genuine economic growth and food production. It results in a lack of protection, danger and presents a hazardous condition and a state of disorder (Etim, Duke and Ogbinyi, 2017; Achumba, Ighomereho, Akpo-Robaro, 2013). It also refers to a lack of or an insufficient degree of safety against danger. It is a breach of peace capable of impairing an individual or country's lawful economic and social activities, caused by persons or groups of individuals whose predisposition is always and every time to see their nation or neighbours in pains. This unpatriotic voyage of inflicting either corporate or collateral pains on individuals

or the state has the propensity to impede the implementation of government economic policies, including food production (Oladiran, 2014).

With Nigeria immersed in pervasive insecurity, it is safe to conclude that the country is a nation at war. This is despite the fact that defense receives a colossal budgetary allocation each year. Traditionally, the threshold for a struggle to be classified as a civil war is 1,000 battle dead (Nwozor, 2019), a figure which Nigeria has continuously recorded even in excess of 1,000 as a result of different violent conflicts around the country by various terror gangs against Nigerian's innocent and vulnerable population. Between 2010 and 2020, the Nigeria Security Tracker and the Armed Conflict Location and Event Data Project (ACLED) projected that between 55,261 and 88,530 persons died as a result of the Boko Haram terrorist group (Campbell & Harwood, 2018). All of these disputes and turbulence have a destructive effect on every area of the economy, with food production bearing the worst brunt of the carnage and damage.

In addition to the above, other violent deaths occur due to intra-community conflicts, herders-farmers conflicts, armed banditry, clashes between security agencies and socio-cultural and religious groups like the Independent Peoples of Biafra (IPOB), El-Zakzaky Shiite movement, and other criminal gangs, especially kidnappings for ransom. While the Boko Haram sect's deadly activities have grossly undermined food production, especially in the northeastern geopolitical zone of the country, another major danger to national security and food security is the threat of marauding herdsmen and armed bandits. Nigerian herders, who are mostly nomadic, always traverse the country in search for a better pasture for their flocks. Conflicts between nomadic herders from northern Nigeria and sedentary agrarian populations from the country's central and southern zones have risen dramatically in recent years, posing a danger to the nation's sovereignty. These battles, which have literally stagnated food production across the regions, are becoming as hazardous as the Boko Haram insurgency in the North-East (International Crisis Group, 2017).

Since Nigeria's return to democracy in 1999, conflicts between cattle herders and farmers have become more frequent, persistent, and violent, with all conventional dispute resolution channels unable to contain them. The severity of the herders' violence caused the Institute for Economics and Peace to label them a "terrorist organization" and the fourth deadliest in 2014, with 1,229 deaths (IEP, 2015). This categorisation was instructive and timely, given that the group was only responsible for 63 deaths in 2013 but scaled up its attacks leading to approximately 1,229 deaths by 2014 estimates (Burton, 2016). Additionally, cattle rustling, crop damage, and water contamination are among the issues that herders moving into the savannah and rain forests of the central and southern states face. In the absence of mutually acceptable mediation channels, these disputes escalate. The violence in southern states is already straining regional, ethnic, and religious relations with debilitating effect on overall food production.

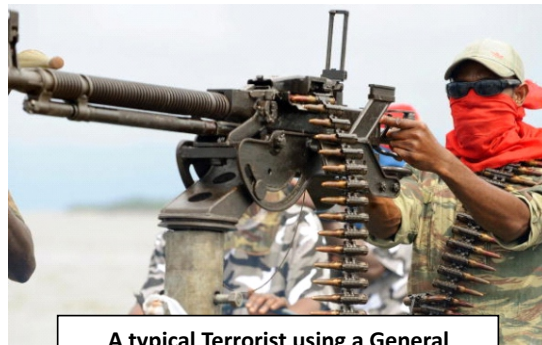
Given the presence of these herders in a number of West and Central African countries, any big clash with them in Nigerian could have regional ramifications, as these herdsmen militias come from other nations in support of their kith and kin living in Nigeria. The ultimate victim in all these confrontation is food production; as farmers who happens to be the major victims of these attacks migrate or run from their farming zones, thereby abandoning their farming

activity in search of refuge wherever there is a guarantee of safety. The cumulative consequence of these conflicts is an interruption of food production, which has major ramifications for Nigeria's food security aspirations. While the North-west and North-central regions were hitherto immune to Boko Haram's frequent insurgent attacks in the past, they are now the hotbeds of armed banditry, with daily bloodletting from Katsina to Sokoto to Kebbi to Kaduna, Zamfara to Niger, Nasarawa to Plateau and Benue. Farming occupation has taken a back seat in these states, as farmers must pay ransom to bandits to cultivate their land and also pay ransom prior to harvesting. Anything else is akin to gambling with their lives, as they are unlikely to return alive to their destinations. For Zamfara, Kaduna, and Katsina States, which has recently become the epicenter of armed banditry, food production appeared to have taken a permanent back seat, as the nefarious and unpatriotic activities of these marauders and gangsters have kept farmers out of their farming occupation (International Institute of Tropical Agriculture) (IITA, 2019).

**Figure 1:** A simple illustration of the insecurity scenario in Nigeria:



**SAMPLE OF NIGERIAN FARMERS**



**A typical Terrorist using a General Purpose Machine Gun to kill farmers**



**BANDITS/HERDSMEN/TERRORISTS/KIDNAPPERS ONBOARD HUNDRED OF MOTOR BIKES TO ATTACK THEIR TARGETS (mainly farmers)**



**COWS WAITING TO GRAZE ON A FARM**



**Corpses of some Rural Nigerian Farmers in Benue State who were slaughtered in their hundreds by Herdsmen Militias being taken for mass burial, around Makurdi, Benue State, North Central, Nigeria**



**Unarmed and Helpless Nigerian Farmers laboring on their farms**

Source: Author's Design

It is distressing to note that the primary objective of most of these herders and other terror gangs is the coercive takeover and acquisition of ancestral farmlands from mostly indigenous peoples (particularly the farming communities of North-Central Region), with a particular emphasis on key farming states like Nassarawa, Plateau, Niger, Kogi, and Benue State, which is also the nation's 'Food Basket State'. Their destructive tendencies and proclivity knows no bounds, as they are also intent on acquiring enormous swaths of farmland in the North-West, North-East, North-Central, South-South, South-East, and South-West geopolitical zones, for grazing and other yet-to-be-disclosed reasons. On this note, it is instructive to conclude that farmers insecurity is directly linked to food insecurity, and food insecurity could trigger national insecurity, as a hungry man is often regarded as an angry man.

These assertions are variously supported by views expressed by scholars such as Campbell (2018), Adebisi, Azeez. and Oyeduji (2017), Adebayo (2013), kidnapping and criminal activities for Ukoji, Ayodokun and Eze (2019), Nwagwu (2014), violent riots for Navarro (2017), Ojogho and Egware (2015), Fulani Herdsmen- farmers clashes for Fadare, Akerele, Mavrotas and Ogunniyi (2019) have all found via historical rendition that each of these specific insecurity threats impacts food production and thus pose negative implications on food security, hence they articulated that conflicts (insecurity) plays a negative role in every government's quest for sustainable food production and hence food security.

Furthermore, Tanko (2021), Alhaji and Tsendzuul (2019), utilizing descriptive research to study farmers-herdsmen crises, revealed land as being the primary source of conflict between herders and farmers in Benue State, thus impeding sustainable food production. Similarly, Babagana, Madaki, Ibrahim, Adamu, and Gujja (2019), Ladan and Matawalli (2020), indicated that banditry activities posed significant hindrance to farming activities in Yobe and Katsina States. While. Ndubueze-Ogaraku, Etowa, Ekine, and Familus (2017) equally emphasized in their study that increased food costs were among the shocks individuals faced as a result of a lack of a favourable environment for farmers to thrive. Alao, Shaibume, Ogunwemimo, Alao and Ogunwemimo (2019) also made similar statements about an increasing wave of insecurity capable of damaging food supply.

### **Climate Change and Food Security in Nigeria**

The Intergovernmental Panel on Climate Change (IPCC, 2001) views climate change as "any change in climate over time caused by natural variability or human action that modifies the composition of the global atmosphere." As a result, climate change is described as the gradual alteration or modification of the composition of the earth's atmosphere caused by numerous human activities, both directly and indirectly, as well as regular climate fluctuation over time. While weather affects our daily lives, climate affects our decisions about where and how to live, as well as how to cultivate food, all of which have a direct bearing and impact on how communities and economies evolve and prosper (Osuafor and Nnorom, 2014).

The term which is also used interchangeably with global warming refers to an increase in the average air temperature on earth over time (Oxford Dictionary of Science, 2005). The causes of climate change are as varied as they are complex. External causes include solar output variations, variations in the earth's orbit, volcanic eruptions, mountain construction and tectonic movements, and other human-induced phenomena accelerated by the industrial revolution of the last two and a half centuries. The causes of climate change, according to Okebukola and Akpan (2009), are split into two categories: those induced by natural causes and those caused by human activities. Continental drift, volcanoes, ocean currents, the earth's tilt, comets, and meteorites are all natural forces.

Climate change and agriculture are two interconnected phenomena that occur on a global scale. Climate change, which often manifested in greater temperatures, decreased rainfall, and increased rainfall unpredictability, affects crop yields, diminishes net farm earnings, and jeopardizes food security in low-income nations, especially African countries (FAO, 2007 & Achike, 2014). It is already harming crop output in many countries. This is especially true in low-income nations where climate is the key predictor of agricultural productivity with limited adaptive capacity (Apata, Apata, Igbalajobi and Awoniyi. (2010). Nigeria though is yet to face the kind of food crises of its immediate neighbors, Niger or Chad, but its hunger profile is deplorable, with climate change exacerbating the situation.

With 85 percent of her agriculture being rain-fed and many crops sensitive to even minor changes in rainfall and temperature, evidence revealed that Nigeria is already plagued by a variety of ecological issues and imminent food shortages, both of which are directly related to the impact of global warming. With the southern region of Nigeria largely known for high rainfall but now confronted with an irregularity in its rainfall pattern, and the Northern region confronted with the threat of desert encroachment at a very fast rate per year caused by a rapid reduction in the amount of surface water, flora and fauna resources on land, the country is approaching a tipping point, with imminent hunger and starvation staring it in the face (Bello, Ganiyu, Wahab, Afolabi, Oluleye, Ige and Abdulmalik, 2012)

With the advent of climate change and global warming, Nigeria's over-reliance on rainfall for over 80% of crop production would undoubtedly have major ramifications for crop yield and thus food security. The study contends that the continuous movement of nomadic herdsmen and armed bandits from Nigeria Northern axis to the Southern coastal states in search of greener pastures is largely driven by the effect of climate change due to desertification and or desert encroachment, including a lack of rain for their cattle. Furthermore, changes in climatic conditions have harmed the sustenance of many herders in neighbouring African countries



such as Chad, Cameroon, Niger, Mali, and Senegal, and as a result, they continue to migrate southwards due to irregular or reduced rainfall in the north, leading to the search for greener pasture and a more friendly habitation by these nomadic herders. All of these factors contribute to and/or induce increased forcible relocation of farming communities, which has a negative impact on food production and Nigeria's food security targets. The government should begin to devise further measures to stem the tide of global warming, which is already affecting food production in many parts of the world, particularly Nigeria.

The above findings are corroborated by Akukwe, Oluoko-Odingo, and Krhoda (2020), who in their study of South-Eastern Nigeria found that flooding had a detrimental effect on food security by increasing the number of food insecure households. Furthermore, Osuafor and Nnorom investigated the impact of climate change on Nigeria's food security in 2014 and found that the threat of environmental degradation caused by climate change posed a negative impact on food production in Nigeria. Similarly, Eme and Onyishi (2014), Okoli and Ifeako (2014) and Azubuike and Nnubia (2015) all alluded to the fact that climate change precipitates food insecurity in their investigations.

### **Theoretical Review**

#### **Sen's Theory of Poverty and Famine: An Essay on Entitlement and Deprivation**

This theory propounded by Sen (1981) tied its arguments to the fact that hunger and famine for a very long time have been largely rooted in postulations made by Thomas Malthus' food availability approach. Sen did not contribute to challenging Malthus (1798)'s stance on food security until the early 1980s, when attention was shifted from national food availability to people's access to food in a dissertation on "entitlement and deprivation". The emphasis on food security in the entitlement discourse was an insistence on each individual's entitlements to commodity bundles, including food, by viewing famine as a result of households' failure to be entitled to the bundle(s) that assures them sufficient food to improve their welfare (Sen 1981).

It is worth noting that Sen's interest in starvation stems from his personal experience during the 1943 Bengal famine, which killed around 3,000,000 lives. Sen believed that this alarming loss of life was unnecessary because it was thought that the lack of adequate food supply in India at the time was not necessarily the cause, but that its distribution and accessibility were harmed and impeded as a result of certain groups of people, such as rural labourers, losing their livelihoods and jobs, and thus their inability to purchase the food they so desperately needed for sustenance. This much was confirmed in Sen's *Poverty and Famines: An Essay on Entitlement and Deprivation* (1981), which revealed that in many instances of famine, except in cases of war and conflict affecting farming communities, food supplies were not necessarily reduced, but rather a combination of socio-economic factors, such as declining wages, corruption, poverty, changing climatic conditions, higher food prices, unemployment, poverty, a lack of government commitment to agricultural growth. The author's propositions influenced the thinking of many nations and other international organizations in handling food crises as many of these countries who were influenced by Sen's thinking and views encouraged policy makers to devote attention and emphasis not just to alleviating or reducing immediate sufferings among households but also to work towards finding workable ways to replace the lost income of the poor which trigger hunger. Sen's *Poverty and Famine Hypothesis - An Essay on Entitlement and Deprivation*, which examined the socio-economic

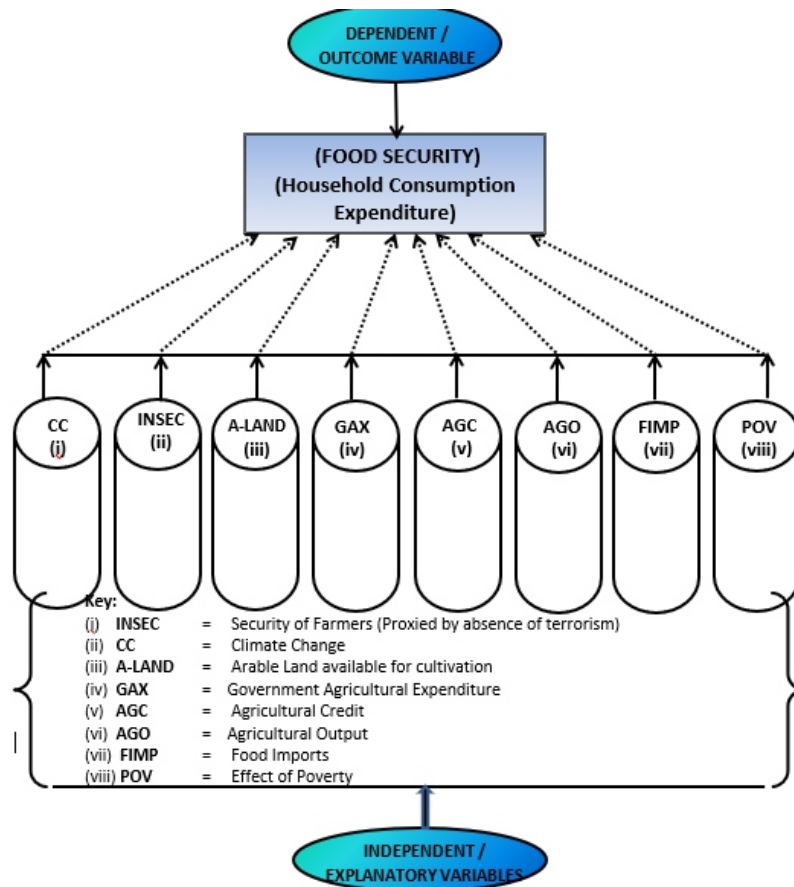
factors that influences food insecurity among nations *is considered as the theory that best provides answers to the discourse on conflicts, changing climatic conditions and food security in Nigeria. This is due to the robustness and logicity of its assumption; hence it is adopted for this study.*

**Model Estimation**

**Model Conceptualization**

To aptly and clearly capture the effect of conflicts, climatic changes on food security in Nigeria, a conceptual model was designed to clearly depict the relationship and interaction between the dependent (food security) and the independent variables. The model is intended to demonstrate how conflicts (insecurity), climatic changes and other associated determinants of food production affect food security in Nigeria.

**MODEL: CONFLICTS, CHANGING CLIMATIC CONDITIONS AND FOOD SECURITY IN NIGERIA**



**Figure 2:** Conceptual Model on Conflicts, Climatic Changes and Food Security in Nigeria  
**Source:** Author's design

### Theoretical Framework

This research model is based on Sen's theory of Poverty and Famine and is derived from Sen's proposition that the causes of food crises and famine in many countries around the world are not simply a result of a food supply gap but that food insecurity globally is precipitated or a consequence of several socio-economic factors including changing climatic conditions and conflicts (e.g. attacks against farmers), declining wages, unemployment/underemployment, the effect of a growing population and food prices. The theoretical model is as represented below:

### Conflicts, Climatic Change and Food Security in Nigeria

$$FdSec = f(INSEC, CC, AL, GAX, AGC, AGO, FIMP, POV) \dots \dots \quad (Eqtn \ 3.1)$$

### Specification of the Models

Accordingly, the study utilized an Autoregressive Distributed Lags (ARDL) technique with a basic description of the connection as illustrated in Equation (3.1). As a result of the preceding equations (3.1), the explicit form of the model becomes:

$$\Delta FdSec = \alpha_0 + \beta_1 INSEC + \beta_2 CC + \beta_3 AL + \beta_4 GAX + \beta_5 AGC + \beta_6 AGO + \beta_7 FIMP + \beta_8 POV + \mu_t \dots \dots 3.2$$

### Where:

FdSec	=	Food security (proxied by Household's consumption expenditure)
INSEC	=	Security of farmers
CC	=	Climate change
AL	=	Arable land available for cultivation
GAX	=	Government agricultural expenditure
AGC	=	Agricultural credit to farmers
AGO	=	Agricultural output
FIMP	=	Food imports
POV	=	Effect of Poverty
$\mu_t$	=	Stochastic error term / time trend

While  $\alpha_0 + \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$  and  $\beta_8$  and respectively are the parameter estimates

The ARDL transformation for Equation 4.26 is stated as follows:

$$\begin{aligned} \Delta FdSec = & \alpha_0 + \beta_1 INSEC_{t-1} + \beta_2 CC_{t-1} + \beta_3 AL_{t-1} + \beta_4 GAX_{t-1} + \beta_5 AGC_{t-1} + \beta_6 AGO_{t-1} + \beta_7 FIMP_{t-1} + \\ & \beta_8 POV_{t-1} + \\ & \sum_{j=1}^p \pi_1 \Delta CC_{t-j} + \sum_{j=1}^p \phi_1 \Delta INSEC_{t-j} + \sum_{j=1}^p \theta_1 \Delta AL_{t-j} + \sum_{j=1}^p \delta_1 \Delta GAX_{t-j} + \sum_{j=1}^p \phi_1 \Delta AGC_{t-j} + \sum_{j=1}^p \theta_1 \Delta AGO_{t-j} \\ & + \sum_{j=1}^p \rho_1 \Delta FIMP_{t-j} + \sum_{j=1}^p \varphi_1 \Delta POV_{t-j} + \mu_t \quad (Eqtn \dots \ 3.3) \end{aligned}$$

A general error-correction representation of the equations above is formulated as follows:

$$\begin{aligned} \Delta FdSec = & \alpha_0 + \sum_{j=1}^p \pi_1 \Delta INSEC_{t-j} + \sum_{j=1}^p \pi_1 \Delta CC_{t-j} + \sum_{j=1}^p \pi_1 \Delta AL_{t-j} + \sum_{j=1}^p \pi_1 \Delta GAX_{t-j} + \sum_{j=1}^p \pi_1 \Delta AGC_{t-j} \\ & + \sum_{j=1}^p \pi_1 \Delta AGO_{t-j} + \sum_{j=1}^p \pi_1 \Delta FIMP_{t-j} + \sum_{j=1}^p \pi_1 \Delta POV_{t-j} + \delta_i ECM_{t-j} \\ & + \mu_t \quad (Eqtn \dots \ 3.4) \end{aligned}$$

## Results and Discussions

### Tests for Stationarity

When an autoregressive distributed lag modeling technique is used in a study, it is important to perform a stationarity test on all variables in the model(s) to ascertain the order of integration of each variable prior to performing Bounds testing. This is a necessary step to guarantee that variables are not second-order stationary (i.e., I(2)), which could result in erroneous or spurious regression findings. According to Ouattara (2006), the estimated F-statistics which Pesaran et al. (2001) present are not valid in the presence of I(2) variables, since the limits tests are predicated on the assumption that variables are either I(0) or I(1). As a result, unit root tests may still be required in the ARDL procedure to ensure that no variable is of order 2 or above. The following table summarizes the results of the ADF/ PP unit root testing.

**Table 1: Augmented Dickey Fuller and Phillips-Perron Unit Root Test**

Variable		Level t-statistic value	1 <sup>st</sup> Difference t-statistic value	5% critical value	Order of Integration
Log(FdSec)	ADF	-3.622137	****	-2.895109	I(0)
	P-P	-4.618824	****	-3.459950	I(0)
INSEC	ADF	****	-3.431079	-2.895512	I(1)
	P-P	-3.993191	****	-2.893589	I(0)
Log(CC/WVR)	ADF	-5.652006	****	-3.012363	I(0)
	P-P	****	-5.660809	-3.012363	I(1)
Log(A-LAND)	ADF	****	-2.253462	-1.944619	I(1)
	P-P	****	-4.097222	-2.893956	I(1)
Log(GAX)	ADF	****	-4.253627	-2.893956	I(1)
	P-P	****	-4.175098	-2.893956	I(1)
Log(AGC)	ADF	-3.051057	****	-3.012363	I(0)
	P-P	****	-4.309974	-2.893956	I(1)
Log(AGO)	ADF	****	-3.138214	-2.895512	I(1)
	P-P	****	-4.458585	-2.893956	I(1)
Log(FIMP)	ADF	****	-2.945851	-2/897223	I(1)
	P-P	-2.987312	****	-2.893589	I(0)
POV	ADF	****	-3.319148	-2.897223	I(1)
	P-P	-3.112550	****	-2.893589	I(0)
Log(POGR)	ADF	-4.862665	****	-3.029970	I(0)
	P-P	-3.032476	****	-3.004861	I(0)

**Source:** Extracts from E-views 10

The results of the unit root test, employing both Augmented Dickey-Fuller (ADF) and Phillips-Perron (P-P) at the level and first difference are as shown in Table 1. The unit root test verifies that the variables in the models are of zero-order I(O) or I(1) integrated, i.e. first difference stationary. If the critical value in absolute terms is less than the test statistic, the variable is believed to be stationary (has no unit root problem). After confirming the stationarity of the model's variables, the long run relationship between them will be determined. However, because all variables were not integrated in the same order but revealed a mixed order of integration, that is, a combination of I(O) and I(1), as shown above, the use of the Johansen co-integration test has collapsed, and the most appropriate choice now is to

examine the existence of long run relationships among the variables in the model using the popular Autoregressive Distributed Lags (ARDL) bound test for co-integration popularized by (Pesaran & Shin, 1999; Pesaran, Shin, & Smith, 2001).

### Lag Selection Criteria

Before delving into the complexities of the cointegration test, it is crucial to choose a suitable lag length. Estimating the lag length is a critical step in many econometric analyses. To determine the appropriate number of lags to be selected during model estimation, the lag length is selected using explicit statistical information criteria obtained through unrestricted VAR estimate. The Akaike Information Criterion, the Schwartz Information Criterion, the Posterior Information Criterion (PIC), and the Final Prediction Error are some of the statistical information criteria (FPE). The study will employ the Akaike Information Criterion as one of the lag selection criteria.

**Table 2: Lag Length Selection Criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2823.127	NA	1.21e+23	67.33635	67.48104	67.39452
1	-2172.023	1209.193	4.05e+16	52.42911	53.29726	52.77810
2	-2082.769	155.1307	8.83e+15	50.89927	52.49088	51.53908
3	-2072.806	16.13087	1.28e+16	51.25729	53.57235	52.18793
4	-2065.417	11.08340	2.01e+16	51.67660	54.71512	52.89806
5	-1916.276	205.9572	1.10e+15	48.72085	52.48283	50.23314
6	-1856.365	75.60167*	5.19e+14*	47.88964*	52.37508*	49.69275*
7	-1847.572	10.04885	8.55e+14	48.27553	53.48442	50.36946
8	-1838.171	9.624885	1.45e+15	48.64693	54.57929	51.03169

**Source:** Author's extract from E-views 10;

LR: Sequential Modified Test Statistic; FPE: Final Prediction Error; AIC: Akaike Information Criterion

SC: Schwarz Information Criterion; HQ: Hannan-Quinn Information Criterion

**Note:** \* indicates lag order selected by the criterion.

For the purpose of this research, the lag selection test indicates the following lag order: Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn Information Criterion (HQ).. The lag test is used to determine the number of lags to include in the model estimation process, as well as the duration of the lag that produces the smallest critical value and most efficient parameter coefficients/estimates. The maximum number of lags that could be taken in this study was determined to be six, utilizing Akaike Information Criterion (AIC), and this was selected for the estimation of a parsimonious model.

### Cointegration Testing Using ARDL Bounds

A cointegration test is one of the most certain ways to determine whether or not there is a long-

run linkage between series in a model. Cointegration of two or more variables is defined economically as the existence of a long-run or equilibrium relationship between or among variables or series in the model (Gujarati, 2004:822). Given that not all variables are integrated in the same order, but rather a combination of I(O) and I(1), as demonstrated above, the ARDL bounds testing method to cointegration (Pesaran et al, 2001) was used to determine if there is cointegration or a long-run relationship between the independent and response variable (food security) in Nigeria during the referenced periods. As a first step, the cointegration test devised by Pesaran et al. (2001) is used to establish the existence (or absence) of a long-term link between the variables and the results are as summarized in Table 3.

**Table 3: ARDL Bounds Testing**

Test Statistic	Value	K
F-Statistic	5.347353	9
<b>Critical Value Bounds</b>		
Significance	I(0) Lower Bounds	I(1) Upper Bounds
1%	2.65	2.99
5%	2.14**	3.3
10%	1.88	2.99

**Note:** \*\* signifies rejection of the null hypothesis at 5 per cent level of significance

**Source:** Author's Extract from E-views 10

The Wald Test F-statistics computed using the ARDL Bounds Testing yielded a value of 5.347353, which is higher and above the upper and lower bounds of the 95 percent critical value interval (2.14 – 3.3). This gives room for rejecting the null hypothesis that there is no long-run link between the variables, hence it is concluded that there is evidence of a unique long-run cointegrating relationship between food security and the independent variables in the model for Nigeria between 1999 to 2021.

#### **ARDL Longrun and Shortrun Estimates:**

To do this, the autoregressive distributed lags (ARDL) long-run relationship and associated short-run dynamics are used. Food security and agricultural productivity are intricately related in a country like Nigeria with a significant rural and agrarian population. As a result, indices affecting a country's aggregate food production include the security of farmers and farming communities, changing climatic conditions, government agriculture spending, availability of agricultural loans / credit to farmers, food imports, as well as poverty. Thus the model is designed to examine the nexus between conflicts (insecurity, changing climatic conditions and food security in Nigeria).

**Table 4: ARDL Regression Estimates**

<b>Dependent Variable:</b>				
<b>Hwfare</b>				
<b>Variable</b>	<b>Coefficient</b>	<b>Std Error</b>	<b>t-statistic</b>	<b>P-value</b>
<b>A: Longrun Estimates</b>				
INSEC	0.549348	0.159742	3.438976	0.0010
CC	0.000002	0.000001	2.594696	0.0116
A_LAND	-0.000000	0.000000	-8.179748	0.0000
GAX	0.392629	0.105516	3.721027	0.0004
Constant	27.047957	0.323256	83.673367	0.0000
<b>B: Short-Run Estimates</b>				
	<b>Coefficient</b>	<b>Std Error</b>	<b>t-statistic</b>	<b>P-value</b>
D(INSEC)	-0.089136	0.018975	-4.697460	0.0000
D(CC)	0.000001	0.000000	5.191363	0.0000
D(A_LAND)	-0.000000	0.000000	-18.470426	0.0000
D(AGO)	0.006096	0.001163	5.242117	0.0000
D(GAX)	-0.095446	0.011588	-8.236339	0.0000
D(FIMP)	0.003246	0.000545	5.960804	0.0000
D(POV)	0.000305	0.000149	2.043660	0.0449
ECM(-1)	-0.069973	0.010016	-6.986316	0.0000

**Source: Author's computation from E-views 10**

**Note:** Only variables that had significant effect on the outcome / response variable are presented

Table 4 above is an extract of the effects of the explanatory variables on the outcome variable (food security) in Nigeria. For instance, in Table 4 (A and B), the interaction between insecurity (INSEC) and food production have reported statistically significant relationship with food security in Nigeria. These have implications for food security, given that the continuance of these attacks on farmers had impacted aggregate food production during the period examined. Additionally, Table 4(A and B) indicated that during the period referenced period changing climatic conditions with adverse effects such as droughts, flooding and other environmental hazards exerted disproportionate impacts on different crop yields, resulting in low output and irreversible food insecurity among households. Equally, both long and shortrun regression estimates revealed that, a unit rise in agricultural output resulted in a corresponding increase in Nigeria's aggregate food stock. However, during the same study period, it was discovered that food production stagnated or suffered due to lack of arable and cultivatable land, perhaps due to the activities of pastoralists and effect of flooding that exerts negative influence on the performance cultivatable land.

Similarly, during the quarters analyzed it was revealed that while in the longrun, government expenditure on agriculture positively influenced food production; the reverse was the case in the short term, as it had a detrimental effect on food supply in Nigeria. That is, each unit decrease in food production was as a result of a fall or decline in government investment in the agricultural sector. The shortrun negative effect of government agricultural spending on food production is not unconnected to the activities of unscrupulous and corrupt elements who have rendered government investment in the sector fruitless.

Furthermore, it was reported that rising poverty among several households had negative implication for enhanced and sustainable food production in the country. The type of poverty

prevalent in Nigeria has potential for obstructing households' food security aspirations, given that their purchasing power had collapsed. Again, short-run estimates for the effect of food imports (FIMP) on food security revealed a positive and significant influence on food security during the study period.

The slope coefficient of the error correction term (-0.069973) represents the rate of adjustment and is also consistent with the long-run equilibrium convergence. Given system innovation, the error correction term suggested that it will take approximately 7 percent, i.e. one year, four months, and a two weeks speed of adjustment to attain equilibrium in the system. Although the rate of adjustment is rapid, the ultimate convergence to an equilibrium state is contingent on the effectiveness of government initiatives aimed at resolving Nigeria's food security crisis. Additionally, the adjusted R-squared of 95 percent and statistically significant F-statistics at the 1% level indicate that the model is well fitted and explained. This means that the conflicts, climate change and food production model is adequately explained by the predictors or independent variables.

### Post-estimation Analysis

#### Robustness Test

To confirm the robustness of the model estimates for the food security conflicts and climate change equation, the results were subjected to various econometric and or parametric tests. These tests were for serial LM correlation, heteroscedasticity, descriptive statistics and stability of the residuals. The diagnostic estimates are as summarized below:

**Table 4.5.1: Residual Diagnostic Tests**

Description	Model 2 P-value	Decision based on Statistical Test
Breusch-Godfrey Serial Correlation LM Test autocorrelation	0.1400	Insignificant, No Serial
Heteroskedasticity Test: B-Pagan-Godfrey homoscedastic	0.4563	Insignificant, residuals are
Ramsey test (Model Mis-specification)	0.2040	Insignificant, free of multicollinearity
Normality (Jarque Berra) Test distributed	0.6321	Insignificant, series are normally

*\*\* indicates 5% significance level*

Source: Extracts from E-views 10

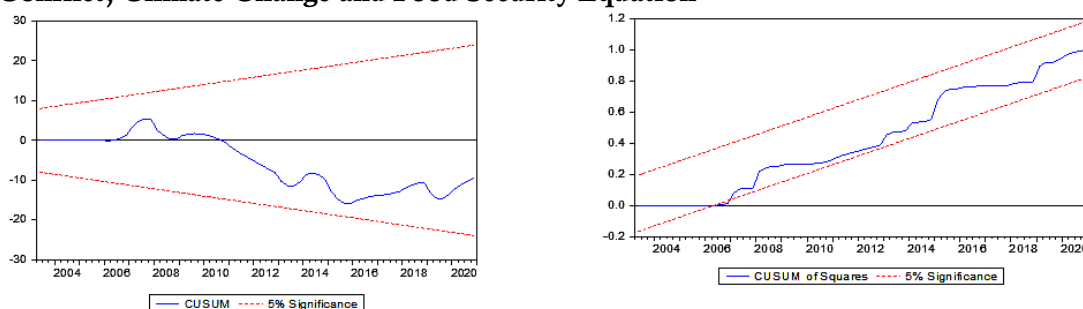
The results shown above highlight the equation's robustness and validity. The statistically insignificant probability values associated with the various measurements substantiate this. The model's residuals are homoskedastic and clearly lack a strong presence of serial correlation. As a result, heteroscedasticity is ruled out in the residuals, and they are concluded to be homoscedastic. Additionally, the models were essentially free of substantial concerns of multicollinearity and normally distributed. This is based on the insignificant values of the RAMSEY RESET and Jarque Berra Normality test probability values, indicating that the series were appropriately defined and thus one can conclude that the parameter estimates are legitimate and reliable.



### Examining Models for Structural Defects

To complete this investigation, it is necessary to determine whether the shortrun and longrun associations discovered before remained stable during the study's duration. In doing this the recursive residuals (CUSUM and CUSUMSQ) were used to determine the structural stability of the equations in the models. Unlike the Chow test, which needs the specification of breakpoints, the recursive residual tests can be employed even if the break-points are unknown. Also, while the CUSUM test computes the cumulative sum of recursive residuals based on the first  $n$  observations and plots it against the breakpoint iteratively, the CUSUMSQ test employs recursive residuals squared. If the CUSUM and CUSUMSQ plots remain under the 5% significance level's critical bounds, the null hypothesis that all coefficients are stable cannot be rejected, other than that, the null hypothesis is rejected, especially if one or more of the parallel lines significantly cross the upper and lower bounds. Thus in observing the statistics in Figures 4.5.2, they confirm and validate the fact that the conflicts, changing climatic conditions and food security model do not exhibit substantial instabilities enough to cause significant changes in the estimated parameters in the event of innovations, given that the trend is bounded within the 5% level of significance. In other words, the model is robust and fits the prerequisites for making unbiased statistical judgments, which qualifies it for policy formulation.

### Conflict, Climate Change and Food Security Equation



### Discussion of Major Findings

The foregoing ARDL longrun and shortrun regression threw up the following significant findings: The long and shortrun output from Table 4(A and B) is quite revealing. To clearly situate the significance of the results deduced from Panels A and B, a negative (-) sign connotes the presence of insecurity situation whereas a positive (+) sign signify the absence of insecurity in the land. Therefore, the longrun estimates (INSEC) as revealed in Table 4(A) typifies a period in our national life when the incidence of political violence and terrorism would be non-existent or completely nib in the bud. That 'longrun' scenario was simply an assumption, which Keynes (1939) concluded, was at best illusionary; as in the longrun, we are all dead. Consequently, the shortrun inverse relationship between 'insecurity' and food production becomes germane to our analysis of food security as it relates to our current environment, soaked with political instability, violence and terrorism, particularly itinerant conflicts between Boko-Haramists, herdsmen, bandits kidnappers and farmers which have had detrimental effects on the Nigerian economy and her food system. ). To be precise, the output connotes the fact that improve food production in Nigeria was contingent upon government's commitment to fighting insecurity and creating a conducive environment devoid of political instability, violence, terrorism, particularly itinerant conflicts between

Boko-Haramists, herdsmen, bandits and kidnappers and farmers, which have had detrimental effects on farmers and farming communities in Nigeria.

That is, given the prevalence of conflicts, particularly in ungoverned places (rural areas), where the majority of farming activity occurs, any investment and expectation of increased yields or food production would be a mirage and illusionary. This implies that in the presence of widespread insecurity (terrorism, most notably Boko-Haram attacks, banditry, herdsmen-farmers conflicts, and kidnapping), which results in mass killings and the multiplication of internally displaced persons homes, there is little hope for viable farming activities and thus the infinitesimal increase in food production. There is no doubt that insecurity has a detrimental effect on food production and undermines the country's quest for food security. Consequently, given the continuation of these attacks on farmers and farming communities, any investment in the agricultural sector by the Nigerian government will have little or no positive effect. Moreover, these attacks have the capacity to stall sustainable agriculture, and when sustainable food production fails, food insecurity becomes the norm. Ukoji et al. (2019), Fadere et al. (2019), Campbell (2018), Adebisi et al. (2017), Adebayo (2013), Nwagwu (2014), Navarro (2017), and Ojogho et al. (2015) all endorsed these findings in their studies. Furthermore, Tanko (2021), Ladan et al. (2020), Alao et al. (2019), and Ilo et al. (2019) also made similar statements about an increasing wave of insecurity capable of damaging food supply, while Ndubueze-Ogaraku et al. (2017) equally emphasized in their study that increased food costs were among the shocks individuals faced as a result of a lack of a favourable environment for farmers to thrive.

Again, the impact of climate change (CC) on food security as revealed by the ARDL estimates spells doom for Nigeria's goal of becoming a food secure nation. Changing climatic conditions such as droughts, flooding caused by rising sea levels and excessive rains have implication for not only sustainable food production, but by extension access and stability of access, and given its severe repercussions in the recent past, the country's food security goals would remain illusory. Nigerian farmers battle with a web of climatic and environmental disasters, including low or insufficient rainfall (drought), followed by catastrophic flooding events which yearly wipe out tonnes and millions of acres of agricultural land and farm produce, particularly rice has become a cause for concern. Except the government evolve time-tested measures, the country may find itself almost unable and incapable of responding to the type of unjust and unfavourable weather conditions, particularly flooding that have become the new normal in Nigeria. This is because natural disasters are frequently beyond man's control, and hence the government might be helpless and incapacitated to deal with it when these natural phenomena occur, especially where funds appropriated for projects such as flood control and building irrigation systems / dams for conservation of flood water get misappropriated by unscrupulous government officials, leaving the food sector to suffer. This finding is corroborated by Akukwe et al. (2020), Osuafor et al. (2014), Eme et al. (2014), Okoli et al. (2014), and Azubuike et al. (2015), all of whom concluded that climate change precipitates food insecurity in their investigations. Additionally, other researchers such as George, Adelaja and Weatherspoon (2020), Ogbo, Ebele and Ukpere (2013) and Ayinde, Muchie and Olatunji (2011) posited that climate change is the key driver of conflict in several parts of Nigeria which has worsened the food security situation in the country, thus reinforcing poverty in some communities.

Deriving from the findings above, this study concludes that conflicts and climate change exerted significant negative influence on food production and hence households' food security during the period studied. To this connection, this study holds that Nigerian households were food insecure between 1999 and 2021, thus the following recommendations were made for policy implementation.

- (i) For enhanced food security, government should earn for more sustainable food production and this they can achieve by improving on security. Thus, security agencies should go beyond its present propaganda and grandstanding, and provide a peaceful environment for farmers. They should be more proactive and devise workable strategies aimed at de-escalating growing tension across Nigeria's six geopolitical zones and the federal capital territory, so as to enable farmers return to more productive farming activities as soon as possible.
- (ii) Government and the private sector should collaborate towards evolving global best practices in livestock management, such as grazing reserves and or ranching to reduce the conflicts associated with roaming or wandering of animals into people's farms.
- (iii) Smart food systems or agricultural techniques that are resilient to the effects of climate change should be adopted to ensure sustainable food production in Nigeria.
- (iv) To stem the tide of rising sea levels across the major rivers in country, the Nigerian government should prioritize the dredging of her rivers, particularly Rivers Niger and Benue to reduce the effect of overflow which often results to flooding that destroys food crops, particularly rice, during the rainy season.
- (v) The Nigerian government should involve the mass media, community leaders and religious bodies on sensitization/campaigns to farmers and pastoralists on best practices so as to reduce the recurrent conflicts between pastoralists and farmers as well as ameliorate the tide of global warming, which is already affecting food production in Nigeria.
- (vi) To further mitigate the impact of changing climatic conditions such as flooding on food production and Nigeria's food security targets, the government should build dams to conserve the flood waters for possible utilization for dry season farming.
- (vii) Creating formal employment opportunities and income-generating activities for all qualified Nigerians holds the potential for deescalating tensions (insecurity) across the country. It will also further empower households to have adequate access to nutritious food, thus making them food secured.

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## **BLOCKCHAIN-ENABLED EDGE COMPUTING: BRIDGING THE GAP FOR SECURE AND EFFICIENT DECENTRALIZED SYSTEMS**

<sup>1</sup>Siman Emmanuel <sup>2</sup>Baku Agyo Raphael <sup>3</sup>Yakubu Ernest Nwuku  
<sup>4</sup>Sumayyah Sophie Nandom <sup>5</sup>Philemon Uten Emmoh  
<sup>6</sup>Joel Yohanna Hezekiah <sup>7</sup>Lawrence, Emmanuel &  
<sup>8</sup>Samuel Amachundi Adda

<sup>1,2,3,4,5,6,7&8</sup> Federal University Wukari, Nigeria

### ***Abstract***

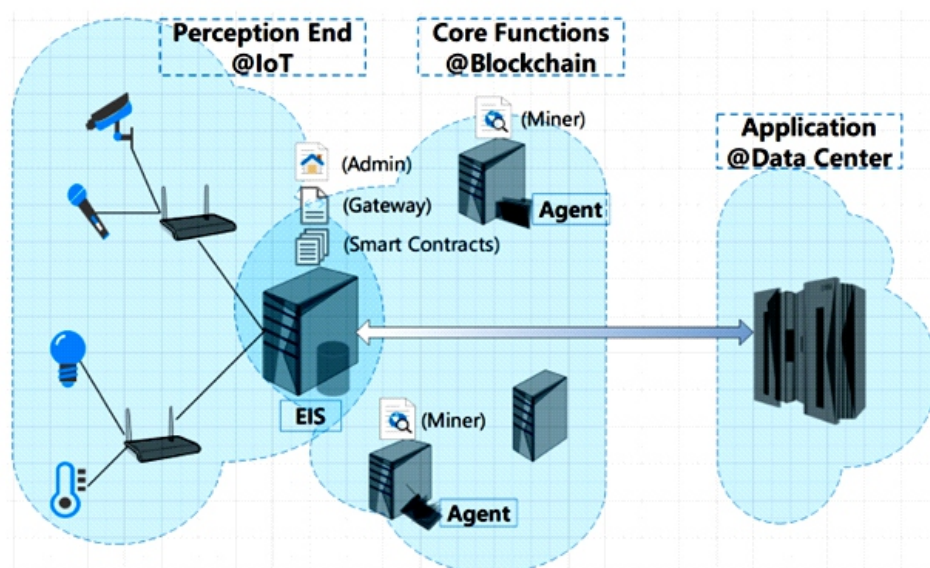
*This survey explores the integration of Blockchain and Edge Computing technologies, spanning the years 2019 to 2021. The study investigates key contributions, findings, and emerging trends within this domain. Notable areas of focus include federated learning with Blockchain in UAV-based air quality monitoring, incentive mechanisms for reliable federated learning, dynamic anti-poisoning strategies with Blockchain, and federated learning applications in vehicular Internet of Things. Additionally, privacy challenges in Blockchain-assisted federated learning for intelligent edge computing are examined. The research also delves into secure architectures implementing trusted coalitions for Blockchain-based distributed learning and semi-asynchronous protocols for fast federated learning with Edge Computing and Blockchain. Furthermore, the survey discusses asynchronous online federated learning for edge devices with non-IID data and the empowerment of intelligent 5G networks with Blockchain and deep reinforcement learning. Lastly, the investigation encompasses the application of Blockchain technology in smart cities, emphasizing research issues and challenges. This abstract offers a condensed overview of the dynamic and multifaceted landscape of Blockchain and Edge Computing integration, highlighting the relevance and potential of this fusion in various domains.*

**Keywords:** *Blockchain, Edge Computing, Federated Learning, Privacy and Security*

### Background to the Study

In recent years, the convergence of blockchain technology and edge computing has emerged as a transformative paradigm, promising to revolutionize the landscape of decentralized systems. This paper delves into the innovative realm of blockchain-enabled edge computing, where the fusion of these two disruptive technologies holds the key to bridging the critical gap in ensuring secure and efficient decentralized systems.

Decentralization has become a cornerstone of modern computing architectures, offering a plethora of benefits such as reduced latency, enhanced scalability, and increased fault tolerance. However, as decentralized systems continue to proliferate across domains ranging from Internet of Things (IoT) to smart cities and beyond, the need for robust security and operational efficiency has become paramount. The distributed nature of decentralized systems introduces unique challenges related to data integrity, privacy, and trust, demanding innovative solutions that safeguard these systems against emerging threats (Liu, Y., Nie, J., Li, X., Ahmed, S. H., Lim, W. Y. B., & Miao, C. 2021), Figure 1.



**Figure1: Electronics | Free Full-Text | Blockchain-Enabled Access Management System for Edge Computing**

In the modern era of computing, two transformative technologies have been at the forefront of innovation: edge computing and blockchain. Understanding the fundamental concepts and significance of each is crucial for appreciating the synergy they bring when combined in decentralized systems (Kang, J., Xiong, Z., Niyato, D., Xie, S., & Zhang, J. 2019). Edge computing represents a paradigm shift in how we process and manage data in the digital age. Traditionally, computing has been centralized, with data processed in remote data centers or cloud servers. However, the rise of edge computing signifies a move towards decentralization at the edge of the network (Chen, Z., Cui, H., Wu, E., & Yu, X. 2022).

Edge computing involves the deployment of computing resources closer to the data source or endpoint devices, such as IoT sensors, smartphones, and edge servers. This proximity to data sources significantly reduces latency and bandwidth usage, making it ideal for applications that demand real-time processing, like autonomous vehicles, industrial automation, and augmented reality. By bringing computational power closer to where data is generated and consumed, edge computing enhances responsiveness and reduces the burden on centralized cloud infrastructure (Du, Z., Wu, C., Yoshinaga, T., Yau, K.-L.-A., Ji, Y., & Li, J. 2020). Moreover, edge computing also contributes to data privacy by allowing sensitive information to be processed locally, minimizing the need for data to traverse large networks and central servers, where security risks may be higher.

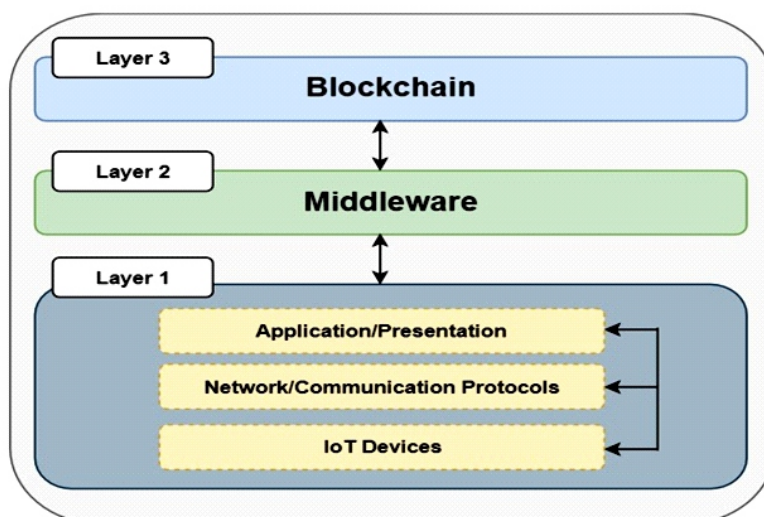
Blockchain technology, initially conceived as the underlying infrastructure for cryptocurrencies like Bitcoin, has evolved into a versatile and disruptive innovation. At its core, a blockchain is a decentralized and distributed ledger that records transactions across a network of computers. Each transaction, once added to the blockchain, becomes immutable and transparent, making it highly secure and resistant to tampering (Shen, M., Wang, H., Zhang, B., Zhu, L., Xu, K., Li, Q., & Du, X. 2021). Blockchain's role in decentralization is pivotal. It eliminates the need for intermediaries, such as banks or centralized authorities, in transactions and data management. Through consensus mechanisms and cryptographic techniques, blockchain establishes trust among participants in a network, enabling peer-to-peer interactions without the need for a central authority (Lugan, S., Desbordes, P., Brion, E., Ramos Tormo, L. X., Legay, A., & Macq, B. 2019). Smart contracts, programmable self-executing agreements on the blockchain, further extend its utility beyond financial transactions. Smart contracts enable automation of various processes, ensuring transparency, trust, and efficiency in a decentralized environment (Wu, W., He, L., Lin, W., Mao, R., Maple, C., & Jarvis, S. 2021).

While decentralization offers numerous advantages, it also introduces unique challenges, particularly in terms of security and efficiency. Decentralized systems are not immune to security threats. The distributed nature of data and lack of a central authority make them susceptible to various attacks, including 51% attacks, double-spending, and consensus manipulation. Ensuring the security and integrity of data on a decentralized network is a paramount concern. Decentralized systems must address data privacy concerns, especially when handling sensitive information. Balancing transparency with privacy is a complex task, and solutions need to provide cryptographic protections and privacy-preserving mechanisms (Chen, Y., Ning, Y., Slawski, M., & Rangwala, H. 2020).

As decentralized systems grow, scalability becomes a significant challenge. Ensuring that the network remains efficient and responsive while accommodating a growing number of participants is crucial for long-term sustainability. In light of these challenges, the convergence of blockchain and edge computing presents a promising solution. Blockchain's security features can enhance trust and data integrity, while edge computing's proximity to data sources can improve efficiency. Together, they offer a pathway to addressing the security and efficiency concerns inherent in decentralized systems. In the subsequent sections, we will delve deeper into the integration of blockchain technology within edge computing environments, exploring real-world use cases and innovative solutions that leverage their combined potential.

### Blockchain at the Edge

The integration of blockchain technology into edge computing represents a cutting-edge approach to address the challenges of decentralized systems while harnessing the benefits of both technologies. In this section, we will explore how blockchain can be seamlessly integrated into edge computing environments, the advantages of this convergence, and provide real-world use cases to illustrate its practical applications (Dai, Y., Xu, D., Maharjan, S., Chen, Z., He, Q., & Zhang, Y. 2019), Figure 2.



**Figure 2: A Blockchain-Based Edge Computing Architecture for Internet of Things Systems**

Blockchain technology can be deployed on edge devices, such as IoT sensors, edge servers, and gateways. These devices can host distributed ledgers, allowing them to record and verify transactions locally. This enables real-time data validation and secure storage at the edge, reducing the need for centralized data centers (Xie, J. F., Tang, H., Huang, T., Yu, F. R., Xie, R., Liu, J., & Liu, Y. (2019). Smart contracts, a hallmark of blockchain, can be programmed to execute tasks autonomously at the edge. For instance, in an industrial setting, smart contracts can manage supply chain logistics, quality control processes, and equipment maintenance, all within the edge computing infrastructure (Mishra, A. R. 2018).

Blockchain's immutable and tamper-resistant nature strengthens the security of edge devices. Data transactions at the edge are securely recorded, ensuring data integrity and preventing unauthorized alterations. Edge computing's proximity to data sources ensures minimal latency, making it ideal for time-sensitive applications like autonomous vehicles, telemedicine, and critical infrastructure monitoring. Blockchain's distributed consensus allows for real-time validation of transactions (Pathak, S. 2013). By storing critical data and executing smart contracts at the edge, organizations can reduce their reliance on centralized cloud infrastructure. This not only minimizes latency but also lowers operational costs (Yi, S., Li, C., & Li, Q. 2015, June).

### **The Use Cases and Examples of Blockchain at the Edge**

In a supply chain scenario, IoT sensors at various points (e.g., factories, warehouses, transportation hubs) record data about goods, such as temperature, humidity, and location. Blockchain technology at the edge ensures the authenticity of this data throughout the supply chain journey. Smart contracts can automatically trigger actions like rerouting shipments in case of deviations from predefined conditions. Edge devices in healthcare can securely store patient data, and access to this data can be controlled through blockchain-based permissions. Smart contracts can facilitate automated billing processes among healthcare providers while ensuring data privacy and compliance with regulations like HIPAA. In energy distribution, edge devices within a smart grid can record electricity production, consumption, and distribution data. Blockchain ensures the transparency and traceability of energy transactions, while smart contracts enable automatic billing and switching between energy sources based on predefined conditions.

In urban environments, edge sensors can monitor traffic, pollution, and waste management. Blockchain technology ensures the integrity of collected data and can facilitate decentralized governance systems for smart cities, such as secure voting mechanisms. Edge computing within autonomous vehicles processes vast amounts of data in real time. Blockchain can validate the authenticity of software updates, ensuring the integrity and security of the vehicle's control systems. Edge devices in manufacturing plants can use blockchain to record quality control data and machine performance metrics. Smart contracts can automatically trigger maintenance requests or order replacement parts when necessary, optimizing production efficiency. Therefore, the integration of blockchain into edge computing environments offers a powerful combination of security, efficiency, and real-time capabilities. These technologies complement each other and open up new possibilities for decentralized systems across various industries. As we delve deeper into this paper, we will explore additional use cases, technical considerations, and emerging trends in this exciting fusion of blockchain and edge computing (Peng, M., & Zhang, K. 2018).

### **Security Challenges in Decentralized Systems**

In decentralized systems that leverage edge computing and distributed ledger technology (DLT) like blockchain, security remains a paramount concern (Zhao et al., 2021). This section delves into the multifaceted security challenges posed by these innovative technologies, highlighting the risks associated with edge computing and DLT (Yi et al., 2015) and emphasizing the critical aspects of data integrity, privacy, and trust (Taylor et al., 2020). Decentralized systems rely on data recorded on distributed ledgers (Chen et al., 2022). However, these records can be vulnerable to tampering if not adequately protected (Shen et al., 2021). Unauthorized alterations to data can have significant consequences in sectors like finance (Dai et al., 2019), healthcare, and supply chain (Shahid et al., 2019). Smart contracts, while automating processes, can contain vulnerabilities that malicious actors may exploit (Casino et al., 2019). Code flaws in smart contracts can lead to unintended outcomes or theft of assets (Gupta et al., 2020). Edge devices, often dispersed in uncontrolled environments, are susceptible to physical attacks, device theft, and malware infections (Peng & Zhang, 2018). Protecting these devices is essential to ensure system security (Rahman et al., 2018)."

### **Efficiency Considerations**

Efficiency is a critical aspect of decentralized systems that encompasses factors influencing their performance and resource utilization (Min et al., 2019). This section examines the various elements that impact the efficiency of decentralized systems, including scalability (Chen et al., 2022), consensus mechanisms (Zheng et al., 2017), and energy efficiency (Xie et al., 2019). Additionally, strategies for optimizing resource utilization at the edge are explored (Rahman et al., 2018). The ability of a decentralized system to handle a growing number of participants and transactions without compromising performance is crucial (Cero et al., 2017). Scalability challenges can lead to network congestion and increased transaction confirmation times (Pathak, 2013). The choice of consensus mechanism significantly affects efficiency (Ongaro & Ousterhout, 2014). Proof-of-work (PoW) consensus, while secure, is energy-intensive and can lead to slower transaction processing (Zheng et al., 2017). In contrast, proof-of-stake (PoS) and delegated proof-of-stake (DPoS) aim for energy efficiency but may raise concerns about centralization (Ongaro & Ousterhout, 2014). Decentralized systems often require extensive data storage (Peng & Zhang, 2018). Efficient data management, including pruning and archiving, is essential to maintain optimal performance and prevent data bloat (Herbaut & Negru, 2017). High energy consumption is a concern for blockchain networks using PoW (Chen et al., 2022). Energy-efficient consensus mechanisms, such as PoS or delegated PoS, help reduce the carbon footprint associated with blockchain operations (Ongaro & Ousterhout, 2014). Minimizing latency in decentralized systems is critical, especially for real-time applications like IoT and edge computing (Pathak, 2013). Edge nodes play a vital role in reducing latency by processing data closer to the data source (Peng & Zhang, 2018).

### **Optimizing Resource Utilization at the Edge**

Leveraging edge computing resources helps reduce latency and improve efficiency by processing data closer to the source (Peng & Zhang, 2018). Edge nodes can perform tasks like data filtering, aggregation, and preliminary analysis before transmitting data to the main blockchain network (Rahman et al., 2018). Implementing caching mechanisms at the edge can reduce redundant data transfers (Zhao et al., 2021). Data compression techniques further optimize bandwidth and storage usage (Peng & Zhang, 2018). Distributing workloads evenly across edge nodes prevents resource bottlenecks and ensures efficient resource utilization (Cero et al., 2017). Utilizing containerization and orchestration tools like Docker and Kubernetes allows dynamic allocation of resources based on workload demands, enhancing resource efficiency (Rahman et al., 2018). Edge devices can offload non-essential tasks and prioritize critical functions, reducing unnecessary resource consumption (Min et al., 2019).

Efficiency in decentralized systems is an ongoing challenge that requires continuous innovation and adaptation. Striking a balance between security, scalability, and resource optimization is essential to create decentralized systems that are both robust and efficient. As we explore the future trends in blockchain-enabled edge computing in the following sections, we will see how emerging technologies and strategies aim to further enhance the efficiency of these systems.

### **Blockchain-Enabled Edge Computing Solutions**

In this section, we delve into proposed solutions and architectures that integrate blockchain technology with edge computing to create secure and efficient decentralized systems (Zhao et

al., 2021). We also examine case studies to provide practical insights into the implementation of blockchain at the edge (Peng & Zhang, 2018). Furthermore, performance evaluations and comparative analyses shed light on the advantages of these innovative solutions (Shahid et al., 2019).

### **Proposed Solutions and Architectures**

Hybrid architectures combine the strengths of edge computing and blockchain. These solutions involve deploying lightweight blockchain nodes at edge devices, allowing for data processing and transaction verification at the edge. Examples include IoT devices with embedded blockchain capabilities for enhanced security and reduced latency. Federated learning is employed in edge environments to train machine learning models locally, preserving data privacy. Blockchain is utilized for transparent model updates and consensus on model parameters. This approach ensures data security while enabling collaborative model training.

Blockchain records data provenance, tracking the origin and transformation of data throughout its lifecycle. This enhances data integrity, transparency, and trust, particularly in scenarios involving edge-generated data, such as supply chain tracking and environmental monitoring.

### **Case Studies**

- 1. Smart Cities:** Smart city initiatives leverage blockchain-enabled edge computing to improve urban infrastructure. For instance, edge devices in traffic lights and surveillance cameras process data locally, while blockchain ensures data integrity and secure communication. This results in efficient traffic management and enhanced security.
- 2. Healthcare:** Healthcare providers employ edge devices and blockchain to securely manage patient data and enable real-time monitoring. Decentralized solutions ensure data privacy and integrity, while smart medical devices at the edge facilitate timely diagnostics and treatment.
- 3. Supply Chain:** Blockchain at the edge is employed in supply chain management to track the movement of goods. Edge sensors and RFID devices collect data, while blockchain ensures transparency and immutability. This enhances traceability and reduces fraud in the supply chain.

**Table 1: Performance Evaluations and Comparative Analyses**

Authors	Publication Year	Title	Journal/Conference	Main Contribution	Key Findings
Liu, Y., Nie, J., Li, X., Ahmed, S. H., Lim, W. Y. B., & Miao, C.	2021	Federated learning in the sky: Aerial-ground air quality sensing framework with UAV swarms	IEEE Internet Things Journal	Integration of UAV swarms, federated learning, and air quality sensing with Blockchain.	- Application of federated learning in air quality monitoring with Blockchain. - Use of UAV swarms in data collection.
Chen, Z., Cui, H., Wu, E., & Yu, X.	2022	Dynamic asynchronous anti-poisoning federated deep learning with blockchain-based reputation-aware solutions	Sensors	Dynamic anti-poisoning federated deep learning with Blockchain.	- Use of Blockchain for reputation in federated learning. - Dynamic anti-poisoning mechanisms with Blockchain.
Shen, M., Wang, H., Zhang, B., Zhu, L., Xu, K., Li, Q., & Du, X.	2021	Exploiting unintended property leakage in blockchain-assisted federated learning for intelligent edge computing	IEEE Internet Things Journal	Privacy leakage in Blockchain-assisted federated learning for intelligent edge computing.	- Identification and mitigation of unintended property leakage with Blockchain.
Lugan, S., Desbordes, P., Brion, E., Ramos Tormo, L. X., Legay, A., & Macq, B.	2019	Secure architectures implementing trusted coalitions for blockchain-based distributed learning (TCLearn)	IEEE Access	Secure architectures for Blockchain-based distributed learning.	- Establishment of trusted coalitions for secure distributed learning with Blockchain.
Wu, W., He, L., Lin, W., Mao, R., Maple, C., & Jarvis, S.	2021	SAFA: A semi-asynchronous protocol for fast federated learning with low overhead	IEEE Transactions on Computers	Semi-asynchronous protocol for fast federated learning with Edge Computing and Blockchain.	- Efficient semi-asynchronous protocol for federated learning with low overhead.
Chen, Y., Ning, Y., Slawski, M., & Rangwala, H.	2020	Asynchronous online federated learning for edge devices with non-IID data	Proceedings of IEEE International Conference on Big Data	Asynchronous online federated learning for edge devices with Blockchain.	- Asynchronous online federated learning with non-IID data on edge devices with Blockchain.
Dai, Y., Xu, D., Maharjan, S., Chen, Z., He, Q., & Zhang, Y.	2019	Blockchain and deep reinforcement learning empowered intelligent 5G beyond	IEEE Network	Integration of Blockchain, deep reinforcement learning, and 5G.	- Empowerment of intelligent 5G networks with Blockchain and deep reinforcement learning.

Comparative analyses reveal that integrating blockchain at the edge significantly reduces transaction confirmation times compared to traditional blockchain networks. Edge processing minimizes the need for data to traverse long distances to reach a centralized blockchain network. Performance evaluations demonstrate that hybrid architectures and edge nodes can enhance the scalability of blockchain networks, Table1. These solutions enable increased transaction throughput, making them suitable for applications with high data volume and transaction rates. Blockchain networks utilizing energy-efficient consensus mechanisms, combined with edge computing, result in reduced energy consumption. Performance evaluations highlight the environmental benefits of such systems.

Comparative analyses emphasize the enhanced security provided by blockchain-enabled edge computing. Data remains localized, reducing exposure to external threats, while blockchain ensures tamper-proof records and secure communication. These case studies and performance evaluations underscore the tangible benefits of blockchain-enabled edge computing solutions. By combining the strengths of edge computing and blockchain, these



systems offer enhanced security, reduced latency, improved scalability, and increased energy efficiency, making them ideal for a wide range of applications in decentralized environments.

### **Future Trends and Research Directions**

In this section, we explore the evolving landscape of blockchain-enabled edge computing and outline the emerging trends that are shaping the future of decentralized systems. Additionally, we identify areas that warrant further research and development, providing insights into the pivotal role decentralized systems will play in the future of computing. The integration of 5G networks with blockchain-enabled edge computing is poised to revolutionize communication and data processing. Ultra-low latency and high bandwidth offered by 5G will enable real-time blockchain transactions at the edge, paving the way for applications like augmented reality (AR), virtual reality (VR), and autonomous vehicles.

The fusion of artificial intelligence (AI) with edge computing and blockchain will enable intelligent decision-making at the edge. AI algorithms will analyze data locally, and blockchain will ensure the trustworthiness of AI-generated insights. This trend will be prominent in applications like autonomous edge devices and smart grids. The emergence of EaaS platforms will simplify the deployment of blockchain-enabled edge solutions. These platforms will offer pre-configured edge nodes with integrated blockchain capabilities, reducing the complexity of developing decentralized applications. Efforts to establish interoperability standards for edge devices and blockchain networks will gain traction. These standards will facilitate seamless integration and communication between various edge devices and blockchain platforms, fostering a more interconnected ecosystem.

### **Areas for Further Research and Development**

- 1. Privacy-Preserving Edge Computing:** Research should focus on enhancing privacy-preserving techniques at the edge, such as secure multi-party computation (MPC) and homomorphic encryption. These methods will enable confidential data processing while maintaining data privacy.
- 2. Edge Consensus Algorithms:** Developing lightweight consensus algorithms tailored for edge devices will be crucial. These algorithms should strike a balance between energy efficiency, scalability, and security to accommodate resource-constrained edge environments.
- 3. Edge-Blockchain Security:** Investigating advanced security mechanisms, including zero-trust architectures and edge-based intrusion detection systems, will be essential to fortify the security of blockchain-enabled edge systems against evolving threats.
- 4. Edge Orchestration and Management:** Research into efficient edge orchestration frameworks and management systems will streamline the deployment and maintenance of edge devices in blockchain networks.
- 5. Edge-to-Cloud Integration:** Exploring seamless integration between edge and cloud resources, while maintaining decentralization, will be a key research area. This integration should optimize resource allocation and data flow between edge and cloud components.

### **The Role of Decentralized Systems in the Future of Computing**

Decentralized systems, empowered by blockchain-enabled edge computing, will play a pivotal role in the future of computing. These systems are poised to: Decentralized IoT networks will enable autonomous decision-making, secure data sharing, and efficient resource utilization. Edge devices will operate independently while maintaining trust through blockchain, fostering a new era of IoT applications. Blockchain-enabled edge computing will enhance transparency and traceability in supply chains. From production to delivery, decentralized systems will ensure the authenticity of goods, reduce fraud, and optimize logistics. Smart cities will leverage blockchain and edge computing to improve urban infrastructure, from traffic management to waste disposal. Real-time data processing at the edge will lead to safer, more efficient urban environments.

Healthcare will witness the proliferation of decentralized systems for secure patient data management, remote monitoring, and AI-driven diagnostics. These advancements will lead to personalized healthcare and faster response times. Industry 4.0 will rely on decentralized systems for intelligent manufacturing and supply chain optimization. Edge devices will communicate seamlessly through blockchain, enhancing efficiency and reducing downtime. Therefore, the convergence of blockchain technology and edge computing is driving innovation across various domains. As emerging trends continue to shape this landscape, further research and development efforts will propel blockchain-enabled edge computing into a central role in the future of decentralized systems and computing as a whole.

### **Conclusion**

Throughout this paper, we have explored the intersection of blockchain technology and edge computing, highlighting their symbiotic relationship and potential to revolutionize decentralized systems. The key findings and contributions of this research can be summarized as follows: We elucidated how blockchain technology can be seamlessly integrated into edge computing environments. This fusion empowers edge devices with secure and transparent transaction capabilities, fostering trust and decentralization. Security challenges in decentralized systems were addressed comprehensively. We discussed the importance of data integrity, privacy, and trust in the context of edge computing and distributed ledger technology. Solutions such as zero-trust architectures and privacy-preserving techniques were emphasized.

Factors affecting the efficiency of decentralized systems, including scalability and energy efficiency, were analyzed. Strategies for optimizing resource utilization at the edge were presented, ensuring that blockchain-enabled edge computing remains energy-efficient and responsive. Real-world use cases and examples of blockchain at the edge were provided. These use cases illustrated the practical applications of decentralized systems in industries ranging from healthcare to smart cities, highlighting their transformative potential. Proposed solutions and architectures for secure and efficient decentralized systems were outlined. Case studies and performance evaluations demonstrated the feasibility and advantages of implementing blockchain at the edge. We identified emerging trends in the field, including the

integration of 5G, AI, and Edge-as-a-Service (EaaS). These trends are shaping the future of blockchain-enabled edge computing, enhancing its capabilities and reach.

Blockchain-enabled edge computing holds paramount significance in addressing the dual challenges of security and efficiency in decentralized systems. The immutability and transparency of blockchain ensure the integrity and authenticity of data at the edge. Security threats are mitigated through decentralized consensus mechanisms and zero-trust models, bolstering trust in edge environments. Edge computing minimizes latency by processing data closer to its source, enabling real-time decision-making. Blockchain adds an additional layer of efficiency by ensuring the reliability and integrity of data transactions. Decentralized systems can scale seamlessly to accommodate a growing number of edge devices and transactions. Efficient consensus algorithms and interoperability standards contribute to this scalability. Resource-constrained edge devices benefit from energy-efficient blockchain consensus mechanisms, conserving power while maintaining secure operations. The integration of blockchain and edge computing creates an interconnected ecosystem where data flows seamlessly between edge devices, cloud resources, and other nodes, optimizing resource allocation and data management.

The potential impact of decentralized systems, driven by blockchain-enabled edge computing, is profound and far-reaching. These systems are poised to: Transform industries by enhancing operational efficiency, reducing costs, and enabling innovative business models. Empower individuals and organizations with greater control over their data and transactions, fostering trust in digital interactions. Revolutionize the Internet of Things (IoT), enabling autonomous edge devices to communicate securely and autonomously. Address critical challenges in areas such as healthcare, supply chain management, smart cities, and industry 4.0, resulting in safer, more efficient, and sustainable solutions. In conclusion, blockchain-enabled edge computing represents a transformative paradigm in computing, offering secure, efficient, and decentralized systems that have the potential to reshape industries and empower individuals. As we navigate the evolving landscape of technology, the fusion of blockchain and edge computing will continue to play a pivotal role in shaping the future of computing and decentralized systems.

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## OVERCOMING ETHNIC AND RELIGIOUS CRISES FOR SUSTAINABLE GOOD GOVERNANCE IN NIGERIA

Akanle Tayo Dare <sup>2</sup>Shaibu Oguche Albert & Edigbo Michael Nonso

<sup>1&2</sup>Department of Christian Religious Studies  
Kogi State College of Education, Ankpa

<sup>3</sup>Department of Christian Religious Studies  
Ebonyi State College of Education, Ikwo

### ***Abstract***

*Nigeria is a country with various ethnic groups and with different ideologies. With the rampant crises here and there in the country which often involved Christian and Muslims, one cannot believe this is the religion that preaches peace. The three main religion groups in Nigeria include Christianity, Muslims and Traditional Religion. The relationship among these religious bodies has generated the problem of mistrust and suspicious leading to incessant religious crises in Nigeria. These crises foster widespread social, economic and religious insecurities, including injustice and absence of good governance. These problems threaten Nigerian's social stability and its democratic values thereby making the Nigerian society unsafe for industrialization and economic development. The methodology adopted for this paper is critical analysis. This paper sets out to examine the causes and its effects in a heterogeneous society like Nigeria. With the analysis in the study, one is convinced that the problem needs urgent intellectual and practical solution to save the fourth republic from another disaster as witnessed in the past. The paper therefore recommends that, the Nigeria's government should at the Federal, State and Local levels, adopt an open and uncompromising neutral attitude towards religious organizations in this country. Leaders of various religious groups should conscientise their numerous followers on the great value of religious toleration in a pluralistic religious country. In dealing with people of other faiths, adherents of religion should refrain from using insulting language and from saying anything that could give offence.*

***Keywords:*** Ethnic, Religious, Crises, Sustainable and Good Governance.

### **Background to the Study**

In the past as at now, there had been intra- religious conflicts arising among mostly from differences in doctrinal issues. During economic recession, as witnessed during Buhari first administration (1983 – 1985) the establishment of Churches especially the Pentecostal became one of the most lucrative businesses in Nigeria. Christian had to persecute Christians, religious intolerance, Holy than thou attitude and so on are common with Nigerian religion. Before the advent of the two historic and missionary religions traditions viz: Christianity and Islam, the indigenous religion of Nigeria exercised its control over the people. The economic, social, political and religious values of the society were well internalized, sanctions and prohibitions were imposed on actions which the society or the supernatural entities where they escaped the vigilant attention of the society. The force behind these values was the fear of the Supreme Being, ancestors and to some extent, the fear of reproach and alienation from members of the society.

Violence and wars are evil times that fall upon humans. They are not unexpected because they are human made. However, they do not snare and trap their perpetrators and victims. As Glen Stassen (1992,236) observes that the Gulf War, “The war had a major impact on many peoples values and perceptions”. This statement is not only true of the Gulf War but of any other war or violence that happens anywhere on our planet earth. So in order to understand the misery perpetrated by crises or war, we need to analyze the short and long-term ethnic and religious ramifications of such actions. For more than four decades, Nigeria – Africa's most populous nation has been trapped in spiral cobwebs of crises. Christian and Muslim relationship have soured according to Boer (2003,35). What used of to be seen as ethnic and political crises under the auspices of regional politics, power struggles and competition has now translated into religious crises. In short, greed for political power welled up in each of the three regions struggling to capture more political clout and control of the economic resources of the country, resulting in the politics of numbers, which seeks to use the highest number of voters by using demagogic divisiveness. As each of the country's three major regions – the North, the Southeast, and the Southwest - have vied to capture more political clout and control of the country's economic resources, the country's two main religious communities (Islam and Christianity) have been drawn into this politics of numbers. Therefore, as Boer (2003) points out, “The fear of losing out to Christianity has made Islam even more nervous, for it stakes its claim on the basis of an alleged continued majority. Increasing nervousness spells greater volatility”. Implicitly, the politics of numbers is a time bomb. It is explosive in nature. Perhaps this is one of the reasons why Christians in the Middle-Belt of Nigeria have been the target of Islamic onslaught, resulting in violent attacks and counterattacks.

Undoubtedly, people are aware that ethnic and religious crises have had negative impacts on Nigerians. Falola (1998, 1) notes, “The institutionalization of religious violence and the aggressive competition for dominance by Islam and Christianity continue to have a negative impact on the Nigerian nation”. That means, according to Falola, the bulk of the problem of violence in Nigeria arises from religious conflict. We can now say with precision, how violence issues are profoundly ethnic and religious. Finally, my primary task is to carefully examine the thesis that religious and ethnic crises impact negatively good governance in

Nigeria. In this vein, the paper attempt to under various subheadings, show the Nigerian situation, incidence of religious and ethnic crises, factors responsible for religious crises in Nigeria, remedy of religious crises as useful suggestions and to end with a conclusion.

### **The Nigerian Situation**

Nigeria as it exists today is a pluralistic society, that is a society with different cultural and religious groups. The unification of the North and South by the British colonizers in 1914 by Sir Frederick Lugard put an end to the perception of Nigeria as one homogenous entity with one unifying dominant religion. Instead, Nigeria unity is sought in the strive for significant and relevant common goals, objectives and philosophy which takes cognizance of the common needs, aspirations and values of different ethnic groups within her. At the moment, the goals, aspiration and philosophy of the government of this country are enshrined in her constitution, national anthems and pledge and national policies. In the present Nigerian Federal governments' policy on education, fourth edition (2004), five objectives were outlined: A free and democratic society. A just and egalitarian society; A united, strong and self-reliant nation; A great and dynamic economy; A land of bright and full opportunity for all citizens.

It is the strong belief of the Federal government that if these five objectives are fully implemented in all sectors of education in Nigeria, the hope of a united, strong and self-reliant nation will not be a wishful dream. It is also envisaged that democratic government will be directed toward achieving these goals. This means that democratic government in the Nigerian context will no longer be based on ethnic, sectional, religious and non-cultural interests. The political common good is realized when Nigerian political communities recognize and appreciate not on paper but in practice the values of unity in religious, social, economic and cultural varieties. The unification of the various ethnic groups in Nigeria by the British colonizers, as Arazu (1990) rightly observed is providential and God-given. In his words:

*“... Belief in God's creation of the universe and in His active and universal rule over that creation, does not allow for the emergence of change occurrences within the organized whole ... It is on the basis of this belief or faith that the genuine and faithful Nigerian sets out to continue the work of the evolution of the nascent nation into the full realization of what the author (God) meant. When he said 'let Nigeria be', 'He spoke and colonizing agents did the job and He got them out in due course. We are here to till the political, social, economic and religious ground and master or dominate it’”.*

Hence, in a heterogeneous society as Nigeria, religious is bound to be burning issue unless it is well regulated by effective and functional constitution operated by altruistic, selfless and open-minded politicians. Such leaders are yet to emerge in the Nigerian context since the same homo religious (religious man) in Nigeria is also a political animal. For historical purposes, from the time the British colonizers set foot on Nigerian soil to the present moment, the three major religious have been and are still: Christianity, Islam and African Traditional Religion. The interactions between the adherents of these religions have not been so cordial.



Consequently, the political life of the citizens has been adversely affected. Religious intolerance was sown by the British colonial government through her policy of indirect rule. Through this policy, which encourage the existing religious, political, social and economic institutions of ethnic groups in Nigeria in so far as they are not inimical to British government interests, the three dominant religions were tolerated. However, in practice, the British government learned more to Islam in the North and Christianity in the South to the detriment of African Traditional Religion.

These double standards in attitude towards the dominant religious of Nigeria filtered into the political mind set of the Nigerian politicians from independence in 1960 to this present moment. Hence, while freedom of religious thought and practice is officially embodied in Nigeria's constitution and official government papers (1989) in practice the politicians and leaders seem to say: my particular religion before any other thing else. The common good of all citizens in Nigeria should be evaluated and accepted through the prism of any particular system of government, its norms and values". This seems to be the crux of the religion – political life of leadership in Nigeria. Our politicians and other leaders have not been able to rise above the particularism of religious inclinations to the universality of acceptance of religious pluralism in a heterogeneous society as Nigeria. Consequently, the seed of religious intolerance sown by the British colonial masters are indirectly and often directly watered and cultured by subsequent Nigeria government.

However, the bottled-up discontents associated with ethno-religious conflict in Nigeria exploded with the return of constitutional democracy in 1999, intently throwing up issues beyond the capacities of the civil government. This circumstance invariably threatened the peace, security and survival of the country's long-awaited democracy and its corporate existence. Consequently, government not wanting to be seen as weak, adopted condemnable authoritarian use of massive force to deal with the problem, but it seems the more the fire of ethno-religious conflict is being doused, the more inflammable it has become. In Jos since 2001, ethnic clashes over cattle grazing and control of farmlands have pitched the indigenous ethnic Christian people in Berom against the Hausa-Fulani population. In sustained attacks on communities such as Riyomand Barkin Ladi, entire families have been wiped out in some instances, with attacks occurring daily on homes, fields and roads. Farms are looted, homes burnt, grain stores destroyed, and crops cut down, depriving survivors of shelter, sustenance and income.

Death and destruction resulting from ethnic clashes have been the case of Plateau state since the return to democracy. There is no end in sight to killings in Benue state, apart from the usual face off between the indigenous Tiv and Idoma, deadly clashes have recently occurred when the nomadic Fulani herdsmen slaughtered a number of Agatu ethnic group indigenes. This happened on May 5<sup>th</sup>, 2013 in which they raided eight villages including Okokolo, Abogbe, Adana and Akpeko (Ugwuanyi, 2015). Before the latest massacre in January 2018, there have been clashes between the Tiv and the Fulani herdsmen constantly since May 2001. (SOF News 2018). No doubt, the Fulani herdsmen rage has added another layer to the growing

incidence of clashes among ethnic group in Nigeria.

### **Incidence of Religious Crises in Nigeria**

The history of religious crises in Nigeria runs like a colossus. Nigeria has witnessed about fifty (50) religious crises from 1980 to date. When these riots occur, numerous lives are lost, property worth hundred of millions of naira are destroyed. When religious crises occur, there use to be reprisal attack on other people and in another place or town. Christianity and Islam, the two adopted religions in Nigeria, have made social welfare services and educational development an important component of their activities. What is worrisome is the violence associated with those who have used the two faiths to propagate violence. From the Maitasane uprising of the 1980's to Boko Haram of today it's been violence associated with religious beliefs which have brought insecurity and massive destructions of lives and properties in Nigeria. The following are examples of religious crises in Nigeria.

<b>S/N</b>	<b>Date</b>	<b>Town or State</b>	<b>Cause of Riots/Irritators</b>	<b>Number of casualties</b>	<b>Government response</b>
1	December, 1980	Kano	Abubakar, Rimi Formar civilian Governor of Kano State issued quit notice to Muhammed Maitasine to leave the area illegally occupied by his group.	About 4,177 people were killed	Government paid N8 million as compensation to victims
2	1982	Bulukutu Maiduguri	Maitasine sects attack under the same guise of quitnotice	400 lives were lost and property worth N3 million were Destroyed.	Military and police were used to quell the crises
3	1984	Jemita and Gombe	Maitasine sect attack under the quit notice	763 lives were lost And about 5,913 people Were displace	Military and police were used to quell the crises
4	April 26th 1985	Bauchi Gombe	Maitasine sects attack under the quire of quit notice	More than 100 people Died after about ten hours fighting	Government intervene Using armed force
5	1986	Ilorin	Muslim attack Christian palm Sunday procession	None	Government intervene
6	May 3 <sup>rd</sup> 1986	University of Sokoto	Muslem student Society attack Christian students	Injured but no death. VC Office set on fire	Government intervene
7	1986	University Of Ibadan	Uni-muslim community	None	

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9	1990	Kano	Triggered by an Igbo Christian, Gideon Akaluka who was alleged to have defecated on the Koran	Many people died and properties were destroyed	Government uses police and military to quell the crises
10	1991	Kano	Triggered by Muslim Fanatics who claim to be protesting the Christian religious crusade of evangelist Reinhard Bonnke	People died, Churches and Mosques burnt	Soldier deployed to quell the crises
11	1992	Kaduna	Between Zango Kataf Christians and Zango Muslims	300 people died	Panel of inquiry was set up
12	10 <sup>th</sup> September, 2001	Jos	A Christian woman Attempted to cross a Barricaded street. This led to a scuffle Between her and a group of Muslims.	300 people died a reprisal attack in Aba, Owerri and Umuahia	Obasanjo visited the scene
13	2006	Maiduguri In Borno State and Onisha in Anambra State	Reprisal attack by the Igbos on the House indigene as a result of killing of innocent citizens under the guise of protesting against a publication of Prophet Muhammed by Dannish Newspaper	Over 50 died in Maiduguri over 30 churches and hotels were burnt	Governor Ngige and Borno counterparts intervened
14	December 4 <sup>th</sup> 2010	Potiskum	Consequent upon the conversion of one Cathrine Abbans to	2 lives were lost	Government intervene
15	Jan. 17, 2010	Nassarawa Gowon	Muslim youths attack Christians worshipers on Sunday	Over 100 people died and properties worth millions of naira destroyed	Government intervene

16	July 26, 2009	Teshim in Bauchi and later Spread to Kano, Yobe and	Boko-Haram crises started	Many lives were destroyed and properties worth millions of naira were destroyed	Government have been trying to put an end to the activities of the sect but to no avail
	August 27 <sup>th</sup> , 2016	Borno State and other parts of Nigeria.	This conflict emerged in Benue State and revolved around disputes between the Agatu ethnic group and Fulani herders, resulting in violence, displacement, and loss of lives.	Lives and properties were destroyed	Government Intervene
17	IPOB Agitation 2015 – present	Agatu, Benue State	The Indigenous People of Biafra (IPOB) movements, primarily representing the Igbo ethnic group, have led to protests and confrontations with security forces, demanding secession from Nigeria.	People died and properties worth millions were destroyed.	Governments have been trying to put an end to the activities of the sect but to no avail.
18	Southern Kaduna Crises (Ongoing).	IPOB, movement, Anambra, Imo etc.	This crises pertains to recurring violence in the southern part of Kaduna State, often along religious and ethnic lines, causing displacement and casualties.	Causing displacement and casualties of many lives were lost.	Government uses police and military to quell the crises.
19		Kaduna, Zaria.			

Sources: Onwubiko, E and Okonkwo, N (2012) and (SOF NEWS) 2018.

### Factors Responsible for Religious Crises in Nigeria

Every problem has causes, and the crises of religions are not exempted. A quick look at history of humanity throughout the ages reveals that certain constraint factors breed and nurture religious crises with obvious consequences on the political, social, economic and moral lives of the citizens. Certain things come to mind when one find adherents of religions killing one another in the name of religion. Several factors are identified as source of religions conflicts.

**Religious Intolerance and Fanaticism:** In Nigeria the problem confronting the relationship between Christian and Muslims is attempt to interpret and impose the various doctrines by the various religious groups. To this effect, Umar, Ahmed, Musa and Abdullahi (2014) observe that;

*... Describe the religion or ethnic group as majority or minority for the sake of access to resources. Huge energies are expended and wild argument thrown around on who is the majority, minority e.t.c. Through careless handling, some of these arguments degenerate into violent ethnic or religious conflicts that tend to be extremely savage and bloody with no end, because either group can effectively, let alone permanently neutralize the other.*

Oral or written statement made by the adherents or leaders either to show the superiority or inferiority of other religions lead to conflicts (Ezeh, 1999).

**Particularity:** This is the claim that there is no other religion but one's own religion. Demarest (1989). Clearly represents this position in the following words:

*Biblically speaking, the non-Christian religions ... are at best inadequate vehicles of salvation, and they are at worst demonic ... Christianity is true and the other religions are false... we affirm that other religions and ideologies are not alternative, if unredeemed by Christ, leads not to God, but to judgment, for Christ is the only way. In sum, we conclude from the Biblical evidence that religious plurality is a global manifestation of sinful humanity; flawed responses to general revelation and that the dogma of religious pluralism is false.*

Viewed objectively, and in view of modern theological thinking, the attitude described by Demarest cannot be for Nigerian Christian and pastors. Whoever has listened to Paul in the Areopagus, or Peter in the house of Cornelius or Paul in his letter to the Romans cannot come up with that unacceptable particularity in the modern world (Acts 17:22-24; 10:34-35, Romans 1:18-21).

**Poverty:** Is another factor causing religious riots in Nigeria. The vast majority of Nigerians are desperately poor. They are simply living from hand to mouth. In many families, parents are out of work, children school fees cannot be paid, rents have accumulated and food is in short supply (voice of the voiceless 2002). The poverty rate of the Northeast and North Central zones are 70% and 50% respectively (UNICEF, 2001). In 2004 the North West zone recorded 71.1% North East 72.1% and the North Central zone 70% (CBN, 2004). World Bank 2017 Atlas of Sustainable Development Goals shows that 35 million Nigerians are living in extreme poverty in 2013 than in 1990 which is defined as less than and £1.9 per day (documentsworldbanks.org/crolated/en/275714938835556771/atlasofsustainabledevelopment). According to Ejeh (2007) "poverty manifests itself in insecurity as people are forced to take certain actions to sustain themselves. Poverty has the cumulative effect of raising tension that easily explode on the slightest excuse" (p.305).

**Ignorance:** This is the refusal to know something of other people's faith. It is amazing to know that many Christians who lives and preach among non-Christians know practically next to

nothing about their religions. And yet, they focus on the fantastic, the bizarre and those things that strike them as unchristian and then make pronouncements about people's faiths that order on generalization and truths. Mala (1984) has summarized the situation in Nigeria:

As a matter of fact, the way Nigerians preach, teach and practice their religion betray the intolerance of the various adherents, their ability to accommodate other religious views, their false devotion to religions founders and there seemingly zealous but in fact fanatically uncompromising practices, contrary to the fundamental claims of their religions and the religious founder. The foregoing is saying that what some people do in the name of religion is not part of that religion. An extreme and most ridiculous example is the claim by some that they have to defend God. Who is a man to defend God? Since God alone is Ominipotent, He is surely allowed to defend Himself.

**Unemployment:** Unemployment is at all times very high in Nigeria. Every year, hordes of young people graduate from secondary and tertiary institutions with no prospects of employment. Onwubiko (2012) observed that;

*Unemployment occurs when people are willing and able to work but find it difficult to get a job because the supplies of labour outstrip the demand for labour. Unemployment becomes a problem when there is a saturation of labour market with labour to the extent that the supply of labour is far higher than the demand of it (p. 19).*

The increasing rate of unemployment has made many of the youths to be ready-made tools and vulnerable to the manipulation of agents to commit all forms of vices. Unemployed especially the Almajiri's can easily be mobilized to cause mayhem especially in the Northern part of the country.

### **Effect of Religious Crises on National Development**

Religious crises in Nigeria have led to the destruction of lives and properties. According to Elaigwu (2004) between 1976 and 2009 over 100,000 had lost their lives and properties worth billions of naira have been destroyed. In more that fifty recorded ethno-religious crises in Northern part of Nigeria. Some of the people killed in these ethno-religious crises will no longer contribute to the development of Nigeria. The losses that come in the destruction of property affect the economy of Nigeria. The continuous escalating of religious crises in Nigeria is gradually creating and conditioning people to harbour bitterness, hatred, rancour and grievances against each other, which has the potential danger of bursting into serious crises. Lack of peace will affect foreign investment which would have contributed to national development.

It is a fact today that where religious crises have occurred, a lot of arms have been stockpiled as a measure to either checkmate potential "opponents" or as deterrent to opposing religious foes in the future. The scenario has serious security implications for the peaceful co-existence of Nigeria (Gwaman, 2010). To this effect Ekeh (2007) stated that, "no meaningful development can take place in an atmosphere of insecurity and a breakdown of law and order" (p.306). The image of the Nigeria nation in the international community has been smeared. The

dislocation and relocation of people as a result of religious and ethnic crises have created socio-economic problems as some are thrown out of jobs. Some of these settlements have also become a haven of idle hands which constitute potential hands of armed robbers and other social vices (Adama, 2016).

### **Government Intervention**

1. **1980 – 1990:** During this period, the Nigerian government often responded to religious crises through security measures and law enforcement. Military and Police forces were deployed to areas experiencing religious violence, with attempts to restore peace and order.
2. **2000s:** In the 2000, the Nigerian government initiated various efforts to address religious tensions and conflicts. The Inter-Religious Council (NIREC) was established in 1999 to foster dialogue between Christian and Muslim leaders. Additionally, the establishment of the Nigerian Institute for Peace and Conflict Resolution (NIPCR) aimed to promote peace building and conflict resolution.
3. **2001:** The federal government introduced the Religious Equity Promotion Bill in 2001, which aimed to ensure the protection of Religions right and prevent discrimination. However, the bill faced oppositions and was not passed into law.
4. **2006:** The Nigerian government established the National Inter-Religious Committee (NIREC) to further promote dialogue and Cooperation between religious groups.
5. **2011:** In response to the deadly bombings on Christmas Day in 2011, President Goodluck Jonathan declared a state of emergency in parts of the country, increasing security measures in regions affected by religious violence.
6. **2016:** The Nigerian government launched the National Policy on Religious Tolerance, aimed at promoting peaceful coexistence and mutual respect among religious groups.
7. **2020:** In recent years, government efforts have continued to focus on dialogue, reconciliation and conflict resolution. Various State governments have implemented community-based initiatives to foster understanding between religious groups at the grassroots level.
8. **1992 Kano Crises:** In responses to the Kano crises in 1992, where clashes between Christians and Muslims led to significant casualties, the Nigerian government established the Kukah Foundation to promote interfaith dialogue and understanding. Bishop Matthew Kukah played a key role in facilitating peace talks.
9. **2000s – 2010:** The Nigerian government continued to establish bodies and initiative aimed at promoting interfaith dialogue and religious harmony. For example, the Presidential Committee on Inter-Religious Relation was set up in 2000 to foster peaceful coexistence.
10. **2002 – Sharia Implementation:** The adoption of sharia law in some northern Nigerian States led to tensions between Muslims and non-muslims. The federal government intervened to mediate and encourage dialogue between religious groups to prevent further escalation of violence.

11. **2006 – Yelwa Massacre:** Following the Yelwa Massacre in Plateau State, the Nigerian government set up the Justice Niki Tobi commission of Inquiry to investigate the incident and recommend measures to prevent future violence.
12. **2010 – 2015 – Jonathan Administration:** The administration of President Goodluck Jonathan established Initiatives like the National Committee on Peace and Reconciliation to address religious and communal conflicts across the country.
13. **2015 – Buhari Administration:** The government under President Muhammadu Buhari emphasized counter terrorism efforts against Boko Haram and aimed to strengthen security measures in regions affected by religious violence.
14. **2021 – Onward:** Recent government interventions have focused on deradicalisation programs for former Boko Haram members, as well as initiatives aimed at continuing hate speech and promoting religious tolerance through educational campaigns.

### **Remedy of Ethnic and Religious Crises**

So far, we have been trying to X-ray the root causes of ethnic and religious crises within the Nigerian context and their effects on socio-political and economic life of Nigerian citizens. In view of the magnitude of the problems posed by this cancerous vice, we hereby suggest:

- I. That the Nigeria's government should at the Federal, State and Local levels adopt an open and uncompromising neutral attitude towards religious organization in this country
- ii. Government should build, finance and control an ecumenical school to be run by experts drawn from various religious bodies in Nigeria. This school should be run on a short term bases for present and future politicians, civil and religious leaders.
- iii. Government should ban public preaching, distribution of tracts and others acts capable of provoking violent reactions from different religious group, in public transports and unauthorized public places of worships. As a further check on religious excesses, the government should discuss with at least major religious leaders in Nigeria on the possibility of producing a common code of conduct for the practice of religion in Nigeria.
- iv. Leaders of various religious groups should conscientise there numerous followers on the great value of religious toleration in a pluralistic religious country. They could do this by denouncing religious intolerance in any form and upholding the positive values and functions of religion. Some of these values are; peace, unity, harmony, forgiveness, love and toleration of others. Members of each religious group in Nigeria should be informed and formed by these noble values.
- V. At all levels of education in this country, students and their teachers should constantly reflect on the value of religious toleration in a mixed community of religious believers and practioners. In all tertiary institutions, symposium should be frequently organized on this topic.
- vi. In dealing with people of other faiths, adherents of religion should refrain from using insulting language and from saying anything that could give offence. They should avoid condemning other people's religion as false as this may warrant others to speak blasphemy against Christianity.



- vii. Government should create more jobs opportunities for the idle youths in Nigeria.
- viii. Challenges of poverty should be addressed in a more creative manner. The conditions of the poor must be ameliorated in order to reduce the vulnerability of the poor to mischief making.

### **Summary and Conclusion**

The most important contribution of this paper is that religious pluralism offers to Nigeria the principle of “Live and let Live”, as well as religious understanding, tolerance and harmony. In this paper an effort was made to examine the problems of religious crises in the heterogeneous society like Nigeria. Factors that give rise to this cancerous vice were exposed and its antecedents effects. The paper rounded up with suggestions for meaningful co-existence in Nigeria multi-farious and multi-cultural set up.

Religious crises are problems and a bottleneck to national development in Nigeria. Peaceful practice of religion is a pre-requisite to national development. These crises bring about hatred, rancour, bitterness and insecurity which are not indices for national development. The general knowledge about Nigeria should be promoted among the people. The various religious crises led to lost of lives and properties, lack of peace, the image of country is dented in the international community. No meaningful development can take place in a country that there is insecurity and breakdown of law and order.

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## SOCIAL STUDIES EDUCATION CURRICULUM AS A TOOL IN PROMOTING NATION-BUILDING IN NIGERIA

<sup>1</sup>Shuaibu Godabe <sup>2</sup>Shamsudeen Safiyanu Bayero & <sup>3</sup>Garba Abdullahi Miftahu

<sup>1&3</sup>Department of Social Studies, School of Secondary Education  
Arts and Social Science Programmes, Federal College of Education Kontagora  
<sup>2</sup>Department of Arts and Social Science Educaiton,  
Ahmadu Bello University, Zaria

### *Abstract*

*This paper explores the issue of social studies education curriculum as tool in promoting nation building in Nigeria. It aimed at buttressing how social studies education becomes efficacious in ameliorating the challenge of nation building in Nigeria. The concept of nation, nation-building, and its processes, curriculum were conceptualized. The paper went further to explain or encapsulate the challenges of nation-building in Nigeria, and how social studies curriculum as tools can be used in addressing the challenges of nation building. It is the position of the authors if social studies as an academic discipline is placed in a good pedestal within the school curriculum can help in minimizing or solving the challenges of nation-building in Nigeria: recommendations were also proffered for consideration, and this include: political education for both leaders and followers in Nigeria, norms and values of the society should be inculcated in the minds of children when they are young to develop their community and the larger society for national development amongst others.*

### **Background to the Study**

In the creation of the nation "Nigeria" the British or colonial administration did not give consideration to either the needs of the Nigerian people nor were consideration given to the consequence of bringing so diverse a group of people together. The concern of the colonial government was over the vast natural resources that permeated every part of the vast territory they had discovered, their concern at this point was to protect and properly coordinate the effective exploitation of these natural resources (raw materials). The most cost-effective way of ensuring this was not only to physically administer these regions (colonialism) but also to merge them. The economic, social and psychological effect on the people being brought together notwithstanding.

After the era of colonialism, when the colonial masters had established structures and mechanisms to ensure continuous exploitation or the supply of the raw materials, they needed for their industries the nation was granted independence (neo-colonialism) the child of the marriages of convenience was not left no administer herself. It was now the responsibility of the nation to struggle to live with the problems created by colonialism. In their search to continue to live together, the idea of the subject social studies was conceived. This subject was saddled with the enormous responsibilities of keeping this nation together by exposing its citizens to a body of knowledge, attitudes, values, sentiments and experiences required to produce or make the kind of citizens Nigeria requires in continuing to survive as a nation (one nation). These citizens after acquiring the learning experiences will in turn make Nigeria the nation that it should be. This is the bid task ahead of the subject social studies, its teachers and students, the building and holding together of the Nigerian nation.

How can the subject social studies adequately and effectively carry out this assignment? What body of knowledge can be utilized? What methodologies can be adopted in disseminating the body of knowledge to create the kind of sentiments, attitudes and values that are required for the building of the Nigerian nation? This needs to be done in such a way as not to destroy the uniqueness of each of the people that needs to be remoulded.

Historically, the concept of social studies in Nigeria is a new innovation in education, especially when we talk about the breaking of the traditional subjects like history, geography etc with the introduction of social studies, the idea of isolating traditional subjects was broken to some extent. The reason is that knowledge is integrating.

In the early 60s, efforts were made to introduce social studies, as integrated programme. One of the efforts included the comparative work undertaken by Nigerian educators in collaboration with their American counterparts, which led to the production of a book at the comprehensive high school Aiyetoro in Ogun State. The emergence of Nigeria as a politically independent nation after decades of colonial rule, calls for readiness to accept and maintain changes in the social, economic, political, cultural, scientific and technological responsibilities. This also called for the need to use education for national integration and this need led scholars and government to institutionalize social studies.

As a discipline, social studies is expected to provide a totality of experiences that the citizen needs in order to expose him through societal problems in chosen environment with full knowledge of variable factors such as historical, geographical, traditional, psychological, religious, scientific and technological which are main in man's interactions. Prior to the independence time, Nigerians were in a colonial cave, and after the independence, they were colonially mentalized i.e. thinking like the Europeans. It should be noted that during the colonial period, the traditional subjects were in existence, but could not save the situation. In the past, social studies had perceived a combination of other humanities only. And the society was looked upon as a collection of separate groups of people who shared different characteristics. But social studies implore concepts used by the social scientists to show that

our society is not as distinct as perceived. Social studies is a unique school subject about life and society.

### **Concept of a Nation**

To understand the concept of Nation-building, one needs to have some definition of what a nation is. Carolyn (2005) asserted that early conceptions of a nation defined it a group of people who share history, traditions and culture, sometimes religion and usually language. Smith (2007) distinguished an ethnic nation, based on the social construction of race or ethnicity and a civic nation, based on common national identity, and part of nation-building is the building of that common identity. Nigeria is more of a civic nation than an ethnic nation because of its diversity in culture, religion and language. Therefore, nation-building has become paramount in a country like Nigeria (Bourne, 2015).

### **Nation-Building and its Processes**

Nation-building can be seen as the sense of enhancing the capacity of state institutions, building state relations and also external interactions (Kelih et al, 2016). According to Mylonis (2012), nation-building is constructing or structuring a national identity using the power of the state. This collaborates Dobbins (2007) noted that nation-building aims at the unification of people within the state so that it remains politically stable and noble in the long run. Haris (2010) also noted that legitimate authorities in a modern nation state are connected to popular rule to majority. Nation-building is therefore the process through which these majority are constructed. Wimmer (2016) says that nation-building can also include attempts to redefine the populace of territories that had been carried out by colonial powers or empires without regard to ethnic, religious or other boundaries. These reform states could then become viable and coherent national entities (Mylonis, 2007). At a deeper level, national identity may be deliberately constructed by moulding different ethnic groups into a nation, especially since in many newly established states colonial practices of divide and rule have resulted in ethnically heterogeneous populations (Cannon, 2011).

### **Concept of Curriculum**

Education has a significance role in nation-building. Thus, there is a vital document that guides the education of every nation called curriculum (UBEP, 2008). It is derived from Latin root word-Currere means running off the course or racecourse (Pinar, 2011). In an academic environment, our curriculum – the racecourse, becomes prescribed and described as the programmes of study, made of series of individual courses. Tombs and Tieney (1993) also described the curriculum as an internal design for learning in the context of social expectations and students' needs. However, the curriculum is not static but remains fluid and dynamic, ever dynamic. This means that the curriculum needs to be reviewed from time to time to meet the dynamic needs and expectations of society.

### **Nation Building in Nigeria**

Nigeria since independence has made some efforts targeted at nation-building. Bourne (2015) stated that some of these efforts came after the civil war which understandably was a time to engineer nation-building to enhance proper integration of the warring elements. Among the

efforts is the institution of the policy of 'No Victor, No Vanquished' with its attendant 3RS mechanism, the establishment of the National Youth Service Corps (NYSC) scheme, the convocation of political reform conferences. The 'No Victor, No Vanquished' policy which gave rise to the 3RS of reconstruction, reconciliation and rehabilitation was initiated to integrate the nation. While Wimmer (2018) revealed that the objective of the policy was laudable, the actual implementation was deceitful, however, the policy remained a nation-building effort in Nigeria whether or not it yielded meaningful results. Adepojo (2021) noted that a similar effort was made through the establishment of the NYSC scheme. The National Youth Service Corps was created by decree N024 and 22<sup>nd</sup> May, 1973 in a bid to reconstruct, reconcile and rebuild Nigeria's nation after the civil. Timothy (2021) stated that the core objectives of the scheme include: to foster encouragement and development of common ties among the youths of Nigeria and promotion of national unity and identity. The scheme involves posting of young graduates of thirty years and below to different parts of the country distinct from their state of origin and probably regions. This was to enable them to learn and appreciate the cultures of the people in their places of primary assignment (Adepojo, 2021).

More importantly, the convocation of national political reform conferences over the years in Nigeria has remained an attempt at nation-building, Falola (2001) reported that these conferences were often mandated to draw the way forward for Nigeria but each time, failures have continued to be recorded, either as a result of the character of the delegates or the convocation and selection processes of members. And where the delegates succeeded at reaching a genuine and feasible conclusion, their recommendations are often not implemented and are therefore confined to the dustbin of history. This is why people are increasingly becoming jittery with political reform conferences in Nigeria especially as they have turned into avenues for political settlements (Falola, 2001). In another development, ALuko (2003) stated that equalization of educational opportunities is also an attempt by the Nigerian government to ensure nation-building. In Nigeria, equal access to education for all citizens of the country at primary, secondary and tertiary levels is guaranteed by the national policy in education.

### **Challenges of Nation Building in Nigeria**

Fadeiye, (2005), stated that, "The attempt to build a virile, enviable and stable Nigerians since independence has been thwarted by political, economic and socioreligious problems". These problems underline the struggles for nation-building. Some of these challenges can be stated and discussed below: sectionalism, ethno-religious conflict, terrorism, political instability, amalgamation, socio-economic inequality, corruption, tribalism, leadership problem among others.

### **Sectionalism**

Sectionalism entails a narrow-minded or excessive concern for one's local or regional community's interest as opposed to the interest of the larger community. There is an inclination of favour one group over another that may be the larger group. Sectionalism was the major cause of civil war between the North and South America years ago. Sectionalism happens when people are loyal to their section than their nation resulting in most cases, from a

mistrust and apprehension towards one another. Sectionalism helps to breed tension among the people, hitherto, had lived happily together, because a house divided against itself cannot stand. This is a serious problem that is affecting development in all facets of life.

### **Religious Conflicts**

This implies not allowing other people's views or beliefs. The intolerance often goes beyond religion and rational reasoning on other areas of the economy. Religious intolerance gives rise to fighting and loss of lives and properties which hinders development. Federalism is widely acclaimed as the appropriate government principle for societies with vast ethnic, religious and cultural diversities; the Nigerian federation has been be-devilled with bitter ethno-religious crises since independence. Even in this forth republic where democracies processes were initially thought to be more disposed to mediating the country's diversities peacefully' violent ethnic conflicts have been more rampant thereby slowing down national progress and threatening national unity and stability.

### **Terrorism**

There is no global accepted definition for terrorism. This is because it is a concept and act that the international community has been accepted to exist. This difficulty of providing acceptable definition arises from the fact that the term is politically and emotionally charged. However, terrorism is seen as the use of violence or threat of violence in order to purport a political, religious or ideological change. Terrorism is a crime that is made illegal by legislation Dike (2014). The United Nation General Assembly has condemned terrorist acts using the following political description of terrorism. It is non-combatant but operates either in cells or as individuals. They have hierarchical structure, though in recent times, are connected by their radical environmentalism. Their activities are tantamount to security risk in such areas of their operations. It should be stressed that sectionalism and terrorism, ethnicity have continued to mar public policy implementation in Nigeria, thus, the emergence of so many terrorist groups in the country, the Boko-Haram in the North and militancy in the south.

### **Political Instability**

Leadership has not been stable in Nigeria, based on desire to control the government by a few powerful individuals. This has become a problem especially in less developed countries. Nigeria a nation born in hope and optimism but has lived in anxiety for most of its sixty years history due to the country's failure to produce a nationally acceptable leadership that transcends ethnic, regional and religious boundaries and that can unit its diverse people for mobilization for national development. Nigerian leaders are corrupted, selfish, tribalistic and religious bigotry.

### **Amalgamation of Nigeria in 1914**

The historical legacy of colonial rule created a problem which is militating against nation building in Nigeria because the colonial masters divided Nigeria into two protectorates, which is the Northern and Southern protectorates respectively. Each with different land tenure system, local government administrations, educational systems and judicial systems while large British colonies like India and the Sudan had a single administrative system. Nigeria had

a two, one for the Northern and the other for the Southern. It was almost as if these were separate countries. As a result of that, regionalization has been a major challenge to nation building in Nigeria. Around 1950s and 1960s, Nigerians Nationalists from different regions fought each other as much as they fought the British. Nigeria never had central relaying figures like the saying of Kwame Nkurma of Ghana or Nelson Mandela in South Africa. Instead, each region threw up its own champion from this historical legacy.

### **Socio-economic Inequality**

An important aspect of nation building is the building of a common citizenship. But how can it be? When the person in the southern part of Nigeria has different qualities of life from the person in the middle belt e.g. Jos? In Nigeria, many of our citizens are denied basic rights such as rights to education, health etc. there is also serious variation in the enjoyment.

### **Corruption**

Corruption is a global phenomenon, but it is more prevalent and destructive in the third world countries. Corruption in Nigeria has become an endemic problem threatening the country's socio-economic and political development is common knowledge. While acknowledging the threat of corruption to Nigerian state, Hon. Ghali Umar Na'Abba, former speaker of Nigeria's House of Representatives declared in 2003 that "while we cannot rule out the incidence of corruption and bribery in almost every facet of our society, it is particularly resident in the infrastructure areas in ministries or monopolistic parastatals saddled with the task of making infrastructure available to the public such as water, telecommunication, electricity, roads and railways (NCR). Corruption can be seen as the abuse or misuse of power or position of trust for personal or group benefit. Onwubiko (2021) in Tali & Dimka (2021) assert that corruptions are today recognized by the United Nations as debilitating social evil that requires concerted worldwide effort to tackle. Aliyu (2017) also looks at corruption as a fraud which is regarded as deceptive, trickery guide and deception practices to cause onto surrender something of value or legal right. Corruption therefore is a problem hindering the development of Nigeria and other developing nations which can only be solved through social studies, which encourages unity for national development.

### **Tribalism**

Tribalism is one of the major factors that cause problem in Nigeria. The feeling of superiority of one tribe over another, hatred and suspicion cause a lot of tension that leads to communal/religious crises. This and many others lead to lack of peace in the society which can hinder development.

### **Leadership Problem**

The kind of leadership style adopted in an organization or state can generate conflict. As an example, a leader may adopt the authoritarian style of leadership, which may be contrary to the expectation of his subordinates who may prefer a democratic or participative organizational climate or atmosphere.



### **Role of Social Studies in Nation-Building**

Why is social studies chosen as a curriculum for effective citizenship for nation building? This is a curriculum that imbibes or promotes positive values, attitudes, skills and knowledge (VASK) in the individual. To enable him/her function effectively and efficiently, in the political, social, economic, cultural and technological development of his or her community and the larger society. Social studies education is a problem solver, it teaches holistic training because the subject uses multidimensional approaches to be able to solve all problems of man in the society. The method of teaching social studies is child-centered, structures, facts, concept and generalization is made. Social studies expose individual to its rights and obligations which can develop a nation because the citizens will be well motivated to build their community as well as the larger society.

Social studies is a discipline which cherishes the right type of attitudes, behaviours and life of man in the society, therefore, a society where the citizens of individuals are doing things that are right. Through these, the society will be built and there will be nation building. This is because when rights and obligations are done as expected, the following will be realized:

1. Safeguard and protect the individuals against abusers e.g. the rich dominating the poor.
2. It helps in protecting the denial of the rights of individuals of basic needs of life e.g. food, shelter, health etc.
3. Aims and objectives of the society will be achieved because social studies is expected to bring tolerance, co-operation, honesty, national decision, loyalty, empathy and taking our responsibility serious which will bring national development.
4. The development of national consciousness and commitment as necessary ingredients for nation building.
5. The inculcation of social values and skills for active social life.
6. The development of intellectual skills, knowledge and abilities for better understanding of the immediate and remote environments.
7. Developing rational thinking abilities for practical social life.
8. Promoting political literacy and encouraging democratic values and principles for the promotion of functional citizenship.
9. Identifying and solving social problems using problem-solving techniques.
10. Promoting values awareness and utilization of same in tackling dynamic problems in the society (Iweriebor, 1990; Ololobou, 2000; Sunal and Hass, 2002).

### **Conclusion**

The knowledge of social studies is capable of serving as the most therapy or tool for nation-building. This is because all over the world, social studies is a tool to solve problems of man in his physical and social environment. Nation-building is anything that an individual does to bring growth and development to the society which he lives. The right attitude towards nation building must be inculcated right from the family before a child will grow to meet the larger society. Hence, each citizen must be prepared to embrace one-nation economic and socio-cultural norms and values of society (Husin, 2011).

### **Recommendations**

The following strategies are recommended for nation-building in Nigeria:

- i. There should be political education for both leaders and followers in Nigeria.
- ii. Norms and values of the society should be inculcated in the minds of children when they are young to develop their community and the larger society for national development.
- iii. Social studies should be made compulsory at all levels of education system.
- iv. There should be serious sanctions on those that misuse public funds.
- v. Employment should be based on merit. To encourage qualification instead of god-fatherism.
- vi. Reward and motivation should be encouraged by government to enhance effective productivity in service by our leaders.
- vii. The anti-crime agency like EFCC should improve on their job by punishing defaulters to serve as deterrent to others.
- viii. Government should not interfere in religious matters, government whether federal, state or local should remain neutral and be free from religious issues. They should adhere to the Nigeria constitution (1989).
- ix. Productivity on the part of the citizenry should be encouraged.
- x. Promotion of national unity as against local government or state fractionalization by organizing programs like trade fair, sport should be on yearly based.

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## **BANDITRY AND ITS IMPLICATION ON POLITICAL REPRESENTATION OF THE NORTH WESTERN REGION OF NIGERIA**

**<sup>1</sup>Yusuf Barau Abdulrahman & <sup>2</sup>Mubarak Ahmed Mashi**

*<sup>1</sup>Department of Political Science and International Studies*

*Ahmadu Bello University Zaria, Kaduna, Nigeria*

*<sup>2</sup>Department of Political and Defence Studies*

*Nigerian Defence Academy, Kaduna*

### ***Abstract***

*The paper examined the implication of insecurity on political representation in the North-western region of Nigeria. Insecurity which has manifested in the form of banditry is caused by many factors central among which is the lopsided economic organisation of the country, the peasant's communities in terms of providing them with necessities of life, such as access to education, health facilities, meaningful and gainful employment, and adequate political representation. This becomes alarming and a threat to political stability that serves as an implication for political representation. During this study, data was sourced from two major sources: the Secondary and the Primary Sources. The Secondary sources were from existing literature on insecurity and political representation while the interview method and Questionnaire were adopted as the main primary source of data. The questionnaires distributed were 360 of which 345 copies were retrieved, and 21 respondents were used for the interviews conducted, three from each state with a total number of 366 respondents across the two methods adopted, to generate data from the selected key informants across the region. In addition, descriptive analysis method was adopted to present and analyze data based on study's objectives. Within the theoretical framework of conflict, the study finds out that insecurity has affected the political representation of the region as a result there is wide gap between the elected representatives and the general public, in some areas the voters were disenfranchised as a result of security threats to the voters and less presence of security personnel in the conflict areas which allowed the bandits to attack various communities at will. Based on the findings, the study suggests that the security architecture of the country should be redesigned to integrate the traditional security forces, adequate security presence in the rural areas, adopt an approach to tackling insecurity, synergy amongst the security agencies, and quick intervention from Governments.*

**Keywords:** *Banditry, Insecurity, North-West, Politics, Representation, Voters.*

### **Background to the Study**

Security challenges has become part of the contemporary realities of Nigeria. Since the return of democratic rule in the country in 1999, the country has been dominated by adjectives of crisis, conflict and violence, as if democratization is synonymous with these frightening waffles. The little progress achieved upon the return of democratic politics in the country has been shattered and mired by incessant inter-communal clashes, insurgencies, militarism and violent agitations that have threatened the structural foundation of Nigeria (Moses, 2021). These security challenges have led to the political and leadership crisis, the loss of lives and properties, loss of livestock, displacement of people, disruption of farming, and other socio-economic activities. Evidently, from the South-South Zone with Niger Delta militarism through the South East with violent agitations of the movement for the Actualization of the Sovereign State of Biafra (MASSOB) and Indigenous People of Biafra (IPOB) to the North-East with devastating repulsions of Boko Haram terrorism to the North-West being hallowed in rural in rural terror, kidnapping, armed banditry and cattle rustling through the North-Central being mocked by suspicion and uncertainties over ethnic and religious conflicts and farmers-herders clashes, the picture of Nigeria is one of bloodshed (Moses, 2021). A situation like this, if left unresolved, is capable of seriously threatening peaceful co-existence, democratic consolidation and economic meltdown in the entire country.

Banditry in Nigeria has been on the rise since 2015 (Abbass, 2017). Although, historically, it started earlier in Zamfara State around 2011. And, given the increasing and expanding nature of the problem and how rapidly it has been spreading to other neighbouring states of Katsina and Sokoto states (Moses, 2021). This social conflict started as a conflict over access to scarce natural resources between two socio-economic groups that is mobile pastoralists and sedentary farmers, which ultimately resulted to conflict between these two groups that were before living in peace with each other, with a heavy human and economic cost, ranging from the sexual assault on women and girls, attacks on villages, kidnapping for ransom, killings of farmers and herders to cattle rustling, killing of victims in some instances. Banditry as a violent situation unleashed on rural communities which reorganized armed violence through plunder, extortions, armed robbery, kidnapping for ransom, raping of women and children, village raids and setting them ablaze, terrorism, illegal mining, the rustling of cattle, and murder as a means of fluid occupation by criminals. Banditry, as one of the insecurity challenges affecting the North-Western region of Nigeria, has recently, been affecting the political representation of the region.

Just as in the North-Eastern region of Nigeria, banditry has become one of the major problems bedevilling some States in the North-Western region of Kaduna, Katsina, Zamfara, Sokoto and, Kebbi. These shows that five out of the seven States in North - West are now under their control. The activities of bandits in the affected States have continued to affect the political representation of the region. The rate at which the bandit's activities are escalating is becoming as alarming as it is causing the death, displacement of the peasants within the communities.

Despite trends that suggest entrenchment of democratic elections and peaceful regime change at both national and sub-national levels, the democratic institutions of parliament, the judiciary, political parties, and civil society have remained weak in tackling the situation of insecurity in the country. It is against this backdrop that this paper sought to examine banditry and its implication on political representation in the northwestern geo-political zone of Nigeria.

### **Political Representation**

Political representation refers specifically to the accountability of an individual or political party to the group of people they are representing. Political representation is also a creative activity in which representatives construct themselves as representatives of minorities and at least partly construe ethnic identities and minority groups by making claims about them and their interests. By making claims about groups, representatives constitute them as a democratic political subject “that becomes recognizable as a unified and not merely aggregated entity only by means of representation (Disch, 2015, p. 490). Representation, is also, when elected representatives are expected to act responsively to the needs of their constituents” (Hobolt and Klemmensen 2008, p.309).

### **Insecurity**

Insecurity is the state of being subject to danger or injury. The anxiety that is experienced when one feels vulnerable and insecure. It is a state of being not secure or, lack of confidence. Insecurity can constitute a form of attacking individuals or groups causing panic. The concept of insecurity connotes different meanings such as absence of safety; danger; hazard; uncertainty; lack of protection, and lack of safety. For Onifade, Imhonopi and Urim (2013), in Jubril and Jimoh (2020), insecurity is conceived as a situation the where human and national security of a state is compromised by internal or external forces or interests exacerbated by the former's weak or poor economic, military and/or human resource development conditions.

Insecurity is an absence of protection or safety. As opined by Achumba et al (2013), insecurity entails peril; death trap; ambiguity; the dearth fortification, and lack of security (Achumba *et al.* 2013). They also discuss the problem of insecurity from the following two major perspectives: Firstly, insecurity is the state of being prone or vulnerable to danger or threat of danger. In this situation, the tendency of experiencing hurt based on insufficient measures against danger is very bright. Secondly, Insecurity is the state of being exposed to risk or anxiety. The exposure could be a result of inadequate measures against insecurity by the state or by a group of people etc. This usually happens when the law enforcement agents are poorly educated, trained, remunerated and motivated. It could also occur when people's“ basic necessities of life are lacking.

### **Banditry**

Banditry is organized armed violence through plunder, extortions, armed robbery, kidnapping for ransom, raping of women and children, village raids and setting them ablaze, terrorism, illegal mining, rustling of cattle and murder as a means of fluid occupation by criminals.

Bandits can: strain government capacity, challenge the legitimacy of the state, act as surrogate or alternative governments, dominate the informal economic sector and use violence and coercion to compete with legitimate business while avoiding taxes and co-opting government regulators; and infiltrate police and non-governmental organisations to further their goals and in so doing, demonstrate latent political aims (Sullivan, 2012).

## **Conceptual Review**

### **Political Representation**

Political Representation is a household concept that has been defined variously. In a general sense representation means that when a group of people or individuals represents and acts on behalf of a group which is so large that all its members cannot directly participate in its deliberations, then this is the general understanding of representation. In the specific sense, political representation “is the process through which attitudes, preferences, viewpoints and desires of the entire citizenry or a part of them are, with expressed approval, shaped into government action on their behalf by a smaller number among them, with binding effect upon those represented. According to Robert Von Mohl, in Johari (1989), representation, “is the process through which the influence which the entire citizenry or a part of them have upon government action, is with their expressed approval, exercised on their behalf by a small number among them, with binding effects upon those represented” (Johari, 1989). Political representation is the activity of making citizens' voices, opinions, and perspectives “present” in the public policy-making processes. Political representation occurs when political actors speak, advocate, symbolize, and act on behalf of others in the political arena. In short, political representation is a kind of political assistance.

The development of representative government created the potential for modern mass democracy. Instead of directly participating in political decision making as in the Greek polis or the Swiss canton, the public selects legislators to represent them in government deliberations. Citizen control over government thus occurs through periodic, competitive elections to select these elites. Elections should ensure that government officials are responsive and accountable to the public. By accepting this electoral process, the public gives its consent to be governed by the elites selected. The democratic process thus depends on an effective and responsive relationship between the representative and the represented (Johari, 1989).

Much of the existing literature on minority representation assumes that despite internal heterogeneity, the shared experience of structural discrimination allows us to identify a set of essential interests that are common to all members of a minority group. Based on this, the literature suggests that presence of any member of a group in parliament secures presence to the whole group (Anwar, 2001, Celis, Eelbode et al., 2013, Dancygier, 2013, Moser, 2008, Protsyk, Matichescu et al., 2008, Saggat and Geddes, 2000, Schönwälder, 2013, Teney, Jacobs et al., 2010, Togeby, 2008). These representatives are further expected to advance essential minority interests in parliament (Bird, 2011, Celis and Wauters, 2010, Dunning and Nilekani, 2013, Gay, 2007, Jensenius, 2013, Jones, O'Toole et al., 2015, Saalfeld and Kyriakopoulou, 2011).

The process of representation and the representatives are important because the latter act on behalf of people and is responsible of representing their interests and formulating policies in their favour. Further there is the question of the accountability of the representatives to the people that is invariably connected with the ways by which people can exercise control over their representatives. It is not simply majority representation that is important but each and every segment of the society should get a chance to be represented in the legislature (Johari, 1989).

### **Banditry**

The Concept of banditry has been changing over time, space and circumstances. A bandit in the 19th century Europe and Americas a freedom fighter whose aim was partly to ensure the emancipation of the downtrodden from the upper class or colonised over the colonizer (Warto, 1994). Furthermore, bandits like Chucho el Roto, Herachio Bernel and Santanon were often celebrated as heroes of Mexican independence. Therefore, Mexicans have warm regards and respect for those "social regard" termed bandits, while on the contrary, the State often considered them as nuisance and outlaws that need to be era nuisances (Michael, 1987).

In some pre-industrial societies where peasants see bandits differently from the State not as outlaws, hoodlums and miscreants, but as avengers and bread winners". As constructed Hobsbown cited in Kyari, and Chinyere, (2015). "social bandits", as group of peasant outlaws who maintain some respect within peasant society. Bandits are sometimes considered by their people as heroes, champions, avengers, fighters for justice, perhaps even leaders of liberation. Inland any case, they are seen as men to be admired, helped and supported. This description can best be understood within the purview of what Blumell (2007) described as "ancient banditry" or possibly "traditional banditry", which thrived in preindustrial era. This form of bathing industry is different from the nature of modern banditry. Modern -day bandits are more and destructive in nature.

However, a bandit in an African setting is entirely opposite to the Americas, the former specialized in armed robbery and other related crimes (Curott and Fink 2008). The case of Nigeria has clearly shown that banditry is a criminal activity that involve killing, kidnapping for ransom, and destruction of communities. The most common feature of banditry in Africa has been maiming, killing and wanton destruction of properties and hence, it has a direct relationship with cattle rustling (Rufa'i, 2017).

Banditry refers to the practice of stealing cattle and animals from herders, or the raiding of cattle from the ranches. Although driven by different needs and factors, it is increasingly an economically based form of criminality perpetuated by informal networks (Kwaja, 2013). Rural banditry thrives as a means of 'primitive' accumulation of cowherds in the context of subsistence and commercial pastoralism. The most disturbing effect of this banditry is the unsettling of pastoralist transhumant activities. Furthermore, rural banditry is accompanied by rape, kidnapping, organized attacks on villages and communities, and looting (Kuna, 2013).

With the globalisation syndrome, the manifestation of banditry has turned into a global phenomenon. Bandits in the era of globalisation therefore are more than mere rural gangs and criminals. Slatta (1994), was of, the opinion that bandits usually operate in the shadows, often on the fringes of society, in geographically isolated areas. Those who operate on that platform are regarded as bad people, who have nothing good to offer society. Banditry is now a sophisticated enterprise with the capacity to challenge the authorities of weak and failing states. The scope, dimension and operational pattern of banditry have been enlarged around the world and particularly in Africa. This therefore have a lot of effect on the agricultural and economic development of the rural areas in terms of productivity and sustenance. The rural area is so isolated that the presence of security is limited, and it permits the bandits to carry out attacks on communities, farmland, rustle cattle at will.

### **Nigeria's Security Challenges**

National securities are central to the survival and actualisation of state policies hence, the development of any given state is hinged on and largely determined by the level of prevailing security both externally and internally (Nwolise, 2002). Security relates to the presence of peace, safety, happiness and the protection of human and physical resources or the absence of crisis (Otto and Ukpere, 2012). While to Akin (2008 cited in Ukpere, 2012), defined security as any laid down procedures towards the protection of persons and property against hostile persons. He further opined and observed that:

*It is a situation whereby a conducive atmosphere is created within which people in the state can go about their normal daily activities without threat to either their lives or properties. Thus, security encompasses all approach toward safeguarding human as well as material resources in the state against all forms of aggression or violent conduct (Akin, 2008, cited in Ukpere, 2012).*

This is to say security as a general term encapsulate not just the protection of individuals and property against overall survival of the state and a conducive political vis-a-vis economic atmosphere. Security involves gaining a degree of confidence about our relationships that comes through sharing certain commitment with the other actors, which, in turn, provides a degree of reassurance and predictability. This view argues that it is not particular commodities (such as nuclear weapons) that are crucial factor in understanding the security-insecurity equation but rather relationship between the actors concerned (Williams, 2013).

In recent times, Nigeria has been facing several security challenges. These include rise in armed robbery, kidnapping, and insurgency by the Niger Delta militants, ethnic conflicts, activities of the Boko Haram sect, and recently armed banditry most especially in the northwestern region. Thousands of innocent lives were lost as a result of one violent crime or the other, while property worth billions of naira have also been lost to insecurity in the country. This is the character of Nigeria, which has blurred all the indices of economic growth and development and also contributed to deepening the crisis of poverty (Moses, 2021: 255).

From national security perspective, it is possible to make several deductions on Nigeria's threat analysis in the last decade. As a sovereign territorial entity, Nigeria faces no existential



threat from any of its neighbours, as is the case with say, India and Pakistan, North and South Korea, or Iraq and Kuwait before the first Gulf War. In terms of military and economic capabilities, the country towers over and above all her neighbours in such a way that declaration of open hostility is practically impossible by any of the sub-Saharan countries (Katsina, 2012).

Internally however, no one place is considered totally safe within the country. When those in the southern parts are trying to grapple with kidnapping and other violent crimes, Nigerians in the North live in utter terror not knowing where and when the next set of bombs will explode. Challenges such as massive corruption, tribalism, poverty, poor governance, near-zero industrial bases, and a single-line economic sector are often described as characteristics of developing countries. While this may be true, it is important to observe that in the case of Nigeria, these characteristics have stayed very long for any purposive drive towards national development. Years of military rule, compounded by an ineffective and corrupt bureaucracy have destroyed, by the end of the last century, any semblance of political accountability and people-oriented leadership (Katsina, 2012).

The country's security challenge took another dimension with the 1 October 2010 bombing near Eagle Square in Abuja, venue of the country's 50<sup>th</sup> Independence Celebration since then, a series of attacks have occurred in several parts of the country including Suleja, Jos, Kaduna, Maiduguri, Bauchi, and Kano. The country has also witnessed several ethnic and religious crises which appear to be escalating at an intolerable scale. These crises and criminal activities individually and collectively create insecurity and breach of the peace that are likely to or indeed affect legitimate social and economic activities in the country (Abubakar, 2005). The citizens now live between the edges of security uncertainty and vulnerability.

Over six million of sophisticated arms are in the hands of private individuals in Nigeria (Abubakar, 2005). These security challenges have the very damaging consequence of giving the signal to the rest of the international community that Nigeria is not a safe and secure place and as such not suitable for economic investment and activities. This is particularly important in view of the efforts being made to create the desired atmosphere to attract foreign events. Insecurity is a risk factor which investors all over the world dread, as security uncertainty is not only considered a bad omen for business, but it also sends warning signals to investors to take their investible fund to another country where there is adequate or a semblance of security (Katsina, 2012).

The causes of insecurity within the discourse of security challenges have continue to be a contending issue amongst various scholars, most especially with the way it has continued to cause a serious threat to the peaceful existence of the Nigerian State. Onifade, Imhonopi & Urim (2013), cited in Jubril and Jimoh, (2020), categorised the aetiologies of insecurity within Nigeria in twofold: remote and proximate causes. The remote factors include such causes as absence of institutional capacity resulting in government failure, which Fukuyama (2004) called the breakdown of institutional infrastructures i.e. the ineptitude of the government could be held for the breakdown of security in Nigeria's system. Whereas immediate and

proximate factors according to Achumba et al. (2013) are factors that have contributed to the state of insecurity in the country which include porous borders, rural-urban drift, social irresponsibility of companies resulting in negative externalities which provoke social unrest within their host communities, unemployment, poverty and terrorism, among others (Jubril, & Jimoh, 2020). The state of insecurity in the North-West region of Nigeria could be attributed to the fragility of Nigerian State. Ncube and Jones (2013, 1) defines fragility state as a state that is "incapable of assuring basic security, maintaining the rule of law and justice or providing basic services and economic opportunities for their citizens."

In the past five years, armed banditry in rural areas seems to have taken on a life of its own, with dire consequences for the citizenry in Nigeria. Many analysts associate the phenomenon of rural banditry with the failure of the State, Ibrahim (2014) to provide security and basic services for the populace. Banditry leads to disruption of life as we know it. The desire to avoid strife and its attendant sequences lead to displacement and loss of lives and properties. Armed banditry also leads to the existence of constant fear of attacks, which take away human dignity and people's ability to organize, seek and engage in livelihoods (This Day, February 3, 2014).

The previous conflict in other countries across the Sahara Desert also allows the exportation of weapons used during the conflicts into Nigeria through the poorly governed borders. For instance, illicit SALWs from post-Gadhafi Libya and other parts of the Maghreb and the Sahel region find their way to the region through the porous borders exploited by criminal syndicates. Availability of such arms coupled with poor regulation of the mining sector aids bandit attacks in States like Zamfara, Katsina, Kaduna and Niger State.

The activities of illegal gold mining in Zamfara State is viewed as a major factor in sustaining bandit-related attacks and killings in the State. Bandits are known to have vanquished communities and taken over potential mining spots which they exploit themselves. Furthermore, weak regulation of pastoral activities has led to infiltration by livestock bandits, leading to an increase in cattle rustling in the Northwest. The sudden intensification of cattle rustling in States like Katsina, Kaduna and Zamfara, particularly since 2010, is due to a number of interconnected factors.

These include the conflicts between herders and farmers, commercialization of cattle rustling, availability of SALWs, and the emergence of livestock bandits. The existence of large swathes of uncultivated forest reserves, popularly known as Dajin Dansadau, Dajin Maru have always provided hiding places for bandits. These areas offer perfect hideouts, where bandits could reside for months to organise their terrible activities (Moses, 2021). Others are Kumuku and Kuduru, Kuyambana, Sububu, Dajin Rugu and Burwaye forest are some of the deadliest enclaves of armed banditry in the region.

Bandits are also linked to local and transnational organized crime networks and markets for the sale of stolen cattle. Many of the rustled cattle have been disposed of in many markets of major Nigerian cities, including Maiduguri (Borno State) and Agege (Lagos State) through criminal intermediaries (ICG, 2020 in Jubril & Jimoh, 2020).

## **Theoretical Framework**

### **The Conflict Theory**

Conflict theory is a philosophy that originated from the works of Karl Marx (1818-1883). In conflict theory, Marx claimed that society is in a state of conflict due to competition for social and economic resources. Social order is maintained by domination and power rather than a general agreement. According to conflict theory, those with the most resources use wealth and power to suppress poor and powerless people for their own betterment that leads to inequality and power struggle (Rummel, 1977). Conflict theory believes that crime is caused by social and economic forces operating within society. Human behaviour is influenced by conflict between various groups in society. Marx believes that struggle or conflict among classes was an inevitable feature of capitalism based on the various groups in a society or social classes perpetually fight and compete for resources and power, hence the groups remain polarized against each other.

In consideration to Marx exponential understanding of conflict, Weber's beliefs about conflict extend beyond Marx in that they suggest that some forms of social interaction, including conflict, generate beliefs and solidarity between individuals and groups within a society. In this way, an individual's reactions to inequality might be different depending on the groups with which they are associated, whether they perceive those in power to be legitimate, and so on (Coser, 1964). Dahrendorf (1959) put forward some of the elements of conflict drawing from the works of Marx: Social order is maintained by force from the top, tension is constant, extreme social change happen at any time, there cannot be conflict unless some degree of consensus has already been established, once reached, conflict temporarily disappear (Dahrendorf, 1959). He further asserted that conflict can be regulated through negotiation, mediation, arbitration etc, on that assertion, he gave the following functions of conflict:

1. Conflict establish identity.
2. Conflict serves as safety value to hold the group together.
3. Conflict increase group cohesion.
4. Conflict help in testing the strength of individuals and groups
5. Conflict spurs needed change.

The three basic assumption of conflict theory are:

- 1 Between individual or group, conflict emerges from having opposing interests or competing for limited resources.
- 2 Struggle and conflict typically lead to some groups and individuals controlling and dominating others, and that patterns of subordination and domination are self-perpetuating.
- 3 Dominant groups disproportionately influence resource allocation and societal structure.

### **Criticism of Conflict Theory**

Despite the relevance of the theory in explaining the security issues, the theory is also criticized on certain ground. Some of the critics of conflict argue that Conflict theory was criticize for ignoring stability. As argued, history is made up of both periods of upheaval and

periods of stability. By focusing only on conflict and strife, and ignoring the long stretches of peace and stability, the conflict theory takes a partial view of history and human society, akin to focusing only on the troughs of a waveform and ignoring the crests. Also, the Consensus Theorists forward their argument on the criticism of the Conflict theory. The theory states that human beings are almost as likely, if not more, to cooperate with each other to distribute scarce resources justly, rather than engage in conflict and attempt to subjugate the other (Huntington, 1993).

### **Relevance of the Theory**

Within the context of this study, it is important to acknowledge the fact that the situation of Banditry as it affects the political representation can be synthesized into conflict theory which is expressed in violent conflict. Based on the assumption, the incidence of banditry can be accepted as a conflict issue which needs utmost emergency responses from the government. As conflicts are inevitable, the theory deeply helps in understanding the contending issues that exist within social groups which has led to various confrontations in the form of violent conflict.

### **Political Representation and Insecurity**

From the picture of the high level of insecurity in Nigeria pointed above, it is easy to see how it can serve as a challenge to the political representation in the country. The various issues that have to do with lack of adequate political representation being faced by the country have been attributed to insecurity in many cases. The situation whereby majority of the people are poor and vulnerable to insecurity, displacing them from their community and region as a result of fear of being attacked, will doubtlessly, affect their political participation and representation. In other words, the process of turning the North-West region into an axis of rural terror and killing field could be explained emphatically within the context of the crude crisis of governance catapulted rapidly by politicizing the act of violence conflict through the centripetal and centrifugal forces of corruption and disempowerment. Perhaps, as a strategy of actors perpetuating themselves in power (Moses, 2021). Considering the statement of an informant who stated that:

*"Like the people we sent as our political representatives, most of them are not staying with us here, they do not know our problems, their children do not know our children, their only interest is because they have godfathers, our community leaders will just make all the necessary arrangements for them, and when they get what they want, they will go away and leave us. So because of that, nobody you will see officially that you sent to represent you and he does it" (Interview, 24<sup>th</sup> August, 2023).*

As opined by Danjibo (2008), it is now the norm to see thousands of the farmers and herders turn to Internally Displaced Persons within their own country and locality. The high rate of insecurity and violence in Nigeria reflects long accumulated conflict between and among various groups and fuelled by the political ruling elite for a cheap way of maintaining the status quo (Danjibo, 2008 p 8). This suggests that the insecurity situation also has a political dimension to it, it goes beyond what is in the surface to a more politically conspired phenomenon in order to score cheap political gains.

Clapham opined that “the breakdown of law and order on African continent was basically, the result of the legacy of bad governance” (Clapham, 2002, p.14). The Niger Delta militancy, O'dua Youth restiveness, Bakassi and Egbesu boys' dilemma and Boko Haram sectarian violence are traceable to bad governance. Commenting on poverty-unemployment relationship and interface, the former governor of Rivers State Rotimi Amaechi, asserts that the phenomena are “responsible for high rate of insecurity in Nigeria buttressing his point, he claimed that until we deal with the issues of poverty, wealth creation and unemployment, then we may be able to solve the problem of insecurity” (Amaechi, 2013, p.11). Thus, when government cannot and provide basic necessities of life to its citizens in terms of education, adequate food, water, healthcare and security of life and property, such a government is not only useless, but a shadow of one.

Regrettably, situation of this nature has a serious consequence of affecting the political representation of the rural societies. Further analysis shows that the prevailing insecurity in the form of banditry which is increasing on daily basis continue to pose serious threat on the political representation of the North-West Nigeria. It is on this basis that Abubakar (2019) made some assertion on some of the implication of banditry in West African sub-region with consequence on regional integration of West Africa including the radicalization of youth, increase rate of youth unemployment and their subsequent involvement in illicit guns and narcotic drug trade the sub-region. The emergence of network of miscreants groups, gradual collapse of agricultural and livestock development with effect on income, trade and commerce and proliferation of small firearms and light weapon, bastardization of traditional institutions (Abubakar, 2019, p 644).

### **Strategies for Tackling Insecurity**

The irreducible function of the state is to continually secure itself against internal insurrection and external aggression by providing the security of lives and property of citizens. Ideological differences notwithstanding, this is the state's most critical defining function. The “monopoly of the legitimate” use of force by which the state is defined- to defend itself against possible external aggression- and to secure its citizens against competing users of instrument of force speaks precisely to this point. This is the only way the state harvests in return the loyalty of its citizens, which translates into high degree of legitimacy and the ready inclination to obey its laws (Sofiri, 2020).

The Federal Government's response had been largely through deployment of state security forces. Consequently, “Operation Safe Haven” was created for the North-Central and stationed in Plateau State with areas of operation extending to Benue, Kogi, Nasarawa and Kwara states to quell ethno-religious conflicts and other criminal activities are cardinal evidence in this regard. Other government's response includes constitution of Commissions of inquiry and humanitarian assistance to persons displaced by the conflict. In addition, some State governments in the zone drawing inspiration from the Niger Delta situation have also initiated amnesty programmes - Disarmament, Demobilization and Reintegration (DDR) - as forms of pardon for repentant warlords, yet conflicts and insecurity continue to impact on inhabitants of the zone (Sofiri, 2020:34).

Taking the assertion of a security personnel into cognizance on the role of government in reducing the security challenges in an interview, (2021) he asserts that "as you said, from the government perspective, government has a lot of responsibility; a lot of roles to play in this because it is the major stakeholder. Some of the solutions are economic, some are social, and some are political" (Interview, 8<sup>th</sup> October, 2021).

Because the nomads and herders are being neglected for so many years, nobody is looking after them. Nobody cares about their education, their welfare, where to even settle them; they are just left to their own mercy. So they go around without education, without anything, as if they are not part of us. That is the consequence of what we are reaping and so many injustices have been made against them, so many things that led to the cause of this. So, government must provide a good environment where they can take care of these nomads. Taking care of their social, economic and other aspects of life. Government should be able to provide so many things for them (Interview, 8th October, 2021).

For the North-West, "Operation Sharan Daji and Operation Harbin Kunama II was established to battle armed bandits, cattle rustlers and robbers operating particularly in Zamfara, Kaduna and fringes of Sokoto, Kebbi, Katsina and Kano States, yet the conflicts continue. Government's review of the escalation of insecurity in the zone resulted in the launching of a new operation on Thursday, June 4, 2020 codenamed "Operation Accord" was launched on Thursday, June 4, 2020, to wipe out banditry, Kidnapping and other criminality from the North-West and North- Central part of Nigeria. The operation was promptly planned by the military high command of the armed forces of Nigeria to tackle banditry and other violent crimes in the area. The troops through land and air offensives successfully neutralized 392 bandits and other criminal elements since the commencement of the operation in the two zones (Killte, 2020, cited in Sofiri, 2020).

Commenting further on the measures adopted in reducing the incidence of insecurity in North-west, security personnel (interview, 2021) comments that:

*Right now, operations are ongoing, bandits are being arrested, and some of them are being prosecuted as we speak. With the seizure of network, it has greatly enhanced the security arrangement in the area. In the last two weeks or thereabout, there is no issue of bandit related activities in those areas as we speak. (Interview, 12th October, 2021).*

On the same note, the former Chief of Army Staff, Lieutenant General Tukur Yusufu Buratai flagged off Operation SAHEL SANITY on the 6 July, 2020 as part of activities of the Nigerian Army Day celebration, 2020 during which the Nigerian Army Super Camp IV Faskari in Katsina State was established. The aim of the operation is to support Operation HADARIN DAJI in stemming the tides of the activities of armed bandits, cattle rustlers, kidnapers, incessant killings in the North-West zone of the country. These acts of criminality orchestrated by the bandits had before now crippled the political representation, social and economic activities of the people of this zone.

On the same note, considering the role of informants on worsening the security situation in North-western region of Nigeria, (security, 2021) further asserts that informants are treated like bandits, informants are even worse than bandits because they give information about our troops and other security personnel's movement, the numbers of the troops that are engaged in whatsoever activity, with which they are strategically located. And they disguise as people within us not knowing that they give information. So, we treat them even worse than the bandits whenever we catch them and we take the same procedure. If we arrest you as informants, we take you to Police or DSS, they will in turn charge you to court or does other further necessary action as they deemed fit. (Interview, 12<sup>th</sup> October, 2021).

Likewise, in a separate interaction with other security personnel (interview, 2021), he also asserts that

*In most cases, the security agencies collaborate with the traditional heads, and the traditional head will create awareness on the dangers of informants in the community or in the society. They give the security personnel reliable and timely information about these informants. Once we get these informants, we sink into action. We arrest them, and we investigate. If they are not informants, we release them, but if they are, we take them to the higher level for further investigation and trial. (Interview, 7th October, 2021)*

The people of the North-West zone felt the immediate impact of the operation with the tremendous success achieved within the short period of time. Eighty bandits were killed, 33 suspects arrested, 943 cows, 633 sheep/ram recovered and 7 AK47 rifles, one GPMG, 16 Dane guns were captured in the onslaught against bandits in Katsina State by troops of Operation Sahel Sanity. 17 kidnap victims were also rescued, while 14 bandits' informants and collaborators were arrested. In addition, several bandits' camps including the notorious Dangote Triangle and their logistics bases were destroyed within the first month of the anti-bandit operation codenamed Operation Sahel Sanity (Ndidi, 2020, cited in Sofiri, 2020:34). Prior to the creation of the above Special Security Forces, "Operation Mesa" had been operating as a nationwide security taskforce. It is called "Operation Yaki" in Kaduna State and "Operation Zenda" in Benue State.

On the side of the needs of the security personnel, in order to effectively tackle the incidence of banditry, the security personnel further opine that "the measures to be taken are simple. First, it is on the part of the government. The government must provide the security with arms, because due to the proliferation of arms from Libya, arms are already in the hands of the bandits. So, the government has used dialogue and so many measures but up to today, the incidence is persisting. The main important factors that can eliminate banditry are: They should use security personnel to flush out these bandits in the forest, the use of traditional rulers; they should be given a full hand in terms of security issues if the government really wants to eradicate it. The Fulani's that engage in these activities that is from the grassroots should be educated. If possible, social amenities should be provided to them. That is in terms of dams, schools, animal clinics and so on" (Interview, 7th October, 2021). Despite the strategies adopted by various security networks, the situation of banditry continue to persist,

this is as a result of difficulties attached to penetrating the large ungoverned forest land covering the North-west region that continue to comfortably serve as a potential hideout to the bandits since the securities are finding it difficult to access the forest. As noted Olaniyan and Yahaya (2016, pp 98-99),

Reluctance of the Nigerian security operatives to enter these forests areas seems to be largely due to inefficiency, collaboration and corruption. First, one major consequences of the lack of equipment and poor motivation for the Nigerian security forces is gross inefficiency. The Nigerian security operatives are ill-equipped and ill-motivated, in contrast, the criminals are well armed and motivated. Secondly, security forces and rustlers are often cohorts. This seems obvious given the open manner of rustling and the reluctance of the security operatives to act, even when provided with intelligence by local residents. A third issue is corruption (Olaniyan and Yahaya, 2016, pp.98-99). This is in agreement with the assertion of an informant in Katsina State who assert that: “They should all go to the forest. How is it possible that the security will be in town and the bandits are in the forest? What we use to know is that securities are taken to the forest for training. If the security will be deployed to the forest, military based should be establish in the forest the bandits will never attack the people again” (Interview, 24<sup>th</sup> August, 2023).

### **Discussion of Findings**

The major findings of the study after conducting extensive research on the subject matter have come up with the following findings on the implication of banditry on political representation in the North-western region of Nigeria. The study finds out that there is less presence of security personnel in the rural areas of North-western region of Nigeria that has the highest number of voters. This has given the bandits the opportunity to attack various communities at will. Despite the deployment of various security personnel and the Army Super Camp in Faskari town, that does not deter the bandits to continue causing havoc in many communities across Kaduna, Katsina, Zamfara, Kebbi and Sokoto State. Despite the efforts of both the State and Federal Governments, there are still communities across the affected State that are under the control of bandits. This makes these places no-go areas and a flashpoint of banditry. The rural dwellers of these communities are left with no option than to surrender to the will and conditions given to them by bandits. This has been a threat to political representation as many voters have been displaced, some killed.

The study also discovers that the number of displaced persons is increasing on daily basis as the bandits up to this moment continue to ransack various communities in the affected States. This situation further sends many to neighbouring States that have less security challenges where these displaced persons (mostly widows whose spouses have been killed by bandits) who engage in streets begging as the only viable means for survival. The researcher also agrees after going through various affected communities that the situation is becoming worrisome as both the government and the security agencies are yet to find a lasting solution to the menace. The incessant attacks on the rural communities do not only cause the displacement of people, but also constitute disenfranchisement of eligible voters, threats to life as many peasants have been killed by the bandits.



### **Conclusion**

In conclusion, insecurity which is manifested in the form of banditry which started with cattle rustling has metamorphosed into an economically based form of criminality, incorporating into it kidnapping, arson, rape, armed robbery, killing of innocent citizens and other forms of vileness. The incidence has succeeded in destroying many communities of the North-western region of Nigeria such as; Kaduna, Katsina, Zamfara, Kebbi and Sokoto State. This situation has caused the displacement of thousands of eligible voters and destruction of many polling units in the affected communities within these States.

Insecurity has seriously affected the political representation of the North-western region of Nigeria. This can be seen in the absent of development in the communities affected by the incessant banditry attacks that caused serious declined in voters turnout as a result of the insecurity of the voters. The activities of bandits in the region have caused an increase in human displacement. The situation has increased the high rate of poverty, unemployment and political instability as the majority of the people of the area have left to neighboring states, and this have affected their participation in politics and other socio-economic activities.

### **Recommendations**

1. The level of inequality between the peasants and the city dwellers should be reduced in terms of providing them with social amenities and job opportunities. This will help in reducing the level of poverty and unemployment which trigger many rural dwellers to be lured into criminal activities.
2. The Government at all levels should properly educate the rural dweller on the implication of insecurity, the danger of associating with the criminals as an informant, and also how to quickly respond to incidence of insecurity through prompt reporting of the movement of strangers within and outside the communities. This will help in reducing the activities of bandits that is affecting political representation in the region.
3. The government must incorporate the traditional rulers at various levels, the vigilante groups and other members of the communities into the fight against insecurity. This is because the traditional rulers are closer to the people and can effectively contribute by providing the security agencies with information on the influx of strangers in their various communities.
4. There should be adequate support and intervention of the Federal, State, and Local Government authorities in the fight against rural banditry. Through that, the security can be easily mobilized for quick response to discreet calls. Because presently, the security personnel only receive orders from the Federal Government before engaging in field operation, this process has left the State Government with less power to tackle the menace of insecurity.
5. Adequate security personnel and logistics should be provided in the flashpoint areas where the bandits have turned into their den. This will help the security to confront the bandits that are coming in many to attack communities. This appropriately help in reducing the security situation in the North-western region of Nigeria.

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# RELATIONSHIP BETWEEN POLITICAL PARTIES, DEMOCRATIC GOVERNANCE, AND SUSTAINABLE DEVELOPMENT IN NIGERIA'S FOURTH REPUBLIC

<sup>1</sup>Aliyu Mukhtar Katsina & <sup>2</sup>Lawal Musa Batsari

<sup>1</sup>Department of Political Science,

Umaru Musa Yar'adua University (UMYU), Katsina – Nigeria

<sup>2</sup>Department of Public Administration,

Umaru Musa Yar'adua University (UMYU), Katsina – Nigeria

## ***Abstract***

*This paper studies the correlation between parties, democracy, and development in Nigeria. The functions of parties in democratic states, notably that of competent leadership recruitment and that of articulating cohesive policy frameworks that translate socio-economic visions into reality, make them critical institutions for sustainable development. Against this background, we examine the role of parties in promoting development in the Nigeria's Fourth Republic. This study is important since it investigates the factors that affect parties' ability to pursue cohesive policies for the development of Nigeria since democratization in 1999. Our findings will enrich the current discourse on development, especially the relevance of parties in it. We rely on textual data from multiple sources, including policy briefs, party manifestoes, and other relevant literature on parties and governance. We content analyzed these data to reveal insightful themes and sub-themes about our questions. Our conclusion shows that although parties can promote good governance and development, factors associated with their sociological origins and institutional capacities undermine this ability in the Fourth Republic. Parties' failure since 1999 is partly responsible for Nigeria's current governance and development crises.*

***Keywords:*** Democracy, Development, Fourth Republic, Governance, Nigeria.

## **Background to the Study**

Democratization in 1999 ushered in the Fourth Republic and launched what turned out to be the longest period of democratic governance in Nigeria since decolonization in 1960. Thus, 1999 was an important milestone in Nigeria's political evolution. It marked when Nigerians' quest for democratization and its corollaries, such as the rule of law and multiparty politics,

paid off. The Fourth Republic was birthed and sprung from the ashes of a protracted struggle against extended military rule with its concomitant culture of coups and countercoups, personalization of political power, and other forms of political violence and economic decay. Liberalization of political power and the institutionalization of electoral and voting principles were, however, not the only appeal that democracy and democratization held, and which led to its clamor in the country. Years of poor economic planning, mismanagement, waste and extravagant expenditure, fraud, and outright looting of the public treasury have weakened the economy (Lewis, 1996). The result was a pervasive level of poverty affecting the majority, a widened social inequality gap, and a teeming population lacking gainful employment opportunities (Kalu, 1996). Weakened and compromised political institutions have helped to ensure unbridled corruption in the public sector, which undermines spending on public goods, especially infrastructure and neglects of rural communities.

In many cases, violent intra and inter-group rivalries between the elites have spiraled out of control and transformed into vicious conflicts and crises of different hues leading to identity politics, the resurgence of ethnic nationalisms, and separatist agitations. The situation was as bad as it was complicated such that by 1999 Nigeria had witnessed what one scholar described as the most systematic use of violence in a civil war in Africa, failed attempts at democratization, and a budding insurgency in the Niger Delta (Olukoshi, 2000). Of course, these were occasioned by, or escalated due to, years of neglect, alienation, exclusion, and repression. Effectively, bad governance became systematically entrenched at both federal and local levels with its various manifestations: collapsed infrastructure, widespread corruption, mutual antagonism and suspicion between the constituent units, and, most importantly, loss of confidence in institutions and instruments of formal authority.

Naturally, Nigerians have reasons to welcome democratic governance with great excitement and expectations. Democracy signaled national rebirth and a renewal of the social contract between the governed and the government (Maier, 2000). Since democracy entails a system in which people elect leaders of their choice and hold them accountable, it is conceivable that most Nigerians would hope for greater political inclusion, equitable distribution of national wealth, respect for the rule of law, and compliance with basic principles of constitutionalism. These constitute the indispensable building blocks of good governance, social justice, and economic development. After about two decades of democratic government and five elected presidents, the anticipated transformation and development have not materialized. Critical sectors of the economy and politics have remained grossly underdeveloped. Several critical indicators of human development have stagnated or sharply deteriorated. Available evidence suggests significant deterioration in vital areas related to social equality and justice, political inclusion and rights, economic opportunities, and the general welfare of citizens (Okey & Offoha, 2021). Overall, the quality of life of an average Nigerian recorded no substantial improvement over the past two decades of democratic governance. The implication of this situation is double-edged in nature. On the one hand, it showed the government as unwilling or incapable of meeting the basic expectations of the citizenry. This, in turn, created feelings of anger, frustration, disappointment, and indifference. On the other hand, situations such as

those produced by anger or indifference threaten social stability and democratic consolidation (Ugbudu, 2020). Certainly, this would make the prospects for an enduring consolidation of democracy in Nigeria quite precarious.

Consequently, this paper seeks to achieve three fundamental objectives. Firstly, it explains the current intriguing conundrum of democratic governance and development, which Nigeria battles primarily due to the nature of party politics that has characterized democratization and democratic rule since 1999. The reason for this is clear. Generally, parties aggregate and articulate public interests and, most importantly, serve as the bridge that connects the governed with their government. It is logical, therefore, to expect parties to champion good governance and development in democratic societies. Second, the chapter demonstrates that the nature of party politics, which appears to have impeded good governance and development in Nigeria, is a symbolic manifestation of the nature, character, and outlook of the type of political parties that exist and operate in the country's political space. It is accepted that capacity to function effectively is fundamental to the operations and activities of parties in democratic states. Where parties are weak and characterized by inchoate social ideologies and a fickle membership base, parties would likely be unable to perform their expected functions successfully.

This situation has a significant impact not only on the abilities of parties to govern effectively but also on the long-term development and consolidation of democracies. Although this may appear more acute in developing democracies, it is important to note that it is not limited to them. It also affects advanced and consolidated democracies. Third, proceeding from the first and second objectives, we interrogate the connection between political parties and the quality of governance and state of development obtained in Nigeria since 1999. The purpose is to show that this connection is quite significant and that the apparent failure of parties to govern effectively and spearhead Nigeria's development is fundamentally due to their weak and noninstitutionalized nature and capacity.

Achieving these objectives, however, calls for an innovative engagement with literature and other related materials from varied sources. It suggests the need for a creative methodology and approach that accepts parties' centrality in untangling the development *problematique*, especially in third-world democracies such as Nigeria. Data on critical indices of governance and development is readily accessible on various online databases. Data on parties is available and accessible from their respective websites, constitutions, manifestoes, and other documents and statements from their leaders and other relevant stakeholders. Additional figures and statistics necessary for helping us to achieve our objectives are readily available from government agencies, notably the Nigerian Bureau of Statistics (NBS). Together these will provide an interesting mix of information based upon which definite conclusions on the linkage and the impact political parties have on democratic governance and development in Nigeria could be made.

The significance of the questions which this paper interrogate is twofold. First, it constructs

the much-needed framework for unravelling the complexities of governance and development in emerging democracies. This would help students of democratization and development to appreciate the nexus between important political institutions and how the outcome of this interplay shapes the overall trajectory of growth. Second, it is also significant as it develops a new approach that blends the conceptual with the methodological and offers insight into the indispensability of parties as critical drivers of democratic governance and development. Existing perspectives and approaches to the study of political parties are dominantly institutional. As useful as these perspectives are, they are severely limited in their analysis of democratic states that are substantially matured. Complementing these with a functional angle would, we hope, help to provide a more robust understanding of the importance of parties in establishing the nexus between democracy on the one hand and good governance and development on the other in developing democracies in general and Nigeria in particular.

### **Parties, Democratic Governance, and Sustainable Development: A Framework for Analysis**

Questions about democratic governance and development have always interested social scientists. Scholars have investigated the linkages between democracy and development and how important institutions such as political parties generally affect this nexus. Anthony Downs (1957) was among the prominent social scientists to have focused on deconstructing this relationship. Even before Downs, however, distinguished scholars such as Roberto Michels (2016), Elmer Schattschneider (1942), and Maurice Duverger (1964) have pioneered the study of political parties as critical institutions of democratic governance. Due primarily to the nature of their functions, these scholars and many others have argued that parties are indispensable to the proper and effective working of democratic governments. Elmer Schattschneider, famous for his work on political institutions, was, for instance, so enamored with parties that he categorically dismissed, as practically impossible and politically unwise, democratic governance without the mediating power which the presence of parties imposed based, essentially on their functions. He says, "Modern democracy is unthinkable save within the framework of party politics" (Schattschneider, 1942).

Sweeping generalizations such as these were not specific to Schattschneider alone. Other scholars reached similar conclusions. For instance, Maurice Duverger, another famous social scientist, shared this interesting sentiment. Duverger not only accepted parties as inevitable in liberal democratic states, but as a mark of their indispensability, he recommended the demarcation of a separate discipline dedicated to the study of parties (Duverger, 1964). Stasiology, the field he advocated for, focused on the typologies of parties and the patterns of their evolution, transformation, nature of their organizations, and performance in democratic states. Over time, scholars of comparative politics, political institutions, and democratic studies have generally accepted parties as the necessary evil that democratic states have to live with. Writing in the post-Cold War era when the democratization wave surged and swept many authoritarian regimes in Africa and Latin America, scholars including Stephen Driver (2011), Peter Mair (2008), Vicky Randall (2007), Vicky Randall and Lars Svasand (20002), Richard Katz and Peter Mair (1995), Joseph LaPalombara and Myrion Weiner (1966), and



many others have acknowledged this significance which parties have upon the democratic process.

Before analyzing the relevance of parties to democratic governance, it is important first to interrogate the relationship between democratic governance and development. It is important to note that this relationship has never been contested. It only became reinforced by the significance that governance exerts on the development process. Although it has many definitions, governance is about collective decision-making and policy implementations. There are two approaches to understanding the concept of governance. The first approach is minimalist in nature and conception. It reduces the whole gamut of governance to a process through which specific principles interact to achieve an organization's pre-defined goals or objectives (Kooiman, 1999). The thrust of this conception is on the nature of institutional and other legal dynamics that determine the principles which ensure proper governance. The inadequacy of this approach is in the fact that it omits to note how power and authority are obtained and exercised for the general good of society. Mercifully, the maximalist approach to governance has identified and addressed this flaw by offering a more elaborate conception (Kooiman, 1999).

Under this approach, governance is how "political power is exercised in the management of a country's economic and social resources for development." As is clear to all, governance is, in any case, about properly managing human and material resources to ensure a better and qualitative life for all citizens. Judicious utilization and allocation of human and material resources in any given community are, thus, critical not just to the discourse on governance but also to the trajectory of its security and sustainable development (Peters, 2014). World Bank stresses the linkage between public sector management, accountability, the legal framework for development, and transparency as critical components of good governance, especially in developing states like ours with emerging economies' long-term development.

The scope of governance, whether democratic or otherwise, is therefore quite broad and encompasses "the traditions and institutions by which authority is exercised." Of greater interest, however, is the quantum of issues to which these traditions, practices, and institutions respond, such as i) the entirety of the process through which governments are appointed, removed, and sanctioned; ii) the capacity of the government to effectively formulate and implement sound policies for the security and development of the people; and iii) the respect which citizens and other public officials have for the institutions and laws that govern economic, political, and social interactions among them (Peters, 2014). These issues, it is important to note, reflect upon the fundamental objective and the relationship between the government and the governed. In Africa, it is sad that few governments perform creditably well. Most provide poor illustrations of the concept of good governance. This failure is evident in the difficulties and other challenges that inhibit development, creating conditions that birth and nourish instability and insecurity. It is important to recall what is pointed out in the introduction that any government's capacity to govern well depends on several factors, including the capacity of its leaders, the resources available, and the nature of existing

institutions and bureaucratic organizations. We should add here that the failure of a government, however, always has a significant effect on public opinion and, in many cases, results in the erosion of legitimacy.

To understand the linkage between governance and development, we must first deconstruct the concept of development and consider it objectively devoid of ideological debates and polemics. Although it has several definitions, the idea appears, perhaps on how it is often invoked by scholars and policymakers alike, to have some common features or characteristics which transcend ideological leanings and assume global acceptability. For instance, it is accepted that among its important features, sustained human empowerment supported in the context of human security, higher level of literacy, reduced levels of social inequality, poverty, and dependence among members of any given society are quite prominent. Scholars such as Dudley Seers, who engaged with the concept decades ago, appeared to have resolved the disagreement which inheres in our understanding of development by aligning it with the fundamental aspirations of members and values of the society. For scholars such as Seers (1972), development should thus be seen as a prevailing condition with a pronounced absence of social inequality, reduced levels of poverty, and near or total unemployment. This conception succinctly captures and regards development as a condition with an evident "quantitative growth, qualitative improvement, and expansion in the capabilities, capacities, and choices of individuals, groups or states" (Mirakhor & Askari, 2010, 1).

This transformation signifies enhanced capabilities and reduced challenges. And quite obviously, speaks volumes of the policies and other measures introduced or being promoted by the government, specifically to achieve this condition of significant quantitative growth and qualitative transformation in the lives of members of any given state. Therefore, an appropriate question at this juncture is where parties feature in this nexus; and, most importantly, how do they promote sustainable development while deepening democratic governance?

### **Parties as the Linchpin between Democratic Governance and Development**

In liberal democratic discourse, parties perform a set of functions within the political space. For many scholars, these functions legitimate their existence or serve as their *raison d'être* (Driver, 2011). Whether in or out of government, for parties to be taken seriously, they must provide mechanisms for recruiting and training competent political leadership to fill necessary elective and appointive positions in the political system. They must also develop robust platforms for mobilizing support, articulating policy choices, and forming governments. But recruiting leadership and forming governments are not the only vital functions of parties. Since they compete for support among voters, parties must be able to articulate coherent alternative public policy options and pragmatic programs consistent with their ideologies and vision for society (Randall, 2007). Over time, constructive opposition has been added to the list of functions of parties, especially for those not in power. Irrespective of regime type, parties must be able to promote political participation and hold themselves accountable for their policies and decisions in office. Taken as a whole, these functions

constitute what could aptly be described as the linchpin linking democratic governance to sustainable development (Mair, 2008).

There are, of course, those who would question the reality of this relationship. Parties have, over time, evolved into behemoth political organizations promoting the interests of their founders and leaders to the detriment of the wider public (Katz & Mair, 1995). This practice was not peculiar to the developing democracies. It also exists in advanced Western democracies where parties pander to the dictates of big businesses and special interest groups (Katz & Mair, 1995). The only substantial difference between parties in advanced and developing democracies is the subtleties that manifest within the party organization while pandering to those special interests. What is vital to the consolidation of democracy and its ability to qualitatively transform the living condition of the majority of citizens in any given political system is the capacity of parties to recruit committed, passionate, and competent persons into their ranks; and to sponsor these persons for elective and appointive positions.

To answer our questions, we must concede that parties occupy a central place in the matrix linking democratic governance to sustainable development. This model is universally acknowledged and inheres in all liberal democracies. To a significant degree, we argue that parties' role in promoting development is as prominent as their role in deepening or undermining democracy. They encourage growth through the kind of governments they form and the policies and programs they promote. We contend that development or lack thereof in multiparty liberal democracies depends upon the existing parties' capability to effectively and efficiently channel their resources towards performing leadership recruitment and training, policy formulation and articulation, and promoting political inclusion and accountability functions. As we have demonstrated, these functions crystallize into sustainable development. It is important to quickly add that the urgency for parties to perform these functions to promote development is significantly higher in developing democracies such as Nigeria than in developed ones. The reason for this is clear. Advanced democracies have had the opportunity to institutionalize parties and party politics due mainly to uninterrupted evolution. The opposite is the case in Nigeria, and others like it. Parties have had a disrupted history of growth and development, significantly affecting their prospects for institutionalization and capacity to perform their functions properly.

### **Democratic Governance and the Challenge of Institutionalizing Functional Parties in Nigeria**

Nigeria became independent on 1<sup>st</sup> October 1999 amidst great expectations at home and upheavals abroad. With a population of about 50 million people, with decolonization, the country became the largest democracy in Africa. But the period of its independence coincided with great changes unfolding within the continent, mostly occasioned by the rapid and steady wind of decolonization blowing over most of Africa and Asia. Independence for Nigeria, like for other African states, was a time to build strong and viable institutions, translate citizens' yearnings into better living conditions, and improve economic and political development prospects. However, Nigerians' struggle for independence was non-violent, unlike others,

such as the Algerians and Kenyans. Still, expectations about decolonization and democratization were remarkably high among them. The nationalists' leaders, and later the politicians, presented self-rule and constitutional order to the people as the panacea for the ills of underdevelopment and exploitation imposed by colonization (Meredith, 2006).

In Africa, without exception, political parties emerged from this fog of decolonization as the most visible agents for democratic transition and development, social change and transformation, and sustainable economic development (Katsina, 2016). As the most important institutions in the days preceding and succeeding independence, parties in Nigeria, while mobilizing support and sympathies from voters, made promises and developed programs to expand the political space, promote inclusion, unite the people, deepen democracy, and attain sustainable development. They formulated ideas and promoted public policies that championed the country's and people's socio-economic progress and development. However, the failure to internalize the fundamental principles of democratic theory and practice among the elites sadly truncated the democratization process six years after independence (Katsina, 2016). While politicians were the major culprits for this failure, parties became the major victims. Their growth and development became arrested by intermittent military rule such that by 1999 when the Fourth Republic was inaugurated, none of the parties that operated in the previous republics survived, for whenever the military struck, parties were among its earliest targets for proscription.

This disrupted the growth and development of parties, and party politics had consequences. Some of these consequences, as time revealed, have had long-term negative effects on the nature of parties and party politics that subsist in subsequent democratization attempts, including the present Fourth Republic. Firstly, their process of institutionalization was abruptly frozen, and the opportunities that existed for their steady and even-paced development were irredeemably lost. Since then, the process of party formation has become haphazard. Politicians with different ideological hues often find themselves lumped with other characters of dubious origin in parties championing the same cause. Related to this abrupt disruption of institutionalization was also the difficulty that parties encountered in developing cohesive and coherent programs, outlooks, and policies to attract voters' support. The result of this was a disproportionately low-level polarization within the party system. The parties, both major and minor, became hardly distinguishable from one another. They became undifferentiated in terms of organizational structure. They espoused the same ideas, parroted similar pledges, and made party-switching unimaginably easy (Katsina, 2016; 2013).

Although the Fourth Republic, formally inaugurated on 29<sup>th</sup> May 1999, was the longest stretch of the democratization period in Nigeria's political history, the impact of the previous mishaps that curtailed the growth and development of parties appeared to have caught up with the parties of the present. It has incapacitated their abilities to demonstrate even the faintest idea about their functions and obligations as critical institutions of democratic governance. Thus, what we have today are undifferentiated and chaotic mass groups that possess neither the gravitas nor the discipline and organization to effectively deepen democratic governance and

promote the socio-economic and political development of Nigeria. Two decades of democratic rule in Nigeria have not altered parties' experience from serving as mere vehicles for conveying politicians, usually with the deepest pockets or widest connections, into power (Katsina, 2016). Within this period, they have effectively turned into briefcases in the hands of party leaders and elders, both euphemisms for party financiers, to horse trade and retain political clout in the country. The parties reveal no clarity in ideology or vision and command fickle loyalty from an unreliable support base. Given this situation prevailing in Nigeria, a pertinent question is to what extent has this affected the sustainable development of Nigeria over the last two decades of democratic rule?

### **Parties and Sustainable Development in Nigeria's Fourth Republic: A Failure of Democratic Governance**

Already a robust framework for measuring development has been provided by Dudley Seers (1972). While analyzing Seer's conception of development, we have identified three vital indices as valid measures for determining the level of development in any given society or state. The indices are the general poverty levels, unemployment, and social inequality between and among all social classes. In the following paragraphs, we measure these indices vis-a-vis democratic governance in Nigeria's Fourth Republic. We contend that the overall picture from this analysis is sufficient to give us an idea of the degree to which parties as agents of democratic governance have contributed to the development of Nigeria or otherwise since 1999.

#### **Poverty Levels in the Fourth Republic**

Over a hundred million Nigerians live in abject poverty and squalor. A recent report by the World Bank projected that another 7 million would cross this line and become poor before the end of 2023 (The World Bank, 2023). In a country of about 220 million people, to have about 130 million as multidimensionally poor is horrific (National Bureau of Statistics, 2022). But this is not all. The remaining number of citizens is not doing any better. If we consider figures from the NBS, Nigeria's official statistics agency, we see a picture in which nearly 30 per cent or the remaining 90 million people lives in relative poverty. When we consider an elementary definition of relative poverty as the condition in which things that make life comfortable are not readily accessible to the people, then we can say that only about 20 per cent of Nigerians have access to decent living standards. Figures from the past have shown a rather steady and alarming increase in poverty levels in Nigeria since 1999. For instance, figures obtained from the NBS from 2002 to 2003 show lower levels of abject and relative poverty in Nigeria concerning GDP per capita (National Bureau of Statistics, 2022). Rather than remaining where it was; evidently, poverty continued to rise under different democratic administrations in Nigeria in the Fourth Republic despite dramatic improvement in revenues.

Several reasons have been adduced for this situation. However, the most valid in our view was the series of neoliberal economic policies and measures promoted by successive governments since Obasanjo's in 1999. These policies saw the removal of subsidies on social services, including education, agriculture, and petroleum products, and the deregulation of the

economy and privatization of various national assets. Repeated failures of successive governments to curtail corruption, arrest wastage and extravagance, and plug sources of leakages of public finances meant that corruption, bad governance, and mismanagement had transcended partisan affiliation and have become rampant under different administrations. The failure of the PDP to maximize the groundswell of support it enjoyed in the early days of the Fourth Republic to push for public service reform, promote accountability and ethical governance, and combat corruption compounded the problem of underdevelopment. The APC government's failure to reverse the rot, despite its campaign mantra of change, means a further deepening of the developmental crises in the Fourth Republic, such that Nigeria competes with India for the inglorious title of the world's poverty capital (CNN, 2018).

### **Unemployment in the Fourth Republic**

Unemployment is a socio-economic problem common among societies struggling with weak economic and industrial bases. Available data has shown that unemployment trends are not limited to developing economies of the global south (Uddin & Rahman, 2023). The global north's industrial powers also struggle with unemployment challenges, especially among the urban youths. Unemployment, generally, is a product of socio-economic and political choices, policies, and practices that stifle economic development, trade, and industrial sector, while entrenching poverty and limiting opportunities for gainful vocations (Bakare, 2011). In Nigeria's Fourth Republic, unemployment figures are quite dreadful. The percentage of youths without gainful employment opportunities is enough to be declared a national disaster. From 1999 when the PDP government of Olusegun Obasanjo was inaugurated, to 2023, when the APC government of Muhammadu Buhari completed its term of eight years, the number of unemployed in Nigeria had, sadly, risen exponentially.

For instance, statistics from the NBS over fifteen years have shown an astonishing ability for unemployment to be resilient in Nigeria (National Bureau of Statistics, 2022). The figures increased sharply over two decades, even as the economy supposedly expanded. However, the informal sector, which has always been the country's most reliable source of employment opportunities, shrank within this period. Other factors, such as population growth, may account for the disproportionately higher levels of unemployment in Nigeria since 1999. A plethora of poor economic policies and political decisions that placed Nigeria on a neo-liberal pedestal by successive administrations have created a bipartisan arc in which the political class committed to disempowering and disrobing the citizens. For instance, the privatization program introduced by the PDP under Obasanjo and apparently endorsed by APC under Buhari seemed to have contributed to the closure and selling of various national assets (Adaramola & Dada, 2020).

Since the notion of attracting foreign investment turned into a chimaera, hitherto valuable national assets that have been left to decay have now been stripped of any value, with hundreds of thousands of their employees laid off. Other associated neo-liberal policies, such as deregulating the power sector meant that electricity was no longer cheap or available, forcing thousands of local industries to shut down, further escalating the twin problems of poverty

and unemployment. Nigeria became a member of the World Trade Organization (WTO) as part of the neo-liberal inclination of all our major parties. It subscribed to various trade regulations and protocols, opening our local industries to competition from better-placed global partners. This affected the activities of domestic sectors and disincentivized production. These have negatively affected employment trends in Nigeria over the past twenty years.

### **Social Inequality in the Fourth Republic**

Inequality, according to Sin Yee Koh (2020), "refers to the phenomenon of unequal and/or unjust distribution of resources and opportunities among members of a given society." Scholars such as Guillermina Jasso (2015) tend to characterize inequality into two broad categories: inequality between persons and inequality between sub-groups. The first usually takes the form of differences or consequential gaps in income and wages and access to quality education, while the second is often in the form of differences in terms of opportunities for upward social mobility for members of a particular social group. Although inequality is hard to measure in contexts such as Nigeria's, its manifestations and effects are not difficult to determine. Andreas Peichl and Nico Pestel (2015) suggest that the best approach to explaining inequality in the social system is to attach a definite and clear referent. Thus, we should discuss inequality in terms of social constructs or variables. Therefore, to speak of inequality is to talk of structured, unjust, and unjustified disproportionate distribution of values and resources or access at the personal, sub-group, or group levels in terms of political inequality, social inequality, and income inequality (Muller & Seligson, 1987).

In Nigeria, all indices for measuring political, social, or economic inequality point to a society in which existing gaps have dramatically widened (Archibong, 2018). Income inequality is, perhaps, the most glaring. Income and improved living conditions are both products of economic growth and development. Societies like Nigeria that have experienced economic growth without corresponding development are likely to experience excessive concentration of wealth at the top and heavy deprivation at the bottom, which often results in the middle class's evisceration, leaving only the upper and the lower classes. As pointed out in the preceding paragraphs, a stream of policies pursued by political parties in government since 1999 has led to the near collapse of the economy, thus creating the conditions that nourish and sustain social inequality, poverty, and unemployment (Umukoro, 2014).

The substance of our contention, thus far, rested on the inability of parties that formed and populated the Fourth Republic to channel democratic governance towards the sustainable development of Nigeria, despite repeated promises and abundant human and material resources. Consistent with our assertion that any attempt to understand this failure must consider parties as active agents of democratization and development that have significantly failed to perform their fundamental functions in the political system, we now review some of these functions with immediate relevance to the questions raised and show how their failure in this respect further compounded an already bad situation.

Candidate selection, leadership recruitment and training are among the vital functions of parties in democratic states. One of the unique principles of democracy is how it opens up the process of leadership recruitment in the political system such that prospects for wider cooptation is excessively high. Closely related to this, is the opportunities which parties offer for deepening leadership training for the potential leaders and candidates selected. Available evidence has shown that parties in the Fourth Republic have not been quite diligent in performing these vital and inter-related functions of leadership selection, recruiting, and training (Katsina, 2016). The practice that subsists since the early days of the Republic was one that focuses more on loyalty and primordialism of potential leaders. Consequently, leaders in elective and appointive positions have emerged not because they were the best, but because they were most loyal to the party leaders or were from the right ethnic, linguistic, and religious groups or sub-groups as the case may be. This practice had watered down the quality of governance since leaders lacked the necessary skills, competence, resourcefulness, and stamina to lead effectively and efficiently. The effect on democratic governance is quite clear. It undermines democracy and retards sustainable development.

The parties' failure to develop and articulate cohesive ideologies and other relevant programs for socio-political and economic transformation of the country further reinforced and sustained the perennial failure of leadership in Nigeria. Without any cogent ideologies and programs or plans of action, leaders at all levels were left by their parties to improvise and draw their own governance agenda, which in most cases was as unrealistic as it could be. The leaders lack focus and operate governments that are foggy in vision. Part of the problem which this absence of synergy between parties and governments create is the problem of policy and project continuity during transitions. We experienced this with the privatization of public refineries undertaken by Obasanjo and later reversed by Umaru Musa Yar'adua despite being from the same party. The problem is even more acute at the state level where successor governments tend to become immediate enemies of their predecessors even when they belonged to the same parties. Thus, reversal of policies by governments with seeming inability or unwillingness of parties to mediate is another major failure to perform expected functions. It not only affects the process of sustainable development but also that of democratic consolidation since practices like these deepen existing fragmentations among the political elites and stress the political institutions.

The inability of parties, especially those in opposition, to provide constructive alternatives, check the excesses of the ruling parties at the federal and state levels, and champion ethical governance and greater political accountability is another great minus in the menu of their functions. This failure is often attributed to their poor level of institutionalization. Elsewhere, we have noted how military rule disrupted efforts to evolve and operate strong, ideological, and financially viable parties. The effect of this disruption manifests in the party's inability to enforce discipline among party members, propose acceptable policy alternatives, and provide constructive opposition while out of power. As they stand in the Fourth Republic, parties lacked internal cohesion and often operate under dubious legitimacy. Their programs and manifestoes are poor caricatures of each other. They offer no new ideas on governance or development while repeating stale mantras uncritically. These issues reviewed here are



fundamental and have great impact on democracy and development. The consequences of parties' failure to function effectively and efficiently is mind-boggling and always appears in citizens' increasing loss of confidence on the democratic project. It creates disillusion among citizens and births legitimacy crisis with political leadership and institutions. As it were today, poverty, insecurity, bad governance, corruption and general state of underdevelopment prevail because parties have failed as agents of democratization and development.

### **Conclusion**

The objectives of this paper were to interrogate the nexus between democratic governance and sustainable development and show the significant role which political parties play in this regard. Focusing on the Fourth Republic, we showed that parties were unable to promote development through the vehicle of democratic governance. Their failure in this respect, we argued, was essentially because of the poor institutionalization which denied them the ability to perform their functions credibly, efficiently, and effectively. Thus, in order to launch Nigeria on the pedestal of sustainable development, parties operating in the Fourth Republic must be able to attain an appreciable level of institutionalization as it will protect them from encroachment by unscrupulous politicians and give them the chance to develop robust platforms for leadership selection, recruitment, and training. Parties must also design cohesive social ideologies, programs, and manifestoes to mobilize support among voters and to guide policy formulation while in power. Most importantly, parties must promote ethical governance and political accountability whether in or out of power. Without these, we noted that Nigeria's sustainable development under democratic governance would simply remain a mirage.

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## ADVANCING INTEROPERABILITY, CYBERSECURITY, AND SUSTAINABILITY IN IOT SENSOR NETWORKS: A GLOBAL INITIATIVE PERSPECTIVE

<sup>1</sup>Siman Emmanuel, <sup>2</sup>Oladunjoye John Abiodun, <sup>3</sup>Gani Timothy Abe, <sup>4</sup>Philemon Uten Emmoh  
<sup>5</sup>Okwori Okpe Anthony <sup>6</sup>Anagu Emmanuel John<sup>f</sup>, & <sup>7</sup>Yakubu Yakubani  
<sup>1,2,3,4,5,6&7</sup>Federal University Wukari, Nigeria

### ***Abstract***

*The proliferation of Internet of Things (IoT) sensors has ushered in a new era of connectivity and data-driven decision-making across various domains. This manuscript delves into the multidimensional landscape of IoT sensor technologies, focusing on the critical aspects of interoperability, cybersecurity, and sustainability. The Global Initiative on IoT Sensors serves as a catalyst for progress, bringing together stakeholders from academia, industry, and government to collectively address the challenges and opportunities presented by these technologies. Interoperability, a foundational concern, enables seamless communication among heterogeneous sensors, enhancing data exchange and system efficiency. Strategies such as standardization frameworks, middleware integration, and semantic interoperability are explored to establish cohesive ecosystems. The heightened interconnectivity of IoT sensors underscores the paramount importance of cybersecurity. With a focus on safeguarding data integrity, confidentiality, and service availability, this manuscript presents diverse cybersecurity measures and best practices. Encryption, intrusion detection, and user authentication mechanisms are discussed to mitigate cyber threats and ensure resilient sensor networks. Moreover, as IoT sensors proliferate, their environmental impact becomes increasingly pertinent. The imperative of sustainability is examined through strategies such as energy efficiency, lifecycle assessment, and circular economy approaches. The manuscript also highlights the collaborative power of partnerships between the public and private sectors, fostering resource sharing, innovation, and responsible IoT deployment. Real-world case studies illuminate successful implementations across smart cities, precision agriculture, and healthcare. Anticipating emerging trends such as 5G integration, edge computing, and AI infusion, the manuscript concludes by discussing the Global Initiative's adaptability to evolving*

*challenges. Agile standards development, dynamic cybersecurity strategies, and eco-design principles are proposed to ensure the continued relevance and positive impact of IoT sensor technologies. However, this manuscript underscores the interconnected nature of interoperability, cybersecurity, and sustainability as pivotal enablers for the widespread adoption of IoT sensors. Through collaborative efforts and mindful consideration of emerging trends, the IoT community can pave the way for a future where sensors drive innovation, secure data, and contribute to a more sustainable world.*

### **Background to the Study**

The rapid evolution of technology has given rise to the pervasive integration of IoT (Internet of Things) sensors across various domains, from industrial applications to smart cities and environmental monitoring. These sensors play a pivotal role in collecting and transmitting real-time data, enabling informed decision-making and automation. As the world becomes increasingly interconnected, the significance of IoT sensors becomes more pronounced, transforming how we interact with the environment and shaping the landscape of innovation (MacDonald, D., et al. 2013). However, along with the potential benefits that IoT sensors offer, there come several challenges that warrant careful consideration. One of the foremost challenges is ensuring seamless interoperability among heterogeneous sensor devices and networks. The diversity of sensor types, communication protocols, and data formats poses a substantial hurdle in creating cohesive and efficient systems. The need to establish standardized frameworks and protocols for interoperability has become a critical concern to unlock the full potential of IoT sensor deployments (Jha, R. K. 2023).

Moreover, as the volume of data exchanged by IoT sensors surges, the issue of cybersecurity looms large. The vulnerability of interconnected devices to cyber threats raises concerns about data breaches, unauthorized access, and potential disruptions to essential services. Protecting the integrity and confidentiality of the data transmitted by IoT sensors is imperative to maintain public trust and realize the promised benefits of the technology (Khatoun, R., & Zeadally, S. 2017). In tandem with these challenges, the sustainable deployment of IoT sensors is of paramount importance. The proliferation of sensors can lead to increased energy consumption, electronic waste, and environmental impact. Addressing these sustainability concerns requires innovative approaches to minimize the ecological footprint of IoT sensor networks while maximizing their societal value (Davis, K. 2021). This manuscript delves into the efforts of the Global Initiative on IoT Sensors, a collective endeavor aimed at addressing the complex interplay of interoperability, cybersecurity, and sustainability. By examining the multifaceted strategies and solutions proposed by this initiative, we seek to shed light on the path forward for creating a harmonious and secure IoT sensor ecosystem that aligns with long-term environmental and societal goals (Sengan, S., et al. 2020).

### **Global Initiative on IoT Sensors**

The Global Initiative on IoT Sensors represents a collaborative endeavor aimed at harnessing the potential of IoT technologies by addressing key challenges, fostering innovation, and facilitating the responsible adoption of sensor networks. This section provides an overview of the initiative's objectives and highlights its pivotal role in tackling the challenges associated

with interoperability, cybersecurity, and sustainability (Ayad Abdulrahman Saleem, M. M. H., & Ismael Ali Ali. 2022).

### Overview and Objectives

The Global Initiative on IoT Sensors emerges as a response to the escalating complexities posed by the widespread deployment of IoT sensors across industries and sectors. Its overarching objective is to create a unified platform that brings together stakeholders from academia, industry, government, and research institutions to collectively address the multifaceted challenges that IoT sensors present (Gaur, A., et al. 2015), Figure 1. At its core, the initiative seeks to establish a framework that encourages knowledge exchange, collaborative research, and the development of best practices for IoT sensor ecosystems. By fostering interdisciplinary collaboration, the initiative aims to catalyze advancements in sensor technologies, ensuring they are designed, deployed, and managed in ways that optimize their benefits while minimizing potential risks (Mahmoud Al-Hader, A. R. 2009)



Figure 1: Smart Homes

### Significance in Addressing Challenges

The significance of the Global Initiative on IoT Sensors lies in its ability to serve as a nexus for solutions to challenges that inherently transcend organizational and sectoral boundaries. The challenges of interoperability, cybersecurity, and sustainability that IoT sensors introduce are not isolated concerns; they require concerted efforts from a diverse array of stakeholders (Syed, A. S., et al. 2021). Through cross-sectoral collaboration, the initiative addresses interoperability by facilitating the creation of standardized communication protocols, data formats, and integration methodologies. This harmonization of practices ensures that IoT sensors from different manufacturers and domains can seamlessly communicate, thereby promoting efficient data exchange and synergistic collaborations (Zanella, A., Bui, N., Castellani, A., Vangelista, L., & Zorzi, M. 2014).

Regarding cybersecurity, the initiative becomes a forum for sharing insights, best practices, and cutting-edge solutions to combat emerging threats. By pooling the collective expertise of its participants, the initiative fortifies IoT sensor networks against cyberattacks, safeguarding the integrity and privacy of the data they generate and transmit (Arsénio, A., Serra, H., Francisco, R., Nabais, F., Andrade, J., & Serrano, E. 2014). In the realm of sustainability, the initiative drives research and innovation toward creating energy-efficient sensor designs, environmentally conscious manufacturing processes, and responsible end-of-life strategies. By instilling sustainability principles into the DNA of IoT sensor technologies, the initiative helps mitigate the environmental impact associated with their proliferation (Atzori, L., Iera, A., & Morabito, G. 2010). In conclusion, the Global Initiative on IoT Sensors serves as a beacon of collaboration, knowledge sharing, and innovation in the face of the challenges posed by IoT sensor ecosystems. Its role in advancing interoperability, enhancing cybersecurity, and promoting sustainability ensures that these technologies not only evolve in tandem with societal needs but also contribute positively to a connected and secure future (Borgia, E. 2014).

### **Interoperability Solutions**

Interoperability stands as a foundational pillar for the effective functioning of IoT sensor networks. The ability of diverse sensors to seamlessly communicate, share data, and collaborate is essential for realizing the full potential of this technology. This section delves into the significance of interoperability in IoT sensor networks and explores a range of approaches and strategies to achieve this vital goal (DeVass, T., Shee, H., & Miah, S. 2021).

### **Importance of Interoperability in IoT Sensor Networks**

The heterogeneous nature of IoT sensor networks, comprising a multitude of devices from various manufacturers and operating on different protocols, underscores the need for robust interoperability. Interoperability enables data exchange without hindrance, fostering a cohesive ecosystem where sensors can work together synergistically. Such collaboration is instrumental in deriving meaningful insights from the collected data and supporting complex applications like predictive maintenance, real-time monitoring, and autonomous decision-making (Egwuonwu, A., Mordi, C., Egwuonwu, A., & Uadiale, O. 2022).

### **Approaches to Achieving Interoperability**

Numerous approaches have emerged to tackle the challenges of interoperability in IoT sensor networks. These approaches aim to establish cohesive communication frameworks and standards that facilitate seamless interaction among diverse sensors. Defining common communication protocols and data formats is central to achieving interoperability. Initiatives such as MQTT (Message Queuing Telemetry Transport) and CoAP (Constrained Application Protocol) have gained prominence for their ability to facilitate efficient data exchange across heterogeneous devices. Middleware acts as an intermediary layer that abstracts the complexity of underlying protocols, enabling sensors to communicate regardless of their native communication methods. This approach reduces the burden of developing bespoke integrations and accelerates the deployment of interoperable solutions (Hopkins, J., & Hawking, P. 2018). Going beyond syntactic compatibility, semantic interoperability focuses



on ensuring that data exchanged between sensors is not only understood but also interpreted correctly. Semantic web technologies, such as RDF (Resource Description Framework) and ontologies, play a pivotal role in enabling sensors to share data meaningfully. Well-designed APIs provide a standardized way for sensors to interact with each other. Open APIs that adhere to industry standards facilitate easier integration and collaboration among different sensor devices. Interoperability is the linchpin that holds together the intricate web of IoT sensors. Its significance cannot be overstated, as it unlocks the potential for innovation and value creation across various sectors. By exploring diverse approaches to achieving interoperability, the IoT community can pave the way for a future where sensors collaborate seamlessly, transcending barriers and enriching the data-driven landscape (Koohang, A., Sargent, C. S., Nord, J. H., & Paliszkiwicz, J. 2022).

### **Cybersecurity Measures**

#### **Emphasizing the Critical Nature of Cybersecurity in IoT Sensor Ecosystems**

In the interconnected landscape of IoT sensor ecosystems, cybersecurity emerges as a paramount concern, profoundly impacting the reliability, privacy, and functionality of these systems. The intrinsic vulnerabilities of interconnected devices necessitate a comprehensive approach to safeguarding data, networks, and the broader ecosystem from a plethora of cyber threats. Maintaining the integrity and confidentiality of data is crucial to ensure that information collected and transmitted by sensors remains accurate, unaltered, and accessible only to authorized entities. Attacks on IoT sensors can disrupt services and lead to significant economic and operational losses. Ensuring uninterrupted availability is pivotal, particularly in critical applications like healthcare, industrial automation, and smart infrastructure (Muduli, K., Raut, R., Narkhede, B. E., & Shee, H. 2022). Unauthorized access to sensors can compromise the entire network. Robust authentication and authorization mechanisms are essential to control access to sensitive data and functionalities. Building trust among users, stakeholders, and the public is contingent on implementing strong cybersecurity measures. A single security breach can erode trust and hinder the widespread adoption of IoT sensors (Mansouri, S. A., et al. 2021).

#### **Various Cybersecurity Measures and Best Practices**

Securing IoT sensor ecosystems requires a multifaceted approach encompassing technological, organizational, and regulatory measures. Employing a combination of strategies can fortify these ecosystems against a diverse range of cyber threats. Dividing IoT sensor networks into isolated segments reduces the potential impact of breaches by limiting lateral movement of attackers. Implementing end-to-end encryption ensures that data remains confidential throughout transmission, rendering intercepted data meaningless to unauthorized parties. Timely application of security patches and updates minimizes vulnerabilities that attackers exploit to gain unauthorized access (Alagumalai, A., et al. 2021). IDPS continuously monitor network traffic for suspicious activities and automatically take action to prevent potential threats. Ensuring that devices only run authorized and verified software prevents unauthorized code execution and tampering. Regularly conducting ethical hacking tests can identify vulnerabilities and weaknesses before malicious actors exploit them. Educating users about cybersecurity best practices, such as strong password management and

recognizing phishing attempts, enhances the overall security posture (Gartner. 2022). In the age of interconnected IoT sensors, prioritizing cybersecurity is non-negotiable. The evolving threat landscape demands a proactive and comprehensive approach to protect data, devices, and the overall ecosystem. By embracing a combination of robust cybersecurity measures and adhering to best practices, the IoT community can mitigate risks, enhance trust, and ensure the safe and sustainable growth of IoT sensor networks (Arunkumar, P., & Vijith, K. 2018).

### **Sustainability Considerations**

#### **Explaining the Environmental Impact of IoT Sensors and the Need for Sustainability**

As IoT sensors continue to proliferate across various domains, it becomes increasingly crucial to address their environmental impact. The very benefits these sensors offer in terms of data-driven insights and automation can, if not managed sustainably, lead to significant ecological consequences. The continuous operation of numerous IoT sensors, often requiring constant data transmission and processing, can lead to substantial energy consumption, contributing to carbon emissions and resource depletion. Rapid technological advancements can render sensors obsolete relatively quickly, contributing to a mounting electronic waste problem that poses challenges for disposal and recycling. The production of IoT sensors relies on a wide range of materials, some of which are finite resources. Unsustainable sourcing of these materials can exacerbate resource scarcity. The production, use, and disposal of sensors can contribute to pollution through various means, including energy production, chemical processes, and improper disposal (Zhang, Q., et al. 2018).

#### **Exploring Strategies to Make IoT Sensor Networks More Sustainable**

Addressing the environmental concerns associated with IoT sensors requires a multifaceted approach that combines design, manufacturing, usage, and disposal considerations. By integrating sustainability into every stage of the IoT lifecycle, the technology can be harnessed to benefit both society and the environment. Designing sensors with low-power consumption and employing energy-efficient communication protocols can significantly reduce their environmental footprint. Conducting a thorough assessment of a sensor's entire lifecycle, from raw material extraction to end-of-life disposal, helps identify areas for improvement and optimization (Cornel - Cristian, A., et al. 2019). Prioritizing sustainable and recyclable materials during the manufacturing process reduces resource depletion and minimizes the impact of electronic waste. Building sensors with upgradeable components and software, as well as ensuring compatibility with future technologies, extends their usefulness and reduces the need for frequent replacements. Implementing circular economy principles, such as refurbishment, remanufacturing, and recycling, can divert sensors from becoming e-waste and contribute to a more sustainable supply chain (Ahmad, M. A., et al. 2018).

Governments and regulatory bodies can play a role in driving sustainability by enforcing standards for energy efficiency, waste management, and responsible disposal of electronic devices. Raising awareness among users and stakeholders about the environmental impact of IoT sensors can foster responsible usage and disposal practices. The exponential growth of IoT sensors presents both opportunities and challenges. While their data-driven capabilities have the potential to revolutionize industries, the ecological implications must not be

overlooked. By integrating sustainability into every facet of the IoT sensor lifecycle, we can harness their transformative power while ensuring a greener and more resilient future (Williamson, S. S., et al. 2015).

### **Collaborative Approaches**

#### **Driving Progress through Collaboration Among Different Stakeholders**

The intricate and multifaceted nature of IoT sensor ecosystems underscores the importance of collaborative efforts among diverse stakeholders. Effective collaboration not only accelerates technological advancements but also addresses complex challenges more comprehensively, fostering innovation and sustainable growth. Collaborative environments facilitate the exchange of expertise, ideas, and best practices, enabling stakeholders to learn from one another and collectively enhance their understanding of IoT sensor technologies. Collaboration allows stakeholders to pool resources, including funding, research capabilities, and infrastructure, which can significantly amplify the impact of individual efforts (Belrzaeg, M., & Ahmed, A. A. 2023). IoT sensor ecosystems span various disciplines, from engineering and data science to policy and ethics. Collaborative partnerships encourage the integration of insights from different fields, leading to more holistic solutions. Collaborative initiatives often revolve around shared goals and objectives. These common objectives provide a unifying focus that encourages stakeholders to work synergistically toward a collective vision (Ahmad, M. A., et al. 2018).

#### **Partnerships Between Public and Private Sectors for Mutual Benefit**

One of the most potent forms of collaboration in the realm of IoT sensor ecosystems is the partnership between the public and private sectors. These partnerships leverage the strengths of each sector to address challenges and opportunities in a way that benefits society. Collaborations between academia, research institutions, and private companies facilitate the development of cutting-edge technologies and innovative solutions that bridge theory and practical application. Public-private partnerships can involve sharing critical infrastructure, such as communication networks or data centers, which reduces redundancy and optimizes resource utilization. Regulatory bodies and private enterprises can collaborate to establish standards and guidelines that ensure the ethical use, security, and interoperability of IoT sensors. Public-private partnerships can enable the sharing of data collected by IoT sensors, fostering more comprehensive and accurate insights that drive evidence-based decision-making. By aligning their efforts, the public and private sectors can collectively address societal challenges, such as urban congestion, environmental monitoring, and healthcare delivery, through innovative IoT sensor applications (Khaleel, M., Ahmed, A. A., & Alsharif, A. 2023). Collaboration among stakeholders is a linchpin for driving progress in the dynamic landscape of IoT sensor technologies. By fostering an environment of knowledge exchange, resource sharing, and interdisciplinary cooperation, collaborative approaches pave the way for transformative advancements that benefit not only individual stakeholders but society at large. The synergy between the public and private sectors, in particular, holds the potential to create a more sustainable, efficient, and ethically sound IoT ecosystem (Alsharif, A., et al. 2021).

## Case Studies

### The IoT Use Case Adoption Report

In 2021, the average large manufacturing, healthcare, automotive, retail, or energy company has rolled out eight different IoT use cases, according to **IoT Analytics'** latest IoT Use Case Adoption Report. (Perkins, K. M., et al. 2021). The 430-page report, which is part of IoT Analytics' ongoing market coverage of IoT applications, is the first such in-depth report and is based on 200+ interviews with IoT end users who have rolled out more than 1,600 IoT projects over the last few years across 48 different IoT use cases. The report shows where companies have been investing and are planning to invest, which industries and regions are ahead, and which use cases promise the highest ROI. (Alsharif, A., et al. 2022). Oil and gas companies and energy companies are ahead of others. They have rolled out an average of 15 use cases. Make no mistake: For many companies, IoT is still a small fraction of their business. The average company we interviewed had \$9.6 billion in revenue and only currently spends \$33 million on IoT use cases (0.34% of the revenue). The fact that the top use case today has only been adopted by 34% of respondents (but with a predominantly positive ROI) shows how much bigger the IoT opportunity is (González García, C., et al. 2017).

The report looks at IoT use cases that are applicable to most organizations and does not consider industry-specific use cases such as smart heating, ventilation, and air conditioning (HVAC) (applicable only to buildings) or smart transportation systems (applicable to cities), Figure 2. The analysis also does not consider consumer IoT use cases such as Smart Home devices or wearables. For a broader analysis of enterprise IoT applications, see this analysis from 2020. For a deep dive on Smart City IoT use cases, see this analysis. A deep dive on Smart Building use cases will be published later this year (Shiramagond, T., & Lee, W.-J. 2018).

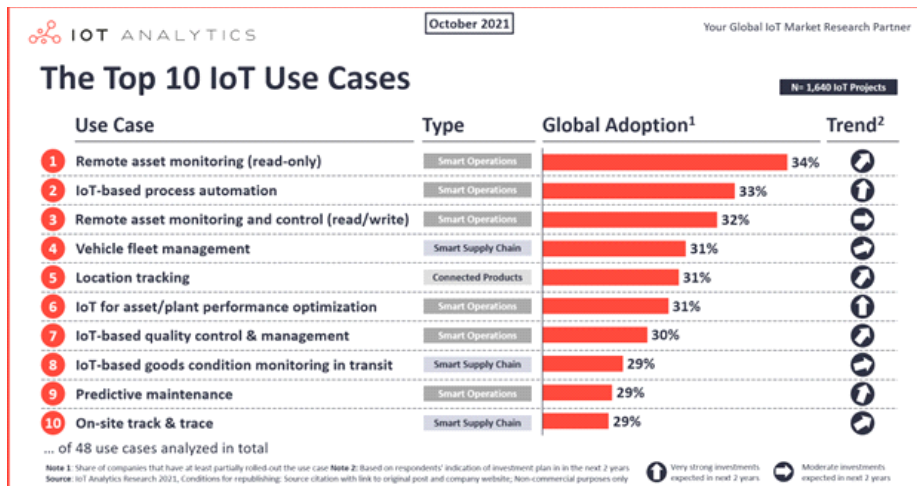


Figure 2: The 10 most adopted IoT Use Cases

Six of the top 10 IoT use cases today (ranked by adoption) aim at making operations smart, thus improving companies' production processes for manufacturing, enhancing maintenance operations, or advancing any other operations (e.g., energy generation in the case of an energy company, running healthcare operations in the case of a hospital, or running store operations

in the case of a retail company). Three of the top 10 use cases are related to smart supply chains, and only one is related to smart products in the field (Gungor, V., et al. 2012).

### Real-World Examples of Successful IoT Sensor Implementations

Highlighting real-world case studies of successful IoT sensor implementations demonstrates the practical applications and benefits of these technologies across various sectors. Showcase a city's implementation of IoT sensors to monitor critical infrastructure like bridges, roads, and buildings in real time. Discuss how these sensors facilitate predictive maintenance, reduce downtime, and enhance the overall resilience of urban infrastructure. Present a case where IoT sensors are used to monitor soil conditions, weather patterns, and crop health on a farm. Explain how the data collected improves crop yields, reduces resource wastage, and enables more sustainable agricultural practices. Explore a healthcare setting where IoT sensors are deployed to monitor patients' vital signs remotely. Discuss how these sensors improve patient outcomes, reduce hospital stays, and lower healthcare costs (Mishra, D., Gunasekaran, A., Childe, S. J., Papadopoulos, T., Dubey, R., & Wamba, S. 2016).

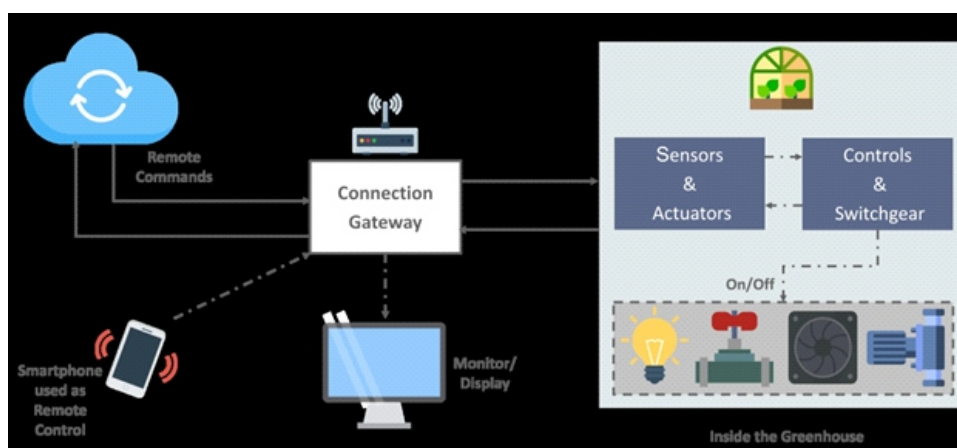


Figure 3: Real-World Examples of Successful IoT Sensor Implementations

### 7.3 Addressing Interoperability, Cybersecurity, and Sustainability

For each case study, delve into how the implementation addresses the key considerations of interoperability, cybersecurity, and sustainability:

- **Interoperability:** Explain how the IoT sensors in each case are designed to communicate seamlessly with each other, regardless of their origins. Discuss any standardization efforts, middleware solutions, or data format harmonization that enable interoperability among the diverse sensor types.
- **Cybersecurity:** Detail the cybersecurity measures in place to protect the sensitive data collected by these sensors. Discuss encryption protocols, intrusion detection systems, and user authentication mechanisms that ensure the security and privacy of the transmitted data.
- **Sustainability:** Describe the strategies employed to minimize the environmental impact of the IoT sensor implementations. This could include energy-efficient design,

responsible materials sourcing, and considerations for end-of-life disposal or recycling.

#### 7.4 Lessons Learned and Future Implications

Conclude each case study by summarizing the key lessons learned from the successful IoT sensor implementation. Discuss how these lessons can be applied to other similar scenarios and highlight any potential implications for the broader adoption of IoT sensors in addressing global challenges. The presented case studies exemplify the diverse and impactful applications of IoT sensors in various sectors. By showcasing their successes in addressing interoperability, cybersecurity, and sustainability concerns, these examples underscore the potential of IoT sensor technologies to revolutionize industries and contribute to a more connected, secure, and environmentally conscious world (Kamble, S. S., Gunasekaran, A., & Gawankar, S. A. 2018), Table 1.

**Table 1: Addressing Interoperability, Cybersecurity, and Sustainability and Future Trends**

<i>Citation</i>	<i>Interoperability</i>	<i>Cybersecurity</i>	<i>Sustainability</i>	<i>Solution</i>	<i>Future Trend</i>
<i>MacDonald, D., et al. 2013</i>	Standardization frameworks promote seamless communication among diverse sensor types.	Robust encryption protocols and intrusion detection systems ensure data privacy and system integrity.	Eco-design principles reduce resource consumption during sensor manufacturing and promote responsible disposal.	Establish standardized communication protocols (MQTT, CoAP) for cross-device interaction.	Integration of IoT with 5G for enhanced connectivity and faster data exchange.
<i>Loschi, H., et al. 2023</i>	Middleware solutions act as intermediaries for diverse sensors to communicate effectively.	User authentication mechanisms prevent unauthorized access to sensor networks.	Lifecycle assessment guides sensor design to minimize environmental impact.	Develop middleware that abstracts underlying protocols, enabling plug-and-play integration.	Increased emphasis on AI-driven security solutions for real-time threat detection.
<i>Loschi, H., et al. 2023</i>	Semantic interoperability ensures shared data is meaningfully interpreted across sensors.	Regular software updates and penetration testing mitigate vulnerabilities.	Circular economy approaches promote refurbishment and recycling of sensors.	Implement standardized ontologies to enable semantic data interpretation.	Growth of blockchain technology for enhancing sensor data integrity and traceability.
<i>Ayad et al. 2022</i>	Well-designed APIs provide standardized interfaces for sensors from different manufacturers.	Intrusion detection and prevention systems monitor network traffic for anomalies.	Energy-efficient designs and responsible sourcing minimize environmental impact.	Develop open APIs to facilitate seamless sensor integration with diverse applications.	Edge computing adoption for faster data processing and reduced energy consumption.
<i>Syed, A. S., et al. 2021</i>	Data format harmonization ensures data consistency across varied sensor types.	Strong emphasis on user training to recognize and counter cyber threats.	Collaborative efforts in research promote sustainable sensor manufacturing practices.	Enforce consistent data formats through industry-wide guidelines.	Integration of IoT and AI to create self-learning cybersecurity systems.
<i>Egwuonwu, et al. 2022</i>	Edge computing reduces data transmission requirements, enhancing interoperability.	Secure boot and device identity prevent unauthorized code execution.	Collaborative research drives innovation for energy-efficient IoT sensors.	Embrace edge computing to process data closer to its source.	Integration of IoT with smart cities to optimize resource usage and environmental impact.

#### Emerging Trends

##### Potential Future Directions of IoT Sensor Technologies

The landscape of IoT sensor technologies is continually evolving, driven by technological advancements, changing societal needs, and new opportunities. Anticipating these emerging

trends is crucial for staying at the forefront of innovation and harnessing the transformative power of IoT sensors.

1. **5G and Beyond:** The rollout of 5G networks promises to enhance connectivity, reducing latency and enabling real-time data processing. This development can propel IoT sensors into more responsive and dynamic applications.
2. **Edge and Fog Computing:** The move toward processing data at the edge, closer to the data source, offers improved speed and efficiency, reducing the need for extensive data transmission to central servers.
3. **AI and Machine Learning Integration:** The integration of AI and machine learning into IoT sensors enables them to analyze data locally and make real-time decisions, leading to more intelligent and autonomous systems.
4. **Distributed Ledger Technology (DLT):** The adoption of blockchain or other DLT systems enhances data security, transparency, and trust in IoT sensor networks, particularly in applications like supply chain management.

### **Adapting the Global Initiative to Evolving Challenges**

As IoT sensor technologies evolve, the Global Initiative must also evolve to address new challenges and leverage new opportunities. Here are some considerations:

1. **Agile Standards Development:** The Global Initiative should foster flexible standards that can adapt to the rapid pace of technological change, ensuring that interoperability remains effective as new sensor types and communication protocols emerge.
2. **Dynamic Cybersecurity Strategies:** With new cybersecurity threats constantly emerging, the Global Initiative should promote continuous assessment and adaptation of cybersecurity measures to protect against evolving risks.
3. **Eco-Design and Circular Economy:** As sustainability gains prominence, the Global Initiative could advocate for eco-design principles that prioritize resource efficiency and end-of-life considerations. Encouraging a circular economy approach can also guide the disposal and recycling of sensors.
4. **Collaboration in Innovation:** The Global Initiative could facilitate collaborative research and innovation to stay ahead of emerging trends. This might involve partnering with research institutions, startups, and industry leaders to explore new applications and technologies.
5. **Ethical and Regulatory Frameworks:** With IoT sensors becoming more integral to daily life, the Global Initiative could contribute to the development of ethical guidelines and regulatory frameworks that ensure responsible and secure usage.

The evolution of IoT sensor technologies presents a wealth of opportunities to transform industries and societies. By keeping an eye on emerging trends and adapting to evolving challenges, the Global Initiative can play a pivotal role in shaping the future of IoT sensors, ensuring their continued relevance, security, and positive impact on the world.

### **Conclusion**

The journey through this manuscript has illuminated the multifaceted realm of IoT sensor technologies and their transformative potential. From the inception of the Global Initiative on

IoT Sensors to the exploration of interoperability, cybersecurity, sustainability, collaborative approaches, case studies, and emerging trends, a comprehensive picture has emerged of the intricate interplay between technology and society. The significance of interoperability as the linchpin for seamless communication among diverse IoT sensors, leading to cohesive ecosystems that leverage data collaboratively. The critical nature of robust cybersecurity measures to safeguard IoT sensor networks against an evolving array of threats, ensuring the integrity, confidentiality, and availability of data. The pressing need to imbue sustainability principles into the lifecycle of IoT sensors, addressing energy consumption, electronic waste, and resource utilization to minimize environmental impact. The power of collaboration, particularly between public and private sectors, to accelerate progress, share resources, and drive innovation that serves the common good. Real-world case studies have showcased the tangible benefits of IoT sensor implementations, underscoring their potential to revolutionize various sectors while addressing core concerns. The exploration of emerging trends has provided a glimpse into the future of IoT sensors, with advancements in connectivity, edge computing, AI integration, and blockchain poised to redefine the possibilities. The intertwining of these elements paints a comprehensive picture of the potential and challenges that lie ahead. It is paramount to recognize that addressing interoperability, cybersecurity, and sustainability is not just a technical pursuit; it's a collective responsibility that impacts industries, societies, and the environment. The widespread adoption of IoT sensors hinges on our ability to foster environments where these technologies can seamlessly communicate, where data is secure, and where our progress is mindful of its ecological impact. By embracing collaborative approaches, adhering to ethical guidelines, and remaining adaptable to emerging trends, we can pave the way for an era where IoT sensors are not only innovative tools but also responsible and sustainable contributors to a better world. As we conclude this manuscript, let us remember that addressing interoperability, cybersecurity, and sustainability in IoT sensor networks is not just a choice—it's a requisite for shaping a brighter, interconnected, and secure future for all.

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## EFFECT OF EXERCISE ON BLOOD PRESSURE AND PULSE AMONG TABLE TENNIS CLUB PLAYERS IN WUKARI, TARABA STATE, NIGERIA

<sup>1</sup>Ikwebe, Joseph, <sup>2</sup>Imo, Chinedu, <sup>3</sup>Tatah, Verwiyeh Silas, <sup>4</sup>Ameh, Sunday Ojonugwa, <sup>5</sup>Shaibu, Christopher Ojomugbokenyode, <sup>6</sup>Abu, Michael Sunday, <sup>7</sup>Boyi, Richard-Harris Nsenreuti, <sup>8</sup>Yohanna, Enochone Roy, <sup>9</sup>Ugwuoke, Kenneth Chinekwu & <sup>10</sup>Akwoga, Talatu

<sup>1,2,3,5,6,7,8&9</sup>Department of Biochemistry, Faculty of Pure and Applied Sciences,  
Federal University Wukari

<sup>4</sup>Department of Sociology, Faculty of Social Sciences, Federal University Wukari, Nigeria.

<sup>10</sup>Wukari Study Centre, Faculty of Health Sciences, National Open University of Nigeria.

### **Abstract**

*This current research study investigated the effect of exercise on blood pressure and pulse of Table Tennis Club players in Wukari, Taraba State, Nigeria. A total of fifteen players of Wukari Table Tennis Club, Wukari, Taraba State, Nigeria was used for the purpose of this research. The equipment used for this research is Wrist Digital cs70 Sphygmomanometer. Each player was requested to relax for few minutes before the exercise and after the exercise for the measurement of his blood pressure and pulse. The cuff of the Wrist Digital Sphygmomanometer was wrapped around the left wrist. The display was placed on the palm side of the wrist. The player was asked to sit upright and ensure the blood pressure monitor was at the same height as his heart. The on/off key was clicked, and the device measured the blood pressure and pulse automatically. The results were recorded. The pulse of all the players increased after exercise. The highest increase was by 38 which represent 58% of the player's initial pulse, while the least increase was by 5 which represents 6% of the player's initial pulse. The mean pulse of all the players increased after exercise. The mean pulse of the table tennis players after exercise is statistically significant ( $p < 0.05$ ) when compared to the mean result of their pulse before exercise. The blood pressure of twelve players was within the normal range, while blood pressure of three players was high before exercise. After exercise, the blood pressure of nine players was normal, while the blood pressure of six players was high. Blood pressure of seven players reduced after the exercise, while blood pressure of eight players increased after exercise. The mean blood pressure of all the players was normal before exercise and after exercise. The mean blood pressure of all the players increased slightly after exercise, but still within the normal range. This study showed that blood pressure may slightly increase immediately after exercise, while pulse is significantly*

*increased by exercise. The rate of increase in pulse by exercise may differ based on individual. Blood pressure may reduce or increase in different individuals following exercise. However, blood pressure may slightly increase in more people than reducing immediately after exercise.*

**Keywords:** *Blood pressure, Cardiovascular disease, Exercise, Hypertension, Pulse.*

### **Background to the Study**

Physical exercise is an activity presenting systematic repetitions of oriented movements feature with consequent increase on the oxygen intake due to muscular demand thus generating work (Barros *et al.*, 1999). The exercise represents a subgroup of physical activity designed with the objective of maintaining the physical conditioning. Aerobic endurance exercise appears to be more effective at lowering blood pressure than other kinds of exercise, including resistance exercise (Bouchard *et al.*, 1998). Any aerobic activity seems to work, including walking, jogging or cycling, although cycling seems to be the most effective (Bouchard *et al.*, 1999).

Moderate intensity exercise seems to be the most effective for reducing blood pressure in hypertensive patients (Hagberg *et al.*, 2000). This would be equivalent to  $\approx 1.5$  mile per day of brisk walking at an energy cost of 150 kcal per day for an average-sized person. This exercise intensity can be accomplished much easier in middle age and old hypertensive patients than more vigorous exercise can, results in less musculoskeletal injuries and cardiovascular events, and can be maintained throughout life.

Moderate aerobic exercise training would correspond to a target heart rate of 75% to 85% of HRmax, or to 65% to 75% in older individuals, to be gradually achieved and maintained throughout the training program. When possible, target HR should be determined on the basis of HRmax actually achieved during an ergometric exercise test to exhaustion, rather than on the basis of nomographic tables (220 minus age). This would avoid overestimation of the training load with respect to the actual exercise capacity/fitness level, which often is less than predicted on the basis of age-predicted maximum HR. This precaution would contribute to lessen musculoskeletal injuries and, most important, lessen exercise-induced cardiovascular events. Reductions in blood pressure are seen usually within 10 weeks after starting an exercise training program. This result could reinforce motivation in patients. However, it should be remembered that the benefits of exercise training are rapidly lost after quitting regular physical activity. Hence, patients have to be informed on this issue and be continuously encouraged to be physically active. It is important to bear in mind that exercise therapy must be continued all life long, musculoskeletal comorbidities permitting.

There are lots of stories of many people suffering and dying as a result of blood pressure related issues. It has been noted that many are not even aware of their blood pressure status and its consequences. Due to lack of proper knowledge of hypertension and hypotension, most patients do not know they may be suffering from them until the condition becomes critical. It is currently being argued: how exercise could influence blood pressure. This

warranted research into the currently study. The findings of this research will help sports men and women and the general public to know the effects of exercise on blood pressure and pulse.

## Materials and Methods

### Study Population and Design

This current project research study was conducted in May, 2022. A total of fifteen regular players of Wukari Table Tennis Club, Wukari, Taraba State, Nigeria was used for the purpose of this research. The players' blood pressures and pulse were checked before and after playing game.

### Equipment used

The equipment used for this research is Wrist Digital cs70 Sphygmomanometer.

### Determination of blood pressure and pulse

Each player was requested to relax for few minutes before the exercise and after the exercise for the measurement of his blood pressure and pulse. The cuff of the Wrist Digital Sphygmomanometer was wrapped around the left wrist. The display was placed on the palm side of the wrist. The player was asked to sit upright and ensure the blood pressure monitor was at the same height as his heart. The on/off key was clicked and the device measured the blood pressure and pulse automatically. The results were recorded.

### Statistical analysis

Statistical analysis was carried out on the results with the use of Students-T-Distribution test using Statistical Package for Social Sciences (SPSS) version 23. The group means were compared for significance at  $p < 0.05$  and the group results presented as mean  $\pm$  standard deviation.

## Results

The results are presented below:

**Table 1: Pulse in Wukari table tennis club players before and after exercise**

S/N	Before exercise	After exercise	Difference between before and after exercise	Percentage difference before and after exercise (%)
1	74	97	23	31
2	89	115	26	29
3	64	87	23	36
4	71	104	33	46
5	59	64	5	8
6	71	88	17	24
7	81	86	5	6
8	87	99	12	14
9	84	106	22	26
10	64	73	9	14
11	71	109	38	54
12	102	117	15	15
13	91	104	13	14
14	60	94	34	57
15	64	73	9	14

The pulse of all the players increased after exercise. The highest increase was by 38 which represent 58% of the player's initial pulse, while the least increase was by 5 which represents 6% of the player's initial pulse.

**Table 2: Mean pulse in Wukari table tennis club players before and after exercise**

Parameters	Before exercise	After exercise	Difference between before and after exercise	Percentage difference before and after exercise (%)
Pulse	75.47 ± 12.91 <sup>a</sup>	94.40 ± 15.82 <sup>b</sup>	18.93 ± 10.59 <sup>c</sup>	25.87 ± 16.27 <sup>d</sup>

The mean pulse of all the players increased after exercise. The increase in mean pulse of the table tennis players after exercise is statistically significant ( $p < 0.05$ ) when compared to the mean result of their pulse before exercise.

**Table 3: Blood pressure level in Wukari table tennis club players before and after exercise**

S/N	Blood pressure before exercise (mmHg)	Remark before exercise	Blood pressure after exercise (mmHg)	Remark after exercise	Difference in blood pressure between before and after exercise (mmHg)
1	181/113	High	164/99	High	17/14
2	122/73	Normal	113/76	Normal	9/-3
3	122/80	Normal	143/85	Slightly high	-21/-5
4	136/89	Normal	157/139	High	-21/-50
5	133/80	Normal	118/86	Normal	15/-6
6	137/82	Normal	155/85	High	-18/-3
7	174/102	High	138/84	Normal	36/18
8	105/86	Normal	151/87	High	-46/-1
9	124/76	Normal	131/80	Normal	-7/-4
10	129/75	Normal	122/73	Normal	7/2
11	117/68	Normal	133/86	Normal	-16/-18
12	114/67	Normal	119/71	Normal	-5/-4
13	175/89	High	158/94	High	17/-5
14	110/72	Normal	114/67	Normal	-4/5
15	129/75	Normal	122/73	Normal	7/2

The blood pressure of twelve players was within the normal range, while blood pressure of three players was high before exercise. After exercise, the blood pressure of nine players was normal, while the blood pressure of six players was high. Blood pressure of seven players reduced after the exercise, while blood pressure of eight players increased after exercise.

**Table 4: Mean blood pressure level in Wukari table tennis club players before and after exercise**

Parameters	Mean blood pressure before exercise (mmHg)	Mean blood pressure after exercise (mmHg)	Remark
Blood pressure	134/82	136/86	Increased slightly after exercise Normal

Result represents mean of results obtained (n=15).

The mean blood pressure of all the players was normal before exercise and after exercise. The mean blood pressure of all the players increased slightly after exercise, but still within the normal range.

### **Discussion**

The pulse of all the table tennis players showed an increase after exercise. This means that it may be certain for exercise to increase pulse rate in individual. It has been reported that both surprise and stress induce physiological response: elevate heart rate substantially (Mustonen and Pantzar, 2013). Exercise may be regarded as stress to the body. The level of increase differs from one player to another. It was observed that the highest increase in a particular player was by 38 which represent 58% of the player's initial pulse, while the least increase in a player was by 5 which represents 6% of the player's initial pulse (table 1). Different research suggests that heart rate variability can be used as an accurate measure of psychological stress and may be used for an objective measurement of psychological stress (Kim *et al.*, 2018). It means that the increase in the pulse rate of the players could suggest stress. The result of this study also implies that pulse rate may depend on the intensity or level of exercise or, and on individual health status.

A comparison of the mean pulse rate of the players before and after exercise showed that the mean pulse of all the players increased after exercise. The increase in mean pulse of the table tennis players after exercise is statistically significant ( $p < 0.05$ ) when compared to their mean result before exercise. The difference in the pulse means about 18, which represent about 26% of the mean pulse of the players before exercise (table 2). This significant increase in mean pulse of the players affirmed the fact that pulse rate is increased by exercise. Individuals with low pulse rate may be advised to engaged in exercise to modulate their pulse rate. The available evidence in research indicates that the normal range for resting heart rate is 50-90 beats per minute (Aladin *et al.*, 2014).

Following the measurement of the blood pressure of the players, it was observed that the blood pressure of twelve players was within the normal range, while the blood pressure of three players were high before exercise (table 3). This showed that some individuals may have high blood pressure without knowing as some testified that it has been long since they checked their blood pressure. it is encouraged that people, especially the aged should frequently check their blood pressure to detect any early challenge associated with blood pressure. Exactly 80% of the players have their blood pressure within the normal range. None of the players is suffering hypotension. This is because a systolic blood pressure of less than 90 millimeters of mercury (mmHg) or diastolic of less than 60 mmHg has been reported to be generally considered as hypotension. (Flynn *et al.*, 2017).

After exercise, the blood pressure of nine players was recorded to be within the normal range, while the blood pressure of six players was above the normal range. This implies that blood pressure may increase above the normal range immediately after exercise. Blood pressure of seven players reduced after the exercise, while blood pressure of eight players increased after exercise. This means that blood pressure may increase in some individuals and may reduce in some individuals immediately after exercise. Some of the result of this research supports a previous reported finding which stated that in mildly hypertensive men, short-term physical activity decreased blood pressure for 8 to 12 hours after exercise, and average blood pressure



was lower on exercise days than on non-exercise days (Pescatello *et al.*, 1991). The pattern of change in blood pressure may differ from one person to another following an exercise. However, it is possible that if the players are allowed to have enough rest after the exercise, the level of change in blood pressure may differ. Out of the six players their blood pressures were high after the exercise, two already had a high blood pressure before the exercise. Their blood pressure even reduced following the exercise, though the level was still above the normal range. This supports the claim that exercise may reduce blood pressure in hypertensive patients. Some researchers have reported that along with pharmacological therapy, there is now established evidence and overall consensus in current guidelines on the effectiveness of regular physical activity in the treatment of hypertension, in combination with drug(s) therapy or even alone (Hagberg *et al.*, 2000; Whelton *et al.*, 2002; Elley and Arrol, 2005). Among the six records of high blood pressure level after exercise, three had their diastolic reading less than 90. This mean that the systolic reading was the major reading above the normal range.

A comparison of the mean blood pressure of the 15 players before and after exercise showed that the blood pressure increased slightly after exercise, but still within the normal range. The mean blood pressure of all the players was normal before exercise and after exercise (table 4). This showed that exercise may not affect blood pressure of individuals negatively. However, the effect of exercise on blood pressure may differ in some individuals.

### **Conclusion**

This study showed that blood pressure may slightly increase immediately after exercise, while pulse is significantly increased by exercise. The rate of increase in pulse by exercise may differ based on individual. Blood pressure may reduce or increase in different individuals following exercise. However, blood pressure may slightly increase in more people than reducing immediately after exercise.

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## AWARENESS OF DRUG EXPIRATION AMONG STUDENTS OF FEDERAL UNIVERSITY WUKARI, TARABA STATE, NIGERIA

<sup>1</sup>Ikwebe, Joseph, <sup>2</sup>Imo, Chinedu, <sup>3</sup>Ameh, Sunday Ojonugwa, <sup>4</sup>Tatah, Verwiyeh Silas, <sup>5</sup>Shaibu, Christopher Ojomugbokenyode, <sup>6</sup>Abu, Michael Sunday, <sup>7</sup>Boyi, Richard-Harris Nsenreuti, <sup>8</sup>Yohanna, Enochone Roy, <sup>9</sup>Ugwuoke, Kenneth Chinekwu & <sup>10</sup>Awen, Mbasughun Judith

<sup>1,2,4,5,6,7,8&9</sup>Department of Biochemistry, Faculty of Pure and Applied Sciences, Federal University Wukari, Nigeria.

<sup>3</sup>Department of Sociology, Faculty of Social Sciences, Federal University Wukari, Nigeria.

<sup>10</sup>Wukari Study Centre, Faculty of Health Sciences, National Open University of Nigeria.

### **Abstract**

*This study evaluated the awareness of drug expiration among students of Federal University Wukari, Nigeria. A drug is any chemical substance that causes a change in an organism's physiology or psychology when consumed. This study was carried out with the use of questionnaire distributed and responses received from one hundred and fifty-two (152) students. The number and percentage of responses received from one hundred and fifty-two (152) respondents on selected questions on expiration of drugs were tabulated. One hundred percent (100%) of the respondents believed that drugs expire, while 89.4% have previously checked the expiring date of a drug. Exactly 71.1% of the respondent believe that many people are aware of expiration of drugs. Exactly 82.9% of the respondents believe that expired drugs will not still have its required positive action. Exactly 60.5% confirmed they have ever purchased a drug and discovered it had expired. Only 22.4% of the respondents had ever heard of any form of campaign against drug expiration recently. Some respondents did not respond to some questions in the questionnaire. The responses received in this study established that a good number of students at Federal University Wukari are aware of issues relating to drug expiration. There may be some expired drugs in some pharmaceutical stores since a good number of the students reported to have experienced purchasing expired drugs. Most students have not heard any campaign against expired drugs recently. Therefore, there is the need to improve the campaign against expired drugs to improve its awareness.*

**Keywords:** Adverse effect, Awareness, Drug, Drug expiration, Healthcare, Pharmaceutical stores.

### **Background to the Study**

Expiry date of drug means “The date placed on the container of a drug product designating the time during which a batch of a product is expected to remain within the approved shelf-life specification if stored under defined conditions and after which it may not be used” (European Medicines Agency, 2003). Consumers can determine the shelf life for a drug by checking its pharmaceutical packaging for an expiration date. According to the product type, the date of expiration is set after manufacturing or after dispensing of the medication or after opening of the medication's container (Ali *et al.*, 2010). However, it is not a fixed concept that all drugs deteriorate at the same rate or interval of time (Lyon *et al.*, 2006) whereas medicines belong to the different synthetic or formulated categories mark the shelf-life position (Khan *et al.*, 2014). According to the World Health Organization (WHO), every pharmaceutical product should have a defined package pamphlet which gives all the essential information regarding the indications of medicines, adverse effects, interactions, and the date of expiration (Abdo-Rabbo *et al.*, 2009). Since 1979, the Food and Drug Administration (FDA), obligated mentioning expiration dates on every pharmaceutical product for pharmaceutical manufacturers (Swaroop and Varun, 2011).

The terms “shelf-life” “expiry date” or “best before” are not only applied to pharmaceutical products but also are applied to products such as beverages, food items, chemicals, and cosmetics (Singh, 1999). In most of the cases of pharmaceutical products, the expiry date reflects the product quality as after the expiration, contamination is observed by increased levels of microbial index or moisture contents can also influence the non-utilization of such medicines (Bajaj *et al.*, 2012). Adverse effects of expired drugs are loss of efficacy, safety, potency, and formation of harmful products (Ogunshe and Adinmonyema, 2014). Expired medication may not adequately treat minor conditions (e.g., minor headache, cold) or serious conditions (e.g., diabetes or heart disease) because of reduced efficacy (Gul *et al.*, 2016). As a consequence, inadequate relief from sickness could eventually lead to longer sick days, increased absences from work/school, and lost productivity at work/school (Gul *et al.*, 2016).

Drug therapy is considered the most commonly used modality for prophylaxis and treatment of diseases (Kheir *et al.*, 2011). Pharmacists and other health-care professionals most often counsel patients about the proper medication use, including route of administration, duration of therapy, and conditions need to be referred to physician during their use for medication. However, sufficient information about storage, disposal, and the decision of either continue on or dispose a drug after a while left there are lacking (Sharif *et al.*, 2010). Inappropriate medications' storage and handling of medications eventually lead to losing their potency and efficacy (Ogle *et al.*, 2016).

There are previous studies which tried to assess awareness, attitude, and practices of people regarding expired medications. A previous Indian study's results showed that about 72% of study subjects do not check expiry date when purchasing or taking the medications (Jain *et al.*, 2012). Another study also provided evidence regarding 17% people's careless regarding checking of expiry date (Rabbo *et al.*, 2009). On the other hand, a previous Nigerian study, the results revealed that majority of participants (93.3%) were well aware regarding expired drugs (Auta *et al.*, 2013). Ahmed *et al.* (2013) conducted a study in Karachi revealed that 20% of participants were unaware of the hazardous effect of expired medicines whereas Singh in his

study indicated that the majority (84%) of people usually checked dates before using medicines.

Expired medications are also a source of unintentional poisoning and abuse, so there should be an adequate system for their disposal. Keeping the medications after their expiration dates may cause them to start absorbing moisture-enhancing microbial contamination. No significant deaths recorded in any study due to the use of expired medications. However, most of the international articles published directly or indirectly reveal their adverse effects. For instance, there is evidence that Fanconi syndrome was caused by expired tetracycline in 1963 in the U.S (Gavura, 2012). Vaccines, insulin, biological products, and oral nitroglycerin could also be subject to quick degradation once the expiration date is reached (Simons *et al.*, 2000).

It has been observed that many consumers of drugs are not aware of drug expiration. Also, those who are aware of drug expiration forget to check for expiration date during the purchase of drugs and as such face dangers associated with expired drugs. There is therefore the need to ascertain the population of people, especially the youths (believed to be the future of tomorrow) that are aware of drug expiration dates. This will help to determine to nature of campaign that may be lunched on drug expiration among students or youth.

## **Materials and Methods**

### **Study Population**

This study was carried out with a random sample of one hundred and fifty-two (152) students (male and female) respondents.

### **The Inclusion Criteria**

The following criteria were included in the study:

- i. Adult male and female students of Federal University Wukari, Nigeria.
- ii. Age  $\geq 16$  years.
- iii. Agree to fill the questionnaire.

### **The Exclusion Criteria**

The following criteria were excluded from the study:

- i. Male and female students of Federal University Wukari below the age of 16 years.
- ii. People who refused to give consent.

### **Data Collection and Data Collection Instrument**

The information used were collected using a questionnaire specially designed for this research purpose. The questionnaire was tested for its readability and understanding to the public before distribution. All participants were asked to answer all questions.

## Results

The result is presented below.

**Table 1: Number and percentage of responses received from one hundred and fifty-two (152) respondents on selected questions on expiration of drugs.**

Question/information	Number of responses as Yes/True	Percentage (%) of responses as Yes/True	Number of responses as No/False	Percentage of responses as No/False
Drugs expires. True or False?	152.0	100.0	0.0	0.0
Have you ever checked for the expiring date of a drug? Yes / No.	136.0	89.4	8.0	5.3
Do you believe many people are aware of expiration of drugs? Yes / No.	108.0	71.1	44.0	28.9
Do you believe expired drug will still have its required positive action? Yes / No.	26.0	17.1	126.0	82.9
Do you believe expired drug will have a negative effect? Yes / No.	146.0	96.1	6.0	3.9
Have you ever purchased a drug and discovered it has expired? Yes / No.	92.0	60.5	54.0	35.5
During the last time you consumed drug purchased from a store/pharmacy, did you check for the expiring date of the drug(s)? Yes / No.	116.0	76.3	36.0	23.7
Have you ever heard of any form of campaign against drug expiration recently? Yes / No.	34.0	22.4	116.0	76.3
Having responded to this questionnaire, will you always remember to check for the expiring dates of drug anytime you are purchasing it? Yes / No.	146.0	96.1	6.0	3.9

One hundred percent (100%) of the respondents believed that drugs expire, while 89.4% have previously checked the expiring date of a drug. Exactly 71.1% of the respondent believe that many people are aware of expiration of drugs. Exactly 82.9% of the respondents believe that expired drugs will not still have its required positive action. Exactly 60.5% confirmed they have ever purchased a drug and discovered it had expired. Only 22.4% of the respondents had ever heard of any form of campaign against drug expiration recently. Some respondents did not respond to some questions in the questionnaire.

## Discussion

The responses received from all respondents showed they are all aware that drugs expire, and they believe much people are also aware, but only 89.4% (table 1) of the respondents have ever checked for the expiring date of a drug. This shows that some students (though not many) do not check if the drugs they are purchasing is expired or not. A previous study carried out in

Nigeria in 2013 revealed that majority of their participants (93.3%) were well aware regarding expired drugs (Auta *et al.*, 2013). These levels of awareness are better than the awareness reported in a previous Indian study's results which showed that about 72% of study subjects do not check expiry date when purchasing or taking the medications (Jain *et al.*, 2012). There is need to always check for expiration date of drugs because it is reported that since 1979, the Food and Drug Administration (FDA), obligated mentioning expiration dates on every pharmaceutical product for pharmaceutical manufacturers (Swaroop and Varun, 2011). Therefore, if consumers of drugs fail to check the expiry dates of drugs before purchasing, there is the tendency of purchasing expired drug which may affect the health of the consumer negatively. There is the need to ensure more people are enlightened about drug expiration because adverse effects of expired drugs have been reported in include loss of efficacy, safety, potency, and formation of harmful products (Ogunshe and Adinmonyema, 2014).

The responses from the students showed there is need for the government and healthcare workers to engage citizens more on the effects of expired drugs. It is possible there may be many expired drugs in some pharmaceutical stores. This is because 60.5% of the respondents reported that they have purchased a drug and discovered it has expired. Expired medications have been reported to also be a source of unintentional poisoning and abuse, hence, there should be an adequate system for their disposal (Vuong and Marriott, 2014). There is need for the government to put up good measures in place to ensure expired drugs are not being sold at the stores or in markets to avoid patients from purchasing them, thereby being exposed to the dangers associated with the consumption of expired drugs.

The respondents were asked if they have ever heard of any form of campaign against drug expiration recently? The responses received showed that only 22.4% of the respondents have heard of such campaign, while 76.3% have not heard of such campaign recently (table 1). This imply that there is a very poor campaign against expired drugs. The Agencies involved in drug related issues need to upgrade and improve the campaign against expired drugs. This will go a long way in educating the citizenry about drug expiration related issues, thereby saving them from the consequences of consuming expired drugs.

One of the purposes of this research study was to campaign against the use or consumption of expired drugs. Therefore, to achieve this, the respondents were asked: having responded to the questionnaire used in this research, if they will always remember to check for the expiring dates of drug anytime they are purchasing drug? Exactly 96.1% of the respondents said yes. This showed this research study and the questionnaire used served as a medium of campaign against expired drugs. The result implies that most of the respondents will henceforth always check for the expiring dates of drugs when purchasing any. However, there is need for more campaign, since 3.9% of the respondents responded that they will not always remember to check.

### **Conclusion**

It is a fact that drugs expire, and its consumption may affect the human health system negatively. With the use of questionnaire designed for this study, the responses received established that a good number of students of Federal University Wukari are aware of issues relating to drug expiration. There may be some expired drugs in some pharmaceutical stores since a good number of the students reported to have experienced purchasing expired drugs.

Most students have not heard any campaign against expired drugs recently. There is the need to improve the campaign against expired drugs to improve its awareness. This study recommend that government should put up serious measures to ensure no expired drug is found in any shop. Also, patients should always check for the expiring date of drugs when purchasing them. Healthcare workers should always educate their patients on dangers of using expired drugs.

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## NEW REACTOR DESIGN FOR PHOTO-OXIDATION OF ACETONE

<sup>1</sup>E. A. Kamba, <sup>2</sup>A. M. Magomya, <sup>3</sup>H. Ataitiya, & <sup>4</sup>A. M. Ago  
Chemical Sciences Department, Faculty of Pure and Applied Sciences,  
Federal University Wukari. PMB 1020, Taraba State. Nigeria

### **Abstract**

*The rate of CO<sub>2</sub> production obtained from the photodecomposition of acetone with different loadings of TiO<sub>2</sub> as photocatalyst is remarkable. During this investigation, the acetone was fed at the rate of 2.8 mmolh<sup>-1</sup> and air flow rate was maintained at 4.3 Lh<sup>-1</sup>. The reaction was carried out at near room temperature as the cold cathode lamps increased temperature very slowly to 63 °C. No CO<sub>2</sub> was produced either without light or catalyst indicating photocatalytic reaction. There was a proportional increase in the production of CO<sub>2</sub> with increase in TiO<sub>2</sub> loading. A maximum rate of 5.75 ± 0.07mMh<sup>-1</sup> for CO<sub>2</sub> production was achieved with a catalyst loading of 5 mg/g<sub>beads</sub>. Increasing the catalyst loading above 5 mg/g showed a decrease in CO<sub>2</sub> production rate which can be attributed to reduced contact between light and catalyst. This technique used here can be adopted for decomposition of various Volatile Organic Compounds (VOCs).*

**Key words:** Acetone, photoreactor, photooxidation, photodecomposition

### **Background to the Study**

For a photocatalytic reaction, a simultaneous contact between the reactants, catalyst and light (photons) is necessary. In order to minimize the  $e^-/h^+$  recombination rate, the catalyst particles must be sufficiently small (tens of nanometres), (Liu, Zhao, Andino & Li, 2021) which renders conventional mechanical filtration ineffective. Certain coupled catalysts such as Fe<sub>3</sub>O<sub>4</sub>-TiO<sub>2</sub> core-shell however, can be separated from the reaction mixture using magnetic separation. This type of reactor is used for wastewater treatment especially where post-reaction purification can be carried out easily. For gas phase reaction applications, it is

possible to monitor reactions spectroscopically as they proceed in situ. (Long & Wang, 2016). However, the catalysts have to be immobilised in order to achieve homogeneous illumination. Meanwhile, the supporting medium needs to be transparent to avoid light absorption and blocking by the solid substrates. The chemical reactants and products can be effectively separated from the immobilised catalysts which is essential for a flow reactor. Photoreactions have also been reportedly performed in a continuous flow system in which the catalyst is immobilised on several materials such as glass rods, mesh, sponge, silica gel, activated carbon and a lot more, to maximise the contact between reactants and catalysts without sacrificing the light illumination.

Since the concentration of gaseous pollutants are typically low (in order of  $10^{-9}$  M) (Railard, Hequet, Le, Cloirec & Legrand, 2004)' (Nagda & Rector, 2003) diffusion-limitations of reactions, (Fujishima, Rao & Tryk, 2000) are not an issue for most domestic applications. Interestingly, using an adsorbent catalyst support can improve the performance of the photoreactor as the adsorbent support can increase the concentration of substrate near the catalyst relative to the gas-phase. This acts as a storage for the reactants that can diffuse to available active sites on catalyst while preventing the escape of reaction intermediates and driving the reaction to completion. This suggests that choice of support can influence the rates of adsorption, surface diffusion as well as desorption.

Nevertheless, in gas-phase systems, catalyst/substrate contact area is reduced which is a drawback, although the light illumination is maximised. Loss of catalyst and deactivation due to accumulation of less reactive intermediates are also possible issues. (Henderson, 2008)' (Fujishima, Zhang & Tryk, 2008). In this work, a flow type photo reactor was constructed and tested for photo decomposition of acetone in gas-phase. Flow reactors with immobilised catalysts have been reported to perform optimally for gas-phase photoreactions. (Verbruggen et al., 2012)' (Nguyen, Lin, Wu & Bai, 2015). However, the efficiency can be achieved by careful design as well as selection of a number of reactor parameters which include source of UV light, reactor configuration, lamp location, type of catalyst, distribution and impregnation of catalyst and more importantly, interaction between the light, catalyst and reacting substrate. The gas phase reactor used in this work is highly compatible with photocatalytic reactions, since the light can illuminate the whole reaction vessel uniformly.

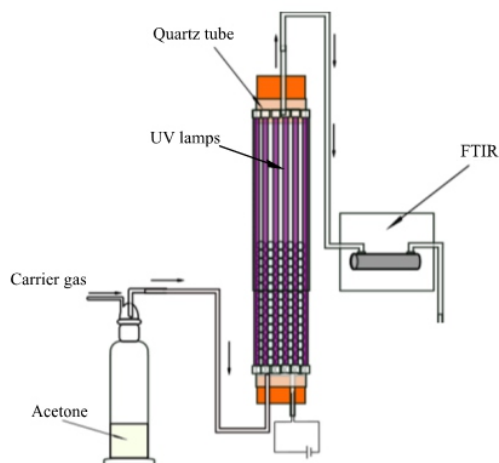
## **Experimental**

### **Catalyst immobilisation**

Prior to pre-treatment, the glass beads were washed with acetone and then refluxed for 2 hours in 6M NaOH. The glass beads were rinsed with deionised water until the washings were neutral, then rinsed with ethanol and allowed to dry in air. This was followed by weighing to account for any loss in mass that could have resulted from the base treatment. The glass beads were then coated overnight with appropriate amounts of catalyst ( $\text{TiO}_2$ ) to give loadings of  $1-7 \text{ mg}_{\text{catalyst}}/\text{g}_{\text{beads}}$ , followed by a second weighing to check the catalyst loading.

### Introduction of acetone in the gas stream

Following a modified procedure reported by Stengl *et al.* (Lin *et al.*, 2013), 5 ml of acetone in liquid form was placed in a Dreschel bottle under a continuous gas stream. Using compressed air as carrier gas at a flow rate of  $4.31 \pm 0.51$  L/h, the acetone was introduced to the reactor.



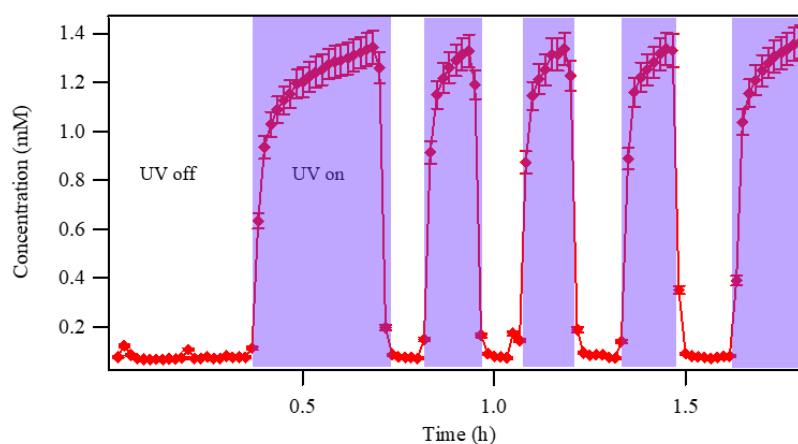
**Figure 1:** Schematic diagram showing the experimental set up.

Due to the high volatility of acetone, the inlet concentration was controlled by maintaining the dip tube in the Dreschel bottle at 2 cm above the liquid to diffuse the acetone vapour, shown in Figure 1. The vapour was collected by the outlet tube on the top. In this arrangement, if the dip tube is moved closer to the liquid level, the acetone vapour concentration will increase and vice versa. If the dip tube is below the liquid level, the concentration of acetone in the mix will be too high for the photoreactor and detection. The true concentration of acetone introduced in the flow reactor was measured by FTIR where the gas stream was passed through a gas sampling cell mounted in the optical pathway of the FTIR (Figure 1). The length of the sampling tube is fixed at 15 cm, which was made from stainless steel tube. Either NaCl, KBr or CaF<sub>2</sub> discs were used as IR windows. After balancing the adsorption equilibrium by the photoreactor and catalysts in the dark, the lights were turned on and the acetone and CO<sub>2</sub> concentrations were monitored. By monitoring these concentrations, it was possible to gain insight into the photo-degradation kinetics of acetone by TiO<sub>2</sub> photocatalysts, thus confirming the functionality of the designed reactor.

## Results and Discussion

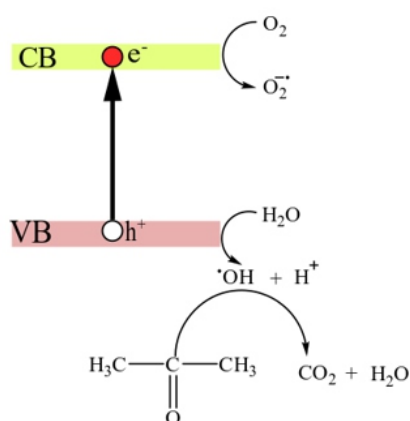
### Effectiveness of acetone photo-degradation

For the environmental treatment, VOCs have to be mineralized into CO<sub>2</sub> and H<sub>2</sub>O without trace of organic fragments. Otherwise, such fragments might cause more hazardous than the original VOCs. By applying UV illumination on the photoreactor fed with acetone and air, CO<sub>2</sub> gas was increased immediately. The transient plot for the CO<sub>2</sub> concentration with light on and off is shown in Figure 2.



**Figure 2:** Concentration of  $\text{CO}_2$  in a gas stream containing acetone versus flow time with the UV illumination on and off.

Verbruggen *et al.* (2011). reported similar increase in  $\text{CO}_2$  concentration in their study of the photodecomposition of acetone. When the light is switched on, the initial concentration slowly increased to the saturation concentration, while the gas flow is constant. This suggests that the created  $\text{CO}_2$  might be adsorbed by the catalysts until the surface is saturated. By increasing the reaction temperature, the adsorption can be reduced, and one might expect a faster increase in the  $\text{CO}_2$  concentration. It is worth mentioning that no  $\text{CO}_2$  was observed in the absence of either light or catalyst. Hence it confirms the nature of photocatalytic mechanism (Scheme 1).



**Scheme 1:** Mechanism for the photocatalytic decomposition of acetone

The sharp drop of  $\text{CO}_2$  concentration when light was switched off possibly reflects the decaying kinetics of the excited states in  $\text{TiO}_2$  and desorption kinetics of the adsorbed  $\text{CO}_2$ . As the desorption is normally slower, hence the decrease of  $\text{CO}_2$  when light is off is dominated by the slow desorption kinetics alone. As it has been established that the concentration of  $\text{CO}_2$  in the gas stream is as a result of the complete mineralization of acetone by  $\text{TiO}_2$  photocatalyst, it became necessary to evaluate the effect of catalyst loading on the

glass beads by monitoring the increase in CO<sub>2</sub> concentration per load. This is the focus of the next section.

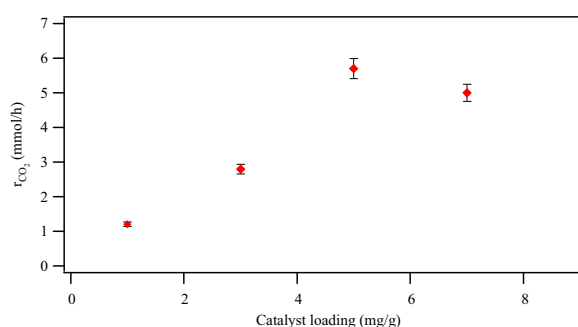
### Effects of catalyst loading

The quantity of catalysts loaded on each bead could affect the photocatalytic reaction rate. At lower loading, there is not enough TiO<sub>2</sub> particles to be excited and to contact acetone, so the overall reaction rate will be low. At higher loading, each bead will absorb more photons and will result in insufficient, un-uniform light illumination. As a result, the reaction rate will also be reduced. Hence an optimum catalyst loading exists which balances the light illumination and contact with reactants. In order to find the optimum loading, the reaction rate was measured as a function of TiO<sub>2</sub> loading.

Here the reaction rate is defined by the CO<sub>2</sub> eluting rate,  $r_{\text{CO}_2}$  at constant gas flow and constant light illumination. The CO<sub>2</sub> production rate,  $r_{\text{CO}_2}$  was calculated as the product of the gas flow rate,  $f$ , and the CO<sub>2</sub> concentration,  $[\text{CO}_2]$ , shown in Equation (1). The CO<sub>2</sub> concentration was determined by the FTIR signal intensity at 2300 cm<sup>-1</sup> calibrated with known CO<sub>2</sub> concentration. The intensity of the CO<sub>2</sub> under dark condition was also subtracted. Similar method was used for measuring the acetone flow rate. By considering the contributions of gas flow rate to the concentration, the flow rate of CO<sub>2</sub> makes a better representation of CO<sub>2</sub> production in comparison with to the molar concentration, since the molar concentration can be affected by overall gas flow rate, hence the reason for this approach.

$$r_{\text{CO}_2} = f[\text{CO}_2] \quad (1)$$

The rate of CO<sub>2</sub> production obtained from the photodecomposition of acetone with different loadings of TiO<sub>2</sub> is presented in Figure 3. During this measurement, the acetone was fed at the rate of 2.8 mmol/hr and air flow rate is maintained at 4.3 L/h. The reaction was carried out at near room temperature as the cold cathode lamps increase temperature very slowly to 63°C.



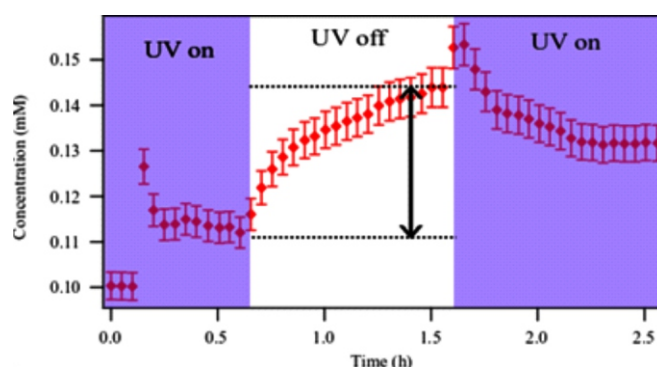
**Figure3:** CO<sub>2</sub> production rates from the photodecomposition of acetone at different catalyst loading.

As shown here, there was a proportional increase in the production of CO<sub>2</sub> with increase in TiO<sub>2</sub> loading. This observed increase in CO<sub>2</sub> production continued until a maximum rate of

$5.75 \pm 0.07 \text{ mM}_{\text{CO}_2}/\text{h}$  was achieved with a catalyst loading of  $5 \text{ mg/g}_{\text{beads}}$ . Loading greater than  $5 \text{ mg/g}$  showed a decrease in  $\text{CO}_2$  production rate which can be attributed to reduced light/catalyst contact. In this case, only catalyst closest to the light source became activated as the coating was too thick. Excess catalyst loading resulted in enhanced local UV adsorption and potentially, increased the surface area as well as active sites for the photocatalytic decomposition of acetone. An optimum catalyst loading of  $5 \text{ mg/g}_{\text{beads}}$  was found to be the best  $\text{TiO}_2$  loading for maximum efficiency of photodecomposition of acetone under the studied conditions.

### Decomposition of Acetone

To study the photodecomposition process of acetone, the flow rate of acetone with and without light was monitored. As can be seen in Figure 4, upon UV illumination a rapid initial increase in concentration of acetone was observed until a steady state was reached; during which the acetone adsorption and decomposition was balanced on the catalyst surface. When the UV irradiation was turned off, the photodecomposition process became halted which resulted in a slow rise in concentration of acetone until another steady state was reached. The increase of acetone concentration at the beginning of light on and slow increase after light is off suggests there are significant effects of adsorption. The illumination of light causes the desorption of acetone and when light is off, the feed acetone is adsorbed back on the catalyst surface.



**Figure 4:** Acetone concentration in the presence and absence of UV illumination using  $5 \text{ mg/g}$  catalysts. The initial acetone concentration was regarded as the background and has been subtracted. The difference between the two steady state concentrations used to determine the decomposition rate of acetone is shown by the dotted lines and arrow.

The actual concentration of photo decomposed acetone  $[A]$ , is given by the difference between the concentrations in dark and under illumination,  $[A]_{\text{dark}} - [A]_{\text{UV}}$ . Knowing the gas flow rate,  $f$ , allows to determine the rate of decomposition of acetone,  $-r_A$  using Equation 2.

$$-r_A = f([A]_{\text{dark}} - [A]_{\text{UV}}) \quad (2)$$

In this study, the gas flow rate was  $4.3 \text{ mM/h}$  and  $[A]_{\text{dark}}$  is  $0.145 \text{ mM}$  while  $[A]_{\text{UV}}$  is  $0.113 \text{ mM}$ , reading from Figure 4. Thus, the acetone decomposition rate is  $0.14 \pm 0.02 \text{ mM/h}$ .

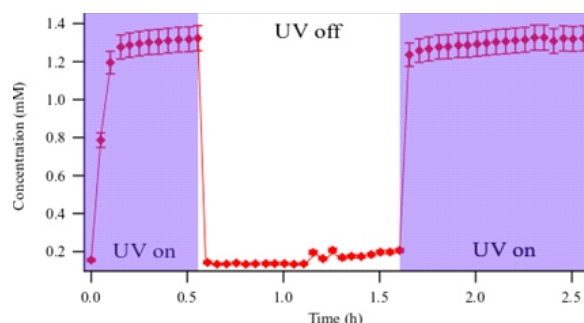
The decomposition efficiency can also be characterized using the concept of conversion. Conversion is defined by the ratio between the decomposed acetone  $[A]$  and the inlet concentration  $[A]_{dark}$  using Equation 3.

$$\text{Conversion \%} = \frac{[A]_{dark} - [A]_{UV}}{[A]_{dark}}$$

In the present work conversion of 22 % was achieved for the photodecomposition of acetone, based on the values of  $[A]_{dark}$  and  $[A]_{UV}$  from figure 4.

Higher conversion value has been reported for photodecomposition of acetone. Žabová and Dvořák (Han et al., 2012) reported 35% conversion of acetone in their study on the photodecomposition of acetone in gas-phase over Degussa P25. They attributed the higher conversion rate to their  $\text{TiO}_2$  immobilisation substrate (polystyrene mesh) which allowed for a significant increase in gas-catalyst contact area with respect to the glass beads used in the present study. However, the ease of handling catalyst makes the immobilization technique used in this work a more industrially viable choice.

The photocatalytic mineralisation of acetone to  $\text{CO}_2$  is known to proceed through various stable chemical intermediates and the mechanism largely depends on the experimental conditions. Several routes have been proposed in the literature for the photo conversion of acetone, many of which show that acetone undergoes several chemical transformations before finally mineralizing completely. (El-Mazawi, Finken, Nair & Grassian, 2000). However, there is likelihood that many partial oxidation products were formed considering that during photodecomposition of acetone, the initial oxidation steps are more kinetically favoured rather than total mineralization. (Henderson, 2008)' (Fujishima et al., 2008); (Fujishima et al., 2008)' (Verbruggen et al., 2011). The partial oxidation products include many carbonyl moieties such as acetic acid, (Henderson, 2008); (Sakai Kubota, Yamaguchi, Fukuoka & Inumaru, 2013) formic acid, (Xu & Raftery, 2001) and mesityl oxide (El-Maazawi et al., 2000)' (Coronado, Kataoka, Tejedor-Tejedor & Anderson, 2003; Xu & Raftery, 2001). Most of them are easily oxidized. In this experiment, variation in  $\text{CO}_2$  produced was also monitored as shown in Figure 5. The maximum production rate of  $\text{CO}_2$  was found to be  $1.31 \pm \text{mM/h}$ . This makes it 9.4 times as much as the corresponding decomposition rate of acetone ( $0.14 \pm 0.02 \text{ mM/h}$ ).



**Figure 5:**  $\text{CO}_2$  concentration from acetone decomposition with and without UV illumination during the photodecomposition process



Due to stoichiometric ratio (1:3) between acetone and CO<sub>2</sub>, it would be expected that the CO<sub>2</sub> concentration would only be 3 times of decomposed acetone. The higher-than-expected CO<sub>2</sub> concentration suggests there are other factors affecting the CO<sub>2</sub> concentration. The possible reason for this is that there are significant amount of organic species, including acetone, and its partial oxidation products such as acetic acid, (Henderson, 2008)' (Sakai et al., 2013), formic acid, (Xu & Raftery, 2001) and mesityl oxide (El-Maazawi et al., 2000)' (Coronado et al., 2003; Xu & Raftery, 2001) were absorbed in the photoreactor. They are then gradually released after being oxidized into CO<sub>2</sub>, since the reaction was carried out at room temperature. The adsorption behaviour was confirmed with the initial increase in the acetone concentration when light was switched on. At room temperature, such adsorption is inevitable. As such, the parameter of conversion could underestimate the performance of the TiO<sub>2</sub> photoreactor. A high temperature measurement could eliminate the adsorption and could give more accurate result.

The existence of intermediates could interfere with the measuring of acetone concentration. The extinction coefficient of these species will not be the same as that of acetone, consequently the carbonyl peak area can increase by unknown amounts due to contribution of the intermediates. As such, the observed reduction in the concentration of acetone could be overestimated. Verbruggen *et al.* (2011) reported similar results where concentrations of produced CO<sub>2</sub> exceeded the complete mineralisation of the photo decomposed species. They also suggested that the deposition of organic residue on the photocatalyst surface may be responsible for the high concentration of CO<sub>2</sub>.

### Conclusions

In this study, a new catalyst immobilization technique with high catalyst-support adherence efficiency have been demonstrated. The key equations used for the design of the photoreactor were derived. The reactor was designed to achieve a uniform irradiation field that affords a plausible control over the average light intensity. The success of the design will produce more reliable experimental data and provide a more simplified photocatalytic process. A promising industrial implication is envisaged when an excellent catalyst adherence on the glass beads with high stability was achieved with the lowest catalyst loading amount.

In this study, the gas-phase, flow-type photo-reactor was successfully tested for photodecomposition of acetone. The immobilisation method developed in this study is indeed complementary and simple to implement. By utilising a highly active, inexpensive commercially available photocatalyst (P25) it was possible to achieve acetone decomposition. The streamline design of the reactor made it possible for all the reacting species to be in contact while the transparency of the glass beads provided an excellent UV light penetration to even the innermost part of the reactor, hence the observed high photo activity. The formation of CO<sub>2</sub> from carbonaceous species adsorbed on the surface of the catalyst during the photodecomposition reactions have been observed. Prolonged illumination in the absence of reactant (acetone) can easily deplete the deposition of these

accumulated carbonaceous species and release more active sites for the adsorption of substrate.

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## PRODUCTION OF CATALYST USING COCONUT SHELL AS A SUBSTRATE FOR BIODIESEL PRODUCTION

<sup>1</sup>A. M. Magomya, <sup>2</sup>E. A. Kamba, <sup>3</sup>A. M. Ago, & <sup>4</sup>H. Ataitiya,

<sup>1,2,3&4</sup>Department of Chemical Sciences,  
Federal University Wukari, Taraba State, Nigeria

### **Abstract**

*Catalyst is a substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change. In this study, the effect of temperature on the percentage yield of catalyst produced, the effect of pH, Fourier Transform Infrared analysis, morphology, ash content, moisture of catalyst produced from Coconut shell was studied. The spectra for Coconut shell catalyst, shows different spectra at different wavelengths of  $3339.7\text{cm}^{-1}$ ,  $2885\text{cm}^{-1}$ ,  $1684\text{cm}^{-1}$ ,  $1581.8\text{cm}^{-1}$ ,  $1151.7\text{cm}^{-1}$ , and  $745.5\text{cm}^{-1}$ .  $3339.7\text{cm}^{-1}$  associated to O-H stretching vibration of OH functional groups. Gradual decrease with increase in the concentration of  $\text{K}_2\text{CO}_3$ , optimum yield was observed at 1:6 with total yield of 84.60%. The effect of activation temperature increases the ash content of the catalyst from 5.4 to 9.6. Moisture content of the catalyst produced at different activation temperatures and impregnation ratios was found to decrease with increase in activation temperatures and increase with increase in impregnation ratio. Catalyst produced at higher activation temperature 700 to  $900^\circ\text{C}$  show a lower moisture content of 5.4 and 3.2% respectively. This work concludes that, Heterogenous catalyst can be produced from Coconut shell which is an agricultural waste and can be further used as catalyst for biodiesel.*

**Keywords:** Activation, catalyst, *Coco nucifera*, shell, waste

### **Background to the Study**

Coconut is mainly composed of lignin, cellulose and hemicelluloses (Borel et al., 2021). Increasing the rate of cellulose breakdown improves the porous structure of biochar (Li et al.,

2020), whereas increasing the rate of lignin breakdown contributes to the formation of biochar with a high specific area, high FC content and fine aromatic structure (Jiang et al., 2020). The composition of lignin, cellulose and hemicellulose in a *Coconut* shell influences the characteristics of *Coconut* shell. Kamaluddeen *et al.* (2022) studied the production of solid catalyst from carbonaceous materials. This requires careful approach so that the physical or mechanical properties of all intermediates are not destroyed. Filtration, drying, calcination, and forming rather than the batch method are recommended.

Dass *et al.* (2018) studied the morphology of catalyst produced from *Coconut* fruit shells by physical activation at 900°C. Cavities were visible on the surface of the catalyst of different sizes. The different pores suggest that these could be sites that may adsorb reactants during catalysis (Jiang & Xiao, 2020). Also, the size of the pore could be related to the different functional groups that may be present (Lee *et al.*, 2019). The nature of functional group on catalyst surface has been related to the nature of reaction that would proceed in heterogeneous catalysis (Charlotte and Bert, 2022). This work focuses on producing a heterogeneous catalyst from *Coconut* shell and evaluation of heterogeneous catalyst produced by physical activation from *coconut* shell.

## Materials and Methods

### Equipment/Apparatus

The following instruments were used for the purpose of the research which include; Oven, Hot plate, muffle furnace, weighing balance, crucible, water bath glass reactor, thermometer, separating funnel, distillatory, sieve, magnetic stirrer, viscometer.

### Methods

The *Coconut* shells were collected from coconut sellers in Wukari LGA, Taraba State. The *Coconut* shell was washed with tap water, sun-dried for two days and crushed to small particle size. A 500g of crushed *Coconut* shell was washed with distilled water till the wash water became colorless. It was then dried at 110°C in an oven for 8 hours to get rid of moisture and other volatiles.

**Physical Activation:** A 100g of pre-treated *Coconut* shell was carbonized in a crucible and at 1000°C for 2 hours. After carbonizing for 2 hours, the sample was kept in a desiccator to cool. It was ground and sieved with a 300µm sieve and Storage in airtight bottle to avoid long contact with oxygen.

### Determination of the percentage yield of Catalyst produced by physical activation ( $K_2CO_3$ , cm<sup>3</sup>) of *Coconut* shell.

The total yield (%) of *Coconut* shell produced by physical activation was determined after sample processing in terms of raw material mass. The dried weight, of the pre-treated and carbonized samples was determined using Metler balance and the carbon yield and calculated as

$$Y\% = \frac{W \times 100}{W^o} \text{ --- Eq 1}$$

Where Y = Carbon yield (%); W = final weight of catalyst prepared; W<sup>o</sup> = initial weight of the sample used in the carbonization and activation processes (Verla *et al.*, 2012).

**Determination of pH of catalyst produced by physical activation of Coconut shell.**

The pH was determined according to ASTM D3838-80 1.0g of each of the catalysts produced by physical activation of *Coconut* shell was weighed and transferred into separate 250 ml beaker and 100 ml of distilled water was added and stirred for 1 hour. The samples were allowed to stabilize and then the pH was measured using a hand-held pH meter, (Jenway 430 Model).

**Determination of percentage Ash content of the produced catalyst**

Ash content determination was done according to the ASTM D2866-94 method. 2g of each of *Coconut* shell catalyst was placed into separate porcelain crucible which was weighed and transferred into a preheated muffle furnace set at a temperature of 1000°C. The furnace was allowed to burned for an hour after which the crucible and its content was transferred to a desiccator and allowed to cool. The crucible and content were re-weighed and the weight lost was recorded as the ash content of the catalyst (W<sub>ash</sub>) and the % ash content (dry basis) was calculated from the equation (Verla *et al.*, 2012).

$$Ash = \frac{W_{ash} \times 100}{W^o} \text{ --- Eq 2}$$

W<sup>o</sup> = initial weight of AC, W<sub>ash</sub> = weight loss

**Moisture (%) of catalyst produced.**

Moisture content was determined according to ASTM D2867-99. From the Catalyst produced, 1g was weighed and dried in an oven set at 110°C. The drying sample was constantly weighed at a 10 minutes' interval until a constant weight (W<sub>p</sub>) was obtained. The crucible and its content were retrieved and cooled in desiccator. The difference in weight was recorded and the moisture content (MC) was calculated from the equation as loss in weight on drying divided by initial weight of activated carbon multiplied by 100. (Donni *et al.*, 2005).

$$MC = \frac{W_f - W_i \times 100}{W_o} \text{ --- Eq 3}$$

Where W<sub>f</sub> = weight of Carbon retrieved from the oven, W<sub>i</sub> = weight of crucible and AC and W<sub>o</sub> = initial dry weight of the AC sample

**The morphological studies of the catalyst** Oven dried porous sample was mounted on an adhesive carbon tape attached to an aluminium-stub and subsequently sputter coated with platinum for 5 min in a JFC-1100 sputter coater. SEM magnification was selected at 370, 500, 1000 and 1500 (Guo *et al.*, 2010). Scanning Electron Microscope (SEM) operating at 25 kV was used to study the morphology.

**Fourier Transform Infrared analysis of catalyst**

Catalyst was analyzed was using a PERKIN-ELMER spectrum One FT-IR

spectrophotometer. Each sample was ground to fine powder and oven dried at 11°C for 2 hours and turned into pellet hydrolytically. The pellet was analyzed immediately and the spectra produced was recorded. A pellet prepared with an equivalent quantity of pure KBr powder was used as control (Sugumaran *et al.*, 2012).

## Results and Discussions

### Effect of Temperature (°C) On the Yield (%) of Coconut Shell Catalyst.

Figure 1: shows the effect of temperature on the yield (%) of the carbonized *Coconut* shell when the temperature was varied from 500 to 900 °C at between constant concentration of catalyst and time, the result shows that the yield of catalyst decreases gradually as the temperature increases from 500 to 700°C and there was a decrease in catalyst yield from 700 to 900°C also. The optimum yield of the *Coconut* shell Catalyst observed at 500°C was 84.60%.

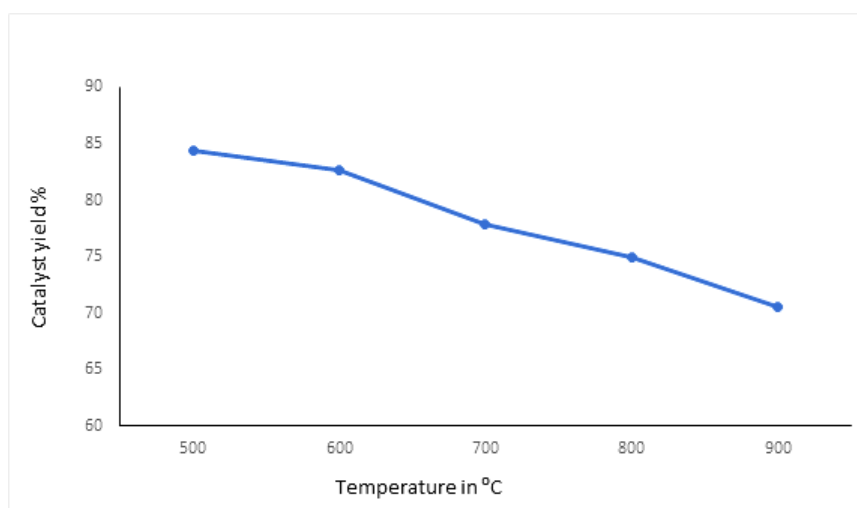


Figure 1: Effect of temperature on catalyst yield at constant impregnation ratio ( $\text{gdm}^3$ ) and time

### Impregnation ratio $\text{K}_2\text{CO}_3$ ( $\text{gdm}^3$ ) on the yield of Coconut shell Catalyst.

Figure 2: The impregnation ratio was varied from 3:2 to 3:10 of  $\text{K}_2\text{CO}_3$  and the *Coconut* shell. As the impregnation ratio was increased at constant temperature and time on the carbonized *Coconut* shell, the catalyst yield decreases progressively as the impregnation ratio increases from 2 to 10  $\text{gdm}^3$ . At 8 to 10  $\text{gdm}^3$ , there was a minimal decrease in the yield of both the *Coconut* catalyst with the highest yield observed at 3: 2 with 86.63% yield. The effect of varying impregnation ratio of catalyst prepared by physical activation to potassium carbonate ( $\text{K}_2\text{CO}_3$ ) at constant temperature and time, the result obtained showed a gradual decrease with an increase in the concentration of  $\text{K}_2\text{CO}_3$ . Optimum yield was observed at 1:6 (catalyst:  $\text{K}_2\text{CO}_3$ ) with total yield of 76.30%. The catalyst exhibits an alkaline nature for all the catalyst prepared at different activation temperature and impregnation ratio, at 800°C with impregnation ratio of 3:6  $\text{K}_2\text{CO}_3$ .



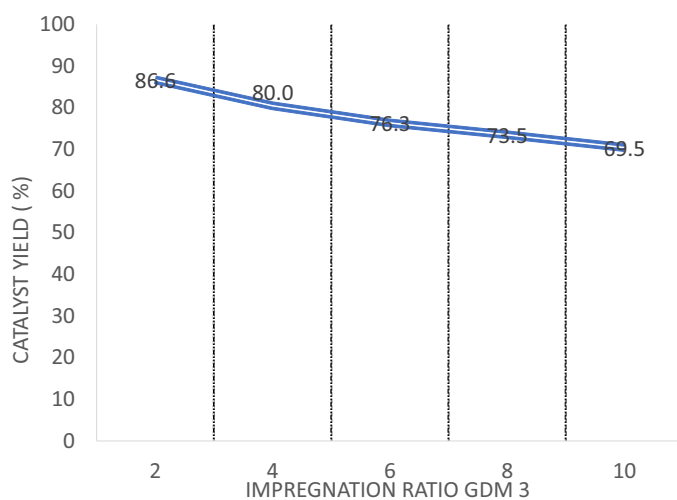


Figure 2: Effect of impregnation ratio (gdm<sup>3</sup>) on catalyst yield at constant temperature (°C)

#### Effect of temperature variation on pH of catalyst

Figure 3: shows the pH of catalyst from carbonized *Coconut* shell at constant impregnation of K<sub>2</sub>CO<sub>3</sub> and time. As the temperature of the reaction increases the pH increases from 9.2 to 10.8. This shows the alkalinity of the catalyst. The optimum temperature for carbonization was observed at 800°C with pH of 10.4. The pH of the catalyst was found to be 10.5. The value of pH obtained in this work is more effective because pH of catalyst obtained from lignocellulosic material is very effective at low pH than high pH (Edward *et al.*, 2014).

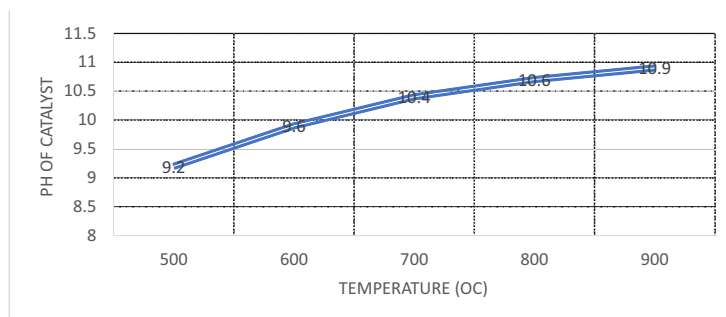
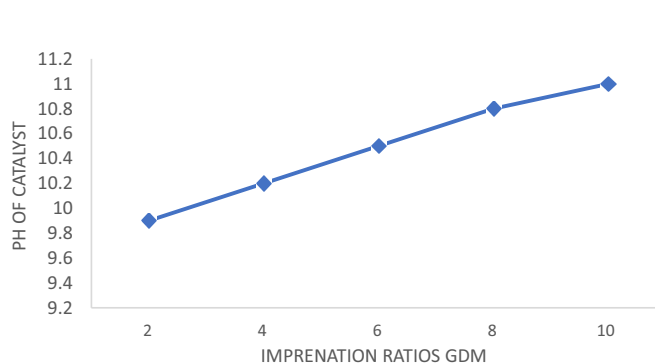


Figure 3: Effect of temperature variation on pH of catalyst at constant impregnation ratio (gdm<sup>3</sup>) and time

#### Effect of various impregnation ratio (gdm<sup>3</sup>) of K<sub>2</sub>CO<sub>3</sub> on pH of the catalyst

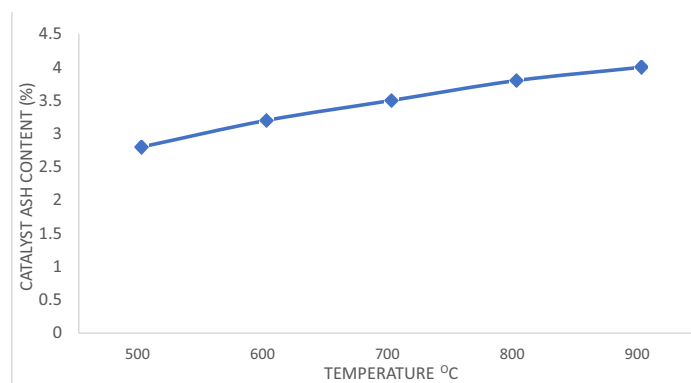
Figure 4: from the results it shows that the pH of catalyst increases with increasing concentration of K<sub>2</sub>CO<sub>3</sub>, this shows an increasing alkalinity of the catalyst. There was a minimal increase from 2 to 4 gdm<sup>3</sup>. The optimum pH was observed to be 10.5 at 3:6.



**Figure 4:** effect of various impregnation ratio (gdm<sup>3</sup>) on pH of catalyst at constant temperature (°C) and time.

#### Impact of temperature variation on ash content of the catalyst

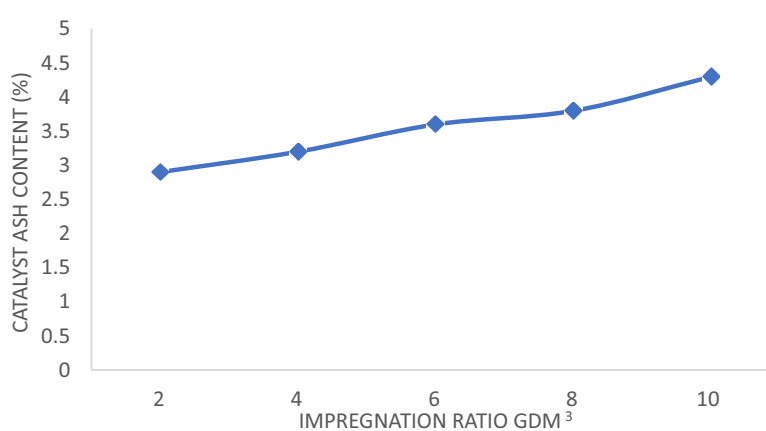
Figure 5, shows the ash content of *Coconut* shell catalyst which was activated at different temperature range and constant concentration of  $K_2CO_3$  and time. The effect of activation temperature increases the ash content of catalyst in both coconut shell and mahogany shell catalyst at 1000°C, catalyst activated at 500 to 700°C shows a gradual increase in ash content from 5.4 to 9.6 and as the temperature increases from 700 to 900°C the ash content increases 9.6 to 13.2 for *Coconut* shell catalyst, as the temperature increases from 700 to 900°C the ash content was observed to be 11.2 to 15.3. The catalyst shows a lower ash content. High ash content is undesirable for catalyst since it reduces the mechanical strength of catalyst.



**Figure 5:** Growth trend of ash content of the catalyst under various temperature at constant impregnation and time

#### Impact of the variation of impregnation ratio on ash content of the catalyst

Figure 6: shows an increasing ash content with increasing impregnation ratio. The highest percentage ash for *Coconut* shell catalyst was observed at 3:10 with 14.8%.

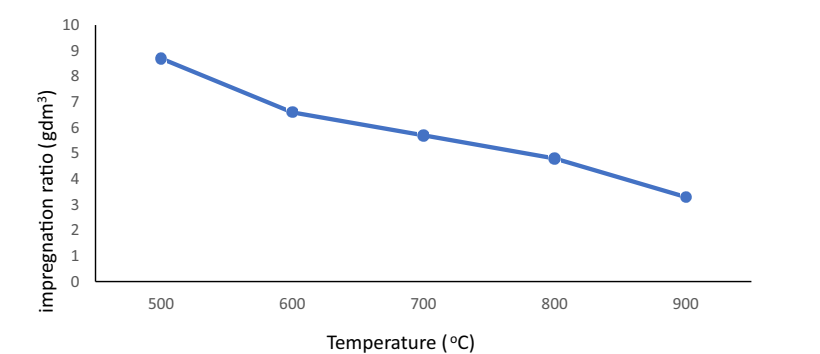


**Figure 6:** Growth trend of ash content of the catalyst under various impregnation ratio

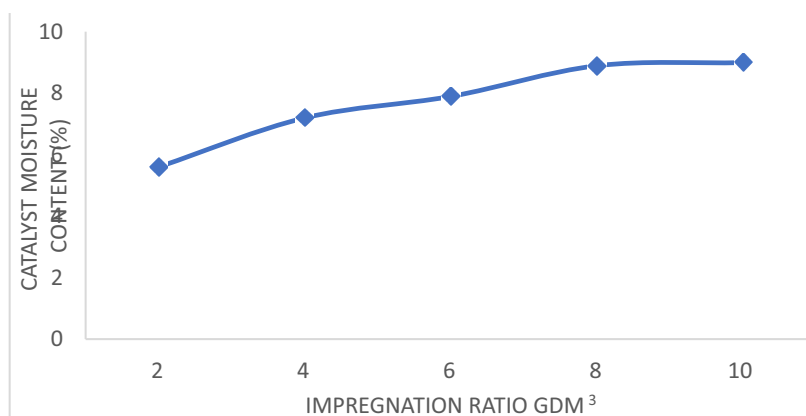
#### Moisture Content (%) of Catalyst at Different Reaction Temperature.

Figure 7: At different reaction temperature, the moisture content of *Coconut* shell catalyst shows a significant decrease in moisture content with the lowest moisture content at 900°C with 3.2% and the highest was 8.9% at 500°C.

Figure 8: shows a gradual increase in moisture content as the impregnation ratio increases from 2 to 10 gdm<sup>3</sup>. Moisture content increases from 5.6 to 9.0% in the coconut shell catalyst and 4.8 to 8.9 in *Coconut* shell Catalyst. The moisture content of the catalyst produced at different activation temperatures and impregnation ratios was found to decrease with an increase in activation temperatures and increase with an increase in impregnation ratio, catalyst produced at higher activation temperature 700 to 900°C show a lower moisture content of 5.4 and 3.2% respectively. Lower moisture content increases the rate of adsorption.



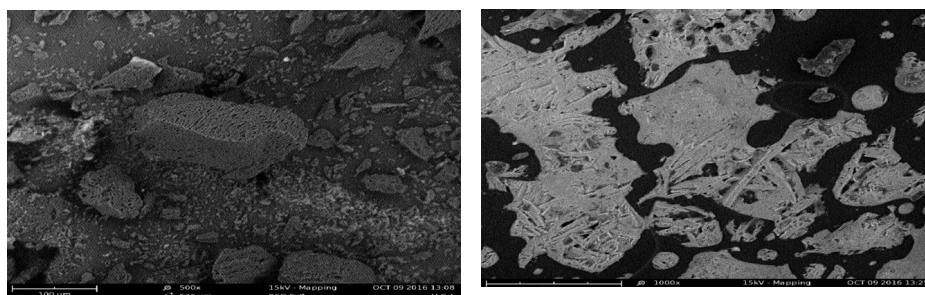
**Figure 7:** Moisture content of catalyst under different reaction temperature (°C) at constant impregnation ratio (gdm<sup>3</sup>) and time (h).



**Figure 8:** Moisture content of catalyst at different impregnation ratio (gdm<sup>3</sup>), constant reaction temperature (°C) and time (h).

#### Morphological characterization of Coconut Shell Catalyst

Figure 9 and 10 shows the different morphology of physically prepared *Coconut* shell activated carbon, coconut shell catalyst produced at 800°C and 3:6 K<sub>2</sub>CO<sub>3</sub> impregnation ratio. From the micrographs, it can be seen that the external surface of the carbon has some pores on the surface which indicates the porosity of activated carbon. Figure 14 shows the morphology of *Coconut* shell catalyst chemically prepared at 800°C from the scanned result, the external surface developed some cracks, crevices of honeycomb-like structure and some crystals and strands with pores scattered on the surface of the carbon. A closer look shows some pores developed on the crystals. The crystals formed on the surface are most likely the potassium compound as is hinted out by the result of the scan (*Eliseo et al.*)

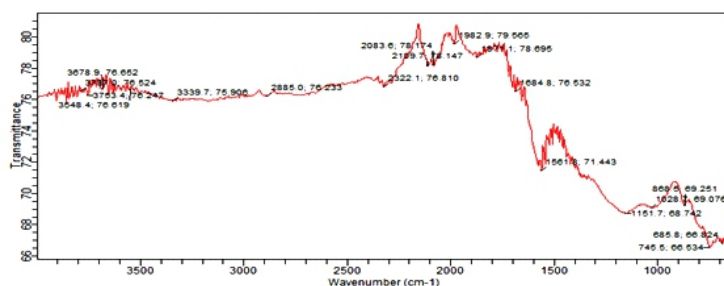


**Figure 9.** SEM for physically prepared *Cocos*. **Figure 10:** SEM result for *Coconut* shell *nucifera* shell catalyst catalyst produced at 800°C.

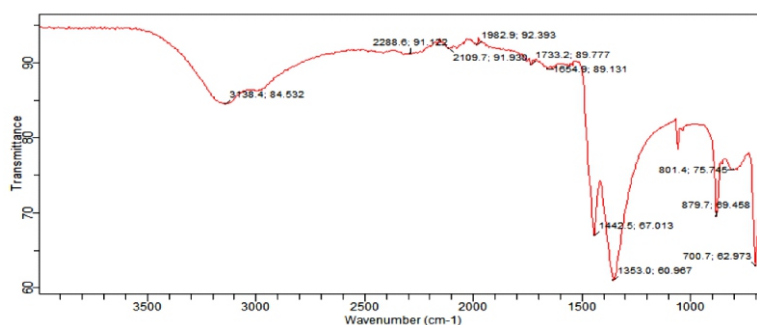
#### Fourier Transformed Infrared (FT-IR) for Coconut Shell Catalyst Produced at Different Activation Temperatures °C.

Fourier transform infrared (FTIR) spectroscopic analysis was used to study the surface chemistry of both physically and chemically prepared coconut shell catalyst. Figure 11 and 12 reveal the FTIR spectra of the *Coconut* shell catalyst where the peaks were slightly shifted.

Figure 11 shows the spectra of physically produced *Coconut* shell catalyst with varying peaks of  $3339.7\text{cm}^{-1}$  which is associated with  $-\text{OH}$  stretching,  $2885.0\text{cm}^{-1}$  which corresponds to  $\text{C}-\text{C}$  stretch, weak peak at  $1684.8$  corresponds to  $\text{C}=\text{C}$  stretch,  $\text{C}=\text{O}$  was found at  $1581.8$ , at  $1151.7$  corresponds to the stretching vibration of  $\text{C}-\text{O}$  and at  $745.5\text{cm}^{-1}$   $\text{C}-\text{H}$  was found.



**Figure 11:** Fourier transform infrared (FTIR) for prepared *Coconut* shell catalyst at  $700^{\circ}\text{C}$



**Figure 12:** Fourier transform infrared (FTIR) for *Coconut* shell catalyst produced at  $800^{\circ}\text{C}$

## Conclusion

The heterogeneous catalyst produced by physically activated *Coconut* shell has shown a good active site which can be used as catalyst for the production of biodiesel and other oil from plant seeds. This study serves as a tool to identify non-edible potential raw materials and to produce heterogeneous catalyst (AC supported on  $\text{K}_2\text{CO}_3$ ) based on indigenous sourced raw materials for possible optimization of the bio-diesel production.

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## ASSESSMENT OF LIVING CONDITION OF INTERNALLY DISPLACED PERSONS IN DURUMI AREA 1 CAMP, FCT, ABUJA

<sup>1</sup>John Abimiku <sup>2</sup>Basil Bawa & <sup>3</sup>Ahmed II Hajarrah Hassan

<sup>1&2</sup>Department of Public Administration, Faculty of Administration,  
Nasarawa State University, Keffi.

<sup>3</sup>Department of entrepreneurship studies, Faculty of Administration,  
Nasarawa State University, Keffi.

### Abstract

*This study was designed to assess the living condition of internally displaced persons in Durumi Area 1 Camp, FCT, Abuja. The major objectives of the study are to examine the feeding condition of the Internally Displaced Persons, to ascertain the standard of accommodation of the Internally Displaced Persons as well as to examine the health condition of the IPDs in Durumi camp. The theory of Social Inclusion is adopted for the research while its methodology was survey research design. After the analysis of data, the study finds out that, feeding condition in IDP camp Durumi is poor as food saved is lacking basic nutrients. Also, health facilities in the IDPs in Durumi camp are poor. Based on the findings, the study suggested that the government should provide basic feeding support such as rich food with good nutrient to support the growth and health of the people as lack of it has resulted to death. Also, the Federal Government of Nigeria in collaboration with the state government should build permanent health facility in the camps for the registered IDPs in order to facilitate healthy life and skillful human being among the internally displaced persons for the betterment of their life and the general society.*

**Keywords:** *Living Condition, Internally Displaced, Persons, Camp, Feeding Condition, Accommodation and Health.*

### **Background to the Study**

The world in recent times is faced with challenging situations which affect human lives and existence. Almost all continents of the world are faced with various kinds of conflict that the resultant effect is displacement of persons from their habitual homes. While several persons scattered to various places in search of refuge. Internal displacement and the consequent humanitarian crises still confront humanity despite the hope that these would no longer be a problem after the Second World War. Since then, however, the global community has remained enmeshed in vicious cycles of war, displacement, and humanitarian crises (Brigido, Zibetti, & Sobrinho, 2019; GRID, 2019; Klugman, 2021; Long, 2014).

The United Nations Humanitarian Commission on Refugees (UNHCR, 2007) estimated that about 25 million people fall into these categories among the world population, Africa shares a significant figure of about 12.8million people displaced, while Nigeria has about 5 million people suffering displacement. Some of these people flee to neighbouring countries as refugees, while many are within their country in either relations homes or harboured by friends, or at government established camps as Internally Displaced Persons (IDPs). Acknowledging the impact of internally displaced persons (IDPs) on global security, scholars have sought to identify the causes and remedies, pointing to various triggers for internal displacement, such as poverty (Admasu, Alkire, Ekhatior-Mobayode, Santamaria, & Scharlin-Petee, 2021; Klugman, 2021), economic crises (Helgason, 2020; Owain & Maslin, 2018), natural disasters (Adeola, 2020; Martin, Weerasinghe, & Taylor, 2013; Olukolajo, Ajayi, & Ogungbenro, 2014), political violence, and armed conflict (Adewale, 2016; Dirikgil, 2022; Okeke-Ihejirika, Oriola, Salami, Obiefune, Ejike, Olutola, A., & Irinoye, 2020; Proukaki, 2018). In response to the IDP crisis, the inter-national community has adopted various protocols and frameworks to manage it.

In Nigeria, the Northern region especially the North-East and North-Central are the most affected in this violent conflict, and with several people displaced from their homes, and sheltered in relations homes, or in friends' homes, or in internally displaced camps. Anywhere these persons find shelter, they are faced with various kinds of challenges ranging from inadequate food, shelter or healthcare facilities, with cases of malaria, traumatized situations, lack of proper security in camps, and various kinds of abuses of women and children as they are the most populated and vulnerable. For those who find shelter in homes of friends or relations constitute burden on their host.

Among the many challenges faced by the Nigerian government and its populace, the scourge of Insurgency and its attendant effects have been particularly disturbing in every sense of the word. The waves of Insurgencies have led to the loss of lives and properties in unprecedented levels across Nigeria, especially in the North-Eastern region of the country. A very much visible consequence is the rising number of Internally Displaced Persons (IDPs) scattered across the country in the wake of destructive insurgent attacks. As a result, a number of IDP camps have been set up and run by the government with the help of several non-governmental organizations.



Internal displacement is a phenomenon in which individuals are forced to leave their homes but remain within the borders of their own countries. IDPs are distinguished from refugees, who are also involuntarily displaced but across internationally recognized state borders while internally displaced persons stay at the border of their countries (World Bank, 1994). It is important to note that these challenges are not unique to Nigerian IDPs and camps.

The plight of the Internal Displaced Persons (IDPs) has become a global phenomenon. Countries around the world are faced with challenges to finding lasting solution to this problem. For example, in the area of study, residences are displaced from their home through various forms of attack, either by herdsmen or insurgency or through terrorism. In other parts of the world, it could be through militancy, persecution or natural disaster, etc. In any form these ugly trends are witnessed, the fabric of peace is broken, lives are lost, while people are rendered homeless. These phenomena have caused untold hardship to people universally.

Internally Displaced persons in Nigeria are going through lots of untold hardship such as social, physical, psychological, emotional and economic torture. Internally Displaced Persons, upon safe arrival at their new but temporary location, have basic needs such as reasonable shelter, food, potable water, healthcare, education, security, clothing, information, etc. which must be met in order to stay alive and inhibit social-cultural and security consequences both on themselves and host communities alike. The challenge of internal displacement could jeopardize the sustainability of peace and development of a country, if not properly handled. Also, social development and economic stability becomes stagnated particularly in the affected states. There is need to holistically review the issue of IDPs in Nigeria to give sense of belonging and sanitize the system (Olanrewaju, 2015).

Fundamentally, the occurrence of disasters often results in displacement of persons. Hence, the global increase in the number of magnitudes of disaster has directly led to the increase in human displacement. This has further given reason to the urgent need to develop laws and national policies on the protection and assistance of internally displaced persons and to strategize on the implementation and the enforcement of these laws. In view of this situation therefore, the aim of this research is to assess the living condition of internally displaced persons in Durumi camp, F.C.T, Abuja.

The main objective of the study is to assess the living conditions of internally displaced persons in Durumi Camp

- i. To examine the feeding condition of the Internally Displaced Persons in Durumi camp.
- ii. To ascertain the standard of accommodation of the Internally Displaced Persons in Durumi camp.
- iii. To examine the health condition of the IPDs in Durumi camp.

## Conceptual clarification

### Concept of Internal Displacement

“Internal displacement” describes situations in which individuals and groups are forced or obliged to leave and remain away from their homes but remain within the borders of their own countries (Adejo, 2013). The second element distinguishes them from refugees, who are also involuntarily displaced but across internationally recognized state borders. Internal displacement occurs typically in response to armed conflict, persecution, situations of widespread violence, natural and human made disasters and, more recently, large-scale development projects (GRID, 2019).

According to the Guiding Principles on Internal Displacement, IDPs are “persons or groups of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or human-made disasters, and who have not crossed an internationally recognized state border”. According to Adejo (2013), the term internally displaced persons refer only to people uprooted by conflict violence and persecution; that is, people who would be considered refugees if they crossed a border. Global statistics on internally displaced persons serially reinforce this view by counting only those displaced by conflicts.

Despite being firmly embedded in the international lexicon, there is a question as to whether internal displacement has become a term of art. In fact there exists, different ideas as to what is meant by “internal displacement and internally displaced persons”. Others, however, consider internal displacement to be a much wider concept which encompasses the thousands of people uprooted by natural disasters and developmental projects. Still, others question whether it is useful to single out internally displaced persons, who commonly are referred to as “IDPs” as a category at all.

There is also no consensus on “when internal displacement ends” that is, internally displaced persons should no longer be considered as such compounding matters, further is that on common parlance, the internally displaced often are referred to as refugees', which tend to be catch all phrase to describe all uprooted people without reference to whether they have left the country as the legal definition of 'refugees' requires. In short, there is a need for clarification of this conceptual issue. The clarifications are as follows:

- i. **Internal Displacement:** According to African Union Convention for Protection and Assistance of Internally Displaced Persons on Africa 'Internal Displacement' means the voluntary movement, evacuation or relocation of persons or groups of persons within internationally recognized state borders.
- ii. **Forced Displacement:** This refers to the involuntary movement of refugees and internally displaced persons from their place of residence. The displaced might be by conflict (Generalized violence), as well as, by natural hazards (floods, land/slides, droughts) or nuclear disaster, famine or development projects. The forced displacement can be categories into:

- (a) **Refugee:** A refugee is a person who owing to well-founded fear of being persecuted by reasons of race, religion, membership of a particular group or political opinion is outside his country or nationality and is unable or owing to such fear is unwilling to afford him of the protection in that country.
- (b) **Internally Displaced Persons (IDPs):** Persons or groups of persons who have been obliged to flee or to leave their homes or places of habitual residency in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violation of human rights or natural or human-made disasters, and who have not crossed an internationally recognized state-borders

### **Internally displaced Persons in Nigeria**

These are people or groups who have been forced or obliged to flee or leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflicts, situation of generalized violence, violations of human rights or natural or human-made disaster, and who have not crossed an internationally recognized border (Adamu and Rasheed, 2016). This definition reveals two understanding: First, IDP are compelled to move in anticipation of or in response to particular risks; secondly, they remain within national borders. Internal displacement is dynamic in nature: anyone can be, or become, another category of mobile population. Refugees, for instance, often begin as IDP; while returning refugees may become IDP if they are unable to return substantially to their communities of origin (IOM, 2017).

Literature attests that IDPs in Nigeria have resorted to similar urban settlement options (Mberu and Pongou, 2010). In a study of the scale and patterns of internal displacement linked to Boko Haram, the Internal Displacement Monitoring Centre found that three dominant patterns have emerged in the settlement patterns of IDPs. Firstly, the IDPs follow the footsteps of economic migrants by escaping to the southern part of Nigeria. Secondly, the IDPs flee from rural to urban areas within the country. Thirdly, there is a secondary displacement of both IDPs and host communities who move once again when their resources have been depleted (Internal Displacement Monitoring Centre, 2014).

Abuja, the seat of government, is not exempted from the influx of IDPs: the city is saturated, on a daily basis, with residents from frontline states such as Borno, Adamawa and Yobe (Adewale, 2017). They are endlessly trooping in with the intention of taking shelter with their relatives, only to soon realize that their presence places an excessive strain on their hosts. Congested living spaces and food constraints have pushed the IDPs onward to various other locations, usually camps. However, neither the federal government nor the Abuja administrators has made any supplies available to them. In fact, these camps have been set up on the initiative of the IDPs themselves, only to be discovered thereafter by various religious bodies, NGOs and sympathetic individuals. Food is as much an issue as shelter, and when the IDPs are fortunate enough to find food to eat, there is often no water, and they settle for muddy brook water instead. The conditions in the camps are exacerbated by the government's unenthusiastic response to Abuja's IDP dilemma. The camp environment is

awful, the security situation of the camps is appalling, and these victims of violence face the constant threat of an epidemic outbreak. These IDPs now live on the assistance provided by religious bodies, various associations and well-meaning Nigerians.

To avoid intimidation from the security agents, many of the IDPs have moved deep into Abuja city where, apart from some relief assistance, their existence can be overlooked. In Area 1 of Dagba village, Abuja, for example, the IDP camp was positioned at the extreme end of the road. The path that leads to the camp is difficult to navigate and the camp is surrounded by bushes. In fact, the topography of the area is intimidating for those visiting the area for the first time. Aside from one yet-to-be-completed structure where clothes were being used as window covers, the rest of the IDPs were living in makeshift tents.

Generally, IDP camps are usually coordinated and managed. According to camp experts, Nunes and Roberson (2015), the task of camp coordination and management is to ensure equitable access to services and protection for displaced persons living in communal settings, to improve their quality of life and dignity during displacement, and advocate for solutions while preparing them for life after displacement, which constitutes parts of their rights. In Nigeria, camps are managed by camp leaders or coordinators (civilians), military, Civilian Joint Task Force (CJTF) – a civilian militia who support the military to provide security and they live inside the camps (Amnesty International, 2018).

### **Living Conditions of internally displaced persons**

The living conditions of the displaced persons are paramount if they must feel they are human beings. As Stock Exchange (2018) puts it, *living conditions* is the circumstances of a person's life – shelter, food, clothing, safety and access to clean water. It is the generality of the circumstances under which people live. Similarly, World Bank (2018) points out that good living condition include access to good schools, healthcare, electricity, food, safe water and other critical services.

This made Elsevier (2014,) stresses that good life cannot be achieved without having good living conditions, and that living conditions affect people's lives, as it represents a direct factor for people to live happily and with contentment. However, it must be noted that the right givers play a vital role in helping IDP to experience good living conditions by complying with human rights legal principles on internal displacement. Interestingly, Mclean and Macmillan (2003) conceived *human rights* as special sort of moral entitlement. They attach to all persons equally, by virtue of their humanity. They specify the minimum conditions for human dignity and a tolerable life. Human rights, according to the United Nations (UN, 2018) are rights inherent to all human status. It includes the right to life and liberty, freedom from slavery and torture, freedom of opinion and expression, the right to work and many more. Everyone is entitled to these rights, without discrimination. Hence, Galtung cited in Rourke (2004) suggests that:

*The most fruitful way to think about human rights is to begin with the idea that "ultimately they are supposed to serve basic human needs" These basic human needs which generate corresponding rights include: "survival needs to*

*avoid violence": The requisite to avoid and the right to be free from individual and collective violence. "Wellbeing needs to avoid depression" (unhappiness/sadness): The right to adequate nutrition and water; to movement, sleep, sex, and other biological wants; to protection from diseases and from adverse climatological and environmental impacts. "Identity needs to avoid alienation": The right to self-expression: to realize their potential, to establish and maintain emotional bonds with others; to preserve cultural heritage and association: to contribute through work other activity; and to receive information about and maintain contact with nature, global humanity and other aspects of the biosphere. "Freedom needs - to avoid repression": The right to receive and express opinions, to assemble with others, to have a say in common policy; and to choose in such wide-ranging matters as jobs, spouse, where to live, and lifestyle.*

To this end therefore, it is crystal clear that human rights is expected to serve man with his social, political and economic needs and perhaps desirable conditions of living, however, applying or operationalizing these rights in some so-called democracies appears to be problematic and it has affected living conditions across the countries of the world.

### **Challenges of the Internally Displaced Persons in Nigeria**

According to Internal Displacement Monitoring Centre (IDMC), as at 2013, 3.3 million people were displaced in Nigeria essentially as a result of insurgency. It also recorded 1,538,982 IDPs in Nigeria as of April 2015. As at December 2015, the total number of IDPs identified in Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe amounted to 2,152,000 people (Dialy Times, 2016). The vast majority of IDPs identified in the above-mentioned states have been displaced because of the insurgency (91.98%), a smaller number was forced to leave their place of origin because of community clashes (7.96%) or natural disaster (0.06%) (IDMC, 2016). In Borno, 24.2% of the population was displaced in 2015 following the increase in violence in this state since the beginning of the year.

A large number of IDPs in northeast Nigeria live with relatives and friends. 87% of IDPs live with host communities and 13% live in camps or camp-like settings. The situation in other states are quite different, while there are no identified camps in Yobe, Bauchi and Gombe, 12% of the IDP population in Adamawa and 18% of IDPs in Borno live in camps or camp-like setting (Ibid). A total of 43 displacement sites have been identified in Adamawa, Borno and Taraba States. The number of individuals residing in these sites consists of 154,008 individuals within 19,348 households (Alobo & Obaji, 2016). The bulk of these victims are women and children who are also the most vulnerable. Research shows that 62% of the IDP population in sites are female while 38% are male. Half of the total numbers of individuals residing in sites are children under 17 years old. The vulnerability identified that within the IDP population, 3.33% are single headed-households, 2.26% are breastfeeding mothers while 1.22% are pregnant women. In addition, 1.61% of the IDPs have been identified as unaccompanied and separated children (Alobo et al, 2018).

The challenges faced by IDPs in Nigeria is not entirely different from the general problems associated with IDPs as observed above but it is necessary to identify specifically those difficulties IDPs encounter in Nigeria. First, there is insufficient understanding of the rights of IDPs as set out in the UN Guiding Principles on Internal Displacement and the Kampala Convention. These rights include the right to life, freedom of movement, association, dignity of human person, personal liberty, right to private and family life etc. IDPs usually suffer the worst violation of their fundamental human right. Their lives are threatened as a result of the violence by the Boko Haram insurgency. They are forced to flee from their homes and seek shelter in schools, churches, mosques and informal settlements and in the process the situation gravely affects their security and health. We have indeed recorded several instances where IDPs are killed in their make-shift camps by boko haram.

Similarly, IDPs along with the majority of the affected population, have witnessed atrocities in addition to losing family members and succumbing to the insurgent's campaign of terror. Many IDPs therefore fear that they will be pursued by the insurgents, will be perceived by the authorities as supporters of the insurgents or will be supposed by the insurgents or other elements as informants for the authorities. Remaining silent and hidden for IDPs becomes the unpalatable option (Alobo et al, 2016).

According to a report on IDP Protection Strategy (2019), women and children remain the most vulnerable to sexual and gender-based violence. There have been reported instances of rape, sexual harassment, forced marriage, infant marriage, sexual diseases and uncontrolled birth occasioning high infant and maternal mortality in make-shift IDP camps in Nigeria. The needs of children are highly disregarded in armed conflict situations and this is the case in Nigeria. Children are being exposed to enhanced risk of abuse, forceful conscription by insurgents as child soldiers, suicide bombers, sex slaves and abrupt discontinuation with their education. Their lives change towards a different direction of malnutrition, inadequate amenities needed for their survival. According to NEMA, there are over 750 unaccompanied and separate children (Alobo, et al, 2016). They further noted that most of the school age children in Adamawa, Borno and Yobe have had their opportunities for schooling severely constrained. The destruction of schools and indiscriminate killing of students and teachers by Boko Haram insurgents has left many schools deserted and deprived children of their right to education. The adopted and yet to be released Chibok girls which has generated international condemnation remains indelible in our memories. Most of the displaced persons are camped in schools thereby interrupting learning and other school activities. The education of displaced victims is virtually non-existent in some camps. There is lack of access to quality learning opportunities. 338 schools have been damaged or destroyed by attacks. At least 196 teachers and 314 school children killed.

The most common types of accommodation used by IDPs in Nigeria are schools and government buildings. Others include tents and bunk houses. Shelter for IDPs in Nigeria is insufficient and most times do not stand the test of time and weather. Many existing shelters have been damaged or destroyed. Report shows that IDPs live in churches, mosques, town

halls, abandoned and uncompleted buildings and where available, other forms of makeshift camps which are grossly inadequate and unsuitable for accommodating the surge in displaced populations. These shelters are not as a result of government effort but as a result of the individual's effort to survive. The shelters are often overcrowded and unsuitable in terms of water and sanitation facilities, cooking and privacy, especially for women. There is often no proper waste management and electricity. This explains the regularity of hygiene-based epidemics in camps.

Things are made worse by the fact that access to health care in Nigeria generally and the North East in particular is severely constrained for both the IDPs and host communities as a result of the destruction of health care facilities and health care workers. Outbreak of disease has increased in areas affected by dislocation. There is also the case of lack of access to vaccinations. The number of cholera cases among IDPs is seriously on the increase. More ailments are undiagnosed as there is no health checks carried out in this camps (Ogundamisi, 2016).

According to Ogundamisi (2017), some IDPs have access to food distribution every day while others receive irregular food distribution. On the other hand, some IDPs never receive food distribution. Malnutrition in the conflict areas continue to rise as there is limited access to food in this situation. This is mainly because no actual statistics of IDPs exist in Nigeria as not all displaced persons are accounted for. For those persons who have the resources, at the occurrence of violence, although they become displaced by virtue of the attaining circumstance, however they migrate to other places where there is peace and stability with their available resources. Others flee to the homes of their extended families or friends in other parts of the country. All these factors makes it nearly impossible to obtain an accurate number of displaced persons in Nigeria.

### **Impact of the challenges of internal displacement**

According to Mooney (2005), the effect of internal displacement on IDPs themselves, as well as on the local authorities and communities that host them, can be devastating. While the act of displacement itself often may violate the human rights of those affected, the subsequent loss of access to homes, lands, livelihoods, personal documentation, family members, and social networks can negatively affect the ability of IDPs to assert and enjoy an entire range of fundamental rights. Most obvious, IDPs immediately become dependent on others for basic needs such as shelter, food and water. At the same time, their vulnerability may be increased by barriers to accessing health care, education, employment, economic activities, and electoral politics in their areas of displacement. Moreover, the longer displacement continues, the greater is the risk that traditional family and social structures break down, leaving IDPs dependent on outside aid and vulnerable to economic and sexual exploitation. Such dependency, in turn, reduces the chances of durable solutions and sustainable reintegration into society once political and security conditions have changed to enable such solutions to take place.

Displacement has a great impact on social roles in a community, as well as on its specific groups, including women and children who typically make up the majority different phase of displacement, gender aspects of displacement and its short term or long-term impact on female and male role in a given culture are frequently touched upon. Find below the impact of disaster on individuals (female, male and children), communities and the state.

Women in certain cultures are not permitted to travel unless accompanied by their husbands or a male family member. They often do not have the necessary personnel documentaries to cross checkpoints or worse in the case of international refugee flow). Once they reach the trial destination, they often congregate in camps, which prevent a new set of risks and hurdle for women, who frequently shoulder all the daily responsibilities of ensuring their survival and that of their families, which absorbs huge amounts of time and energy. This is especially true in case of conflict induced displacement when male family members are recruited to fight or are even dead.

This can result in a loss of identify and status, especially when continued with the disintegration of the family unit which forces women to assume unfamiliar and new roles in livelihood providers, they often have to travel long distances to find water; food, livelihood, machineries and other basic necessities and as they move around, they are at risk of being raped or suffer injuries from landmines and unexpected ordinance. In camps their voices often go unheard as women tend not to talk openly about their most personal needs. In an attempt to make ends meet, some take into prostitution, exchange sex for food.

The male population also suffers specific problems and challenges. As traditional breadwinners, they tend to encounter problems finding employment and generating income in their new displacement environments, which can be a traumatic experience for an individual accustomed to sustaining their family and recourse to violence, drinking or even criminal activity. The economic aspects of involuntary displacement (whether they are conflict, violence or disaster induced) are, however, a general issue that affect displaced population as a whole.

The economic and social loss resulting from displacement cannot be substituted easily, without taking into consideration, the displaced population risk and long –term impoverishment. It is worth noting that the male folks are usually molested, harassed, arrested and even tortured by the security personnels who often take them to be members of insurgent groups. Some of them were even arrested right in the IDP camps and whisked away for offences they do not commit. The children are another social group that could be badly affected by displacement caused by armed conflict and natural disasters. Displacement not only disrupts their education and normal development, but also frequently results in separation from their education and normal development, but also results in separation from their families in the chaos of fight; they are sometimes left to fend for themselves and are at heightened risk of abuse.



The disruption of their education means that, their opportunities to escape the risks are diminished in both the short and long terms. In addition to this, the displaced are often stigmatized and may also be viewed with suspicion hostility in the area to which they flee. Indeed, conflict and natural disasters kill thousands of girls and boys and render many incapacitated with injury. The experience of war often harms children's physical development while the violence they witness inevitably has a psychological impact on them.

One cross cutting issue that affects the majority of displaced populations, but is particularly harmful for younger generations, is food insecurity with limited and often no access to farmland and also cut off from their normal means of income, displaced population tend to be more dependent on food assistance than others in the local population. Displacement creates particular vulnerabilities that may not be suffered to the same extent by the non-displaced populations which increase their food insecurity. Malnutrition is a major cause for some of the highest death rate recorded in humanitarian emergencies involving the internally displaced and explains why death rates among their population have often been substantially higher than for non-displaced, this is a problem that does not necessarily improve over time (Ademu, A. and Rasheed, Z. H. 2016).

The entity data on the health situation of internally displaced persons (though limited) suggest for instances that more than half the countries affected by internal displacement, particularly in Africa and Asian countries, internally displaced persons lack of access to water, insufficient sanitation, poor and insufficient hygiene and sanitary condition contribute to the outbreak and spread of various diseases, including those highly infections that are common to the areas of high population density and HIV/AIDS (Ademu, A. and Rasheed, Z. H. 2016).

The World Food Programme (WFP) noted that they typically comprise the majority of beneficiaries of its assistance. These are some aspects of internal displacement affecting the communities which indicate that we are dealing with a complex phenomenon, that can and should be looked at from an interdisciplinary perspective. Over the years, Nigerians have had to rely on share luck and providence to save them from disasters with little or no help coming from security and emergency agencies which lack the capacity and wherewithal to intervene in such difficult moments. Disasters delay socio-economic progress and put millions of people into dire poverty or make the poor ever poorer. Basically, the occurrence of disasters in Nigeria like in most countries has been on the increase in recent time, particular due to communal conflicts and technological malfunctions (Ademu, A. and Rasheed, Z. H. 2016).

Stakeholders regretted that natural resources which could be utilized for the benefit of human and political developments are either host or misused while budgetary provisions and other resources that could be utilized for the benefits of human and physical developments are deployed to address avoidable disasters due to communal clashes and epidemics. Yet, while the number and gravity of disasters are on the increase locally and

globally, the traditional strategies for disaster management through relief measures have become ineffective because they are largely reactive instead of being proactive in reducing the risk. Disasters that are not properly managed have contributed significantly to loss of skilled personnel, diversion of scarce resources and destruction of infrastructure, negative investment climate and political destabilization (Ademu, A. and Rasheed, Z. H. 2016).

Furthermore, Nigerians are convinced that disasters are indeed a development concern and are increasingly aware of the impact of disasters. The need to systematically reduce the increased impact of disaster should at this rate be steadily gaining recognition and commitment of governments worldwide. It is the first time that Nigeria in recent times, talks about the financial impact of disasters on the state and the people. Another reality that has equally come to the fore is the realization that for Nigeria to effectively reduce the risk of disasters, she needs to incorporate her risk reduction policies into the national development effort.

### **Empirical Review**

In a study conducted by Nasa'i, Mohd, Abdullahi & Sobia (2018) on forced migration and the plight of internally displaced persons in Northeast Nigeria, they noted that the situation of internal displacement in most cases exposes the displaced people to some vulnerability. Among other classes of displaced people, the most notable groups of concern are refugees and internally displaced persons (IDPs). In contemporary time, conflict is identified to be the primary cause of forced displacement. Since 2009, the Boko Haram insurgency and the counter-insurgency by the Nigerian security forces turned northeast Nigeria into a conflict zone. The crisis has forced more than 2 million people to flee for safety within Nigeria as internally displaced persons (IDPs); while many crossed the border into countries neighbouring Nigeria from the Lake Chad region as refugees. They further explored and discussed the suffering of the people internally displaced by Boko Haram conflict from the framework of forced displacement. It is found that, the IDPs in Nigeria suffered from multifaceted problems, ranging from the issues of inadequate life-saving assistance, protection related crisis, and the unclear prospect of achieving durable solutions. Moreover, the lack of a clear national policy, institutional, and legal frameworks in addressing internal displacement in Nigeria is found to be the prime cause of the intensification of the plight of IDPs.

Onuh, EM (2022), on assessment of the role of government in addressing the challenges of internally displaced persons in Abuja, Nigeria Camps. This paper evaluated the role of government in ameliorating the challenges confronting the internally displaced persons in camps in Nigeria. Using semi structured interview, it was established that human rights abuses, lack of access to health care services, difficulty in accessing legitimate means of livelihood, protection risks, discrimination, documentation and identity issues, legal access, lack of protective shelter and negligence by government remain the major challenges for the displaced persons in Abuja camps. Sanctions for nations of UN that fail to comply with the guiding principle on internal displacement, legal documentation and reintegration, media

intervention to draw government closer and periodic monitoring and review of the conditions of IDPs in camps, were recommended.

A review on the study conducted by Idowu, Gideon and Bernhard, (2022). Assessment of the Service Delivery at the Internally Displaced Persons' Camps (IDPS) in the Federal Capital Territory, Nigeria. They found out that exploitation of natural resources by man has triggered conflict which has made man to flee from his original place of abode to seek shelter in other places within the country as IDPs or outside the country as refugees. Surprisingly, unlike the refugees, IDPs remains the major concern of their home country. Systematic random sampling technique was used to sample 331 households in Kuchigoro and Durumi camps. This study is aimed at assessing the types of service delivery in the IDPs camps in the FCT. With a view of determining the effectiveness of the services delivered to the IDPs in FCT. The following objectives were considered for the study: Identify the socioeconomic characteristics of the camps, assess the types of service delivery in the camps, and examine the effectiveness of service delivery in the IDPs camps. The study however, discovered that, electricity in Kuchigoro camp (96.8%) is not available in the camp likewise in Durumi camp (99.5%) is not available in the camp which is an indication that the camps are suffering from energy poverty. The study concludes that concludes that, the IDPs in Abuja camps does not have access to service delivery in areas of electricity supply, potable water supply, healthcare, education, relief materials and security services and therefore, recommend a sustainable good governance strategy in line with the relevant goals of the SDGs; also, sustainable physical planning principles be introduced in the arrangement of space at the camps; in the provision of basic services, partnership with the non-governmental organizations should be encouraged for better service delivery.

In another study conducted by Ejiofor, Oni and Sejoro (2017), on the impact of internal displacement on human security in Northern Nigeria, the pointed through survey research while their findings relied on primary and secondary sources of data for analysis. They reported that the crisis of internally displaced persons is a big challenge in Nigeria's effort at enhancing human security in the region. It is evident that the crisis of internally displaced persons threatens every sphere of human security and if security is not assured, myriad of challenges which affects the people will arise. The lack of basic needs among these groups makes them become vulnerable to any form of radicalization. Findings of the study reveals that measures of the government in addressing the crisis of internally displaced persons in the country is on ad-hoc basis with no solid and durable solution in view. In addition, the crisis of internally displaced persons hinders immensely the developmental process of the region.

From the review of other related study, it was possible to discover that they either focus on forced migration and the plight of internally displaced persons in Northeast Nigeria, the role of government in addressing the challenges of internally displaced persons in Abuja, Nigeria Camps and Assessment of the Service Delivery at the Internally Displaced Persons' Camps (IDPS) in the Federal Capital Territory, Nigeria among others as none seems to assess the

living condition of internally displaced persons in Durumi Area 1 camp, FCT, Abuja. Thus the gap this study filled is in the area of scope as it focuses specifically in Durumi and also on living condition such as feeding, accommodation and health.

### Theoretical Framework

The theory of Social Inclusion is adopted for the research. The Social Inclusion theory is concerned with groups of people who need assistance due to their prevailing situation. The theory is easily associated with 'Social Exclusion' as a theory and is traced to the French notion of les exclusion in 1970 with the authorship of the expression credited to René Lenoir (Robo, 2014). This theory postulates that in a socially inclusive society, everyone is valued, and their basic needs are supplied to them. This in turn leads to a sense of belonging amongst the people. However, there are some values that form the basis of the social inclusion theory such as: everyone needs support, can learn, can contribute, can communicate, is ready and together we are better (Robo, 2014). Social inclusion is a result of the action taken positively to change the circumstances of these people. In a lighter form, social inclusion is the opposite effect to the social exclusion theory (Charity Commission, 2011). This theory is best understood when explaining social exclusion theory as both theories are 'the inseparable side of the same coin' (Robo, 2014). The Social Inclusive theory is apt for the purpose of this study as it supports the integration of the internally displaced persons into the larger society. In Nigeria, if the internally displaced persons are well integrated into the society, this alignment would allow for better management of the crisis and enhanced security of persons in the country. This in turn would enhance the prospects of internally displaced persons as well as help them curb with the challenges associated to internal displacement.

### Research Methodology

In this study, a community-based survey research design was used. The population of study consists of adolescents and adult males and females in Durumi IDP Camp. This group of people was used because they are adults and mature enough to answer questions on challenges and prospects of Internally Displaced Persons in Durumi Camp, FCT, Abuja. According to Register of IDPs in the camp (2022) the camp has a population of 3145 internally displaced persons. A sample represents FCT a portion which forms part of a study. The purpose of a sample is to collect specific cases, events, or actions that can clarify and deepen understanding (Neuman, 2000).

The sample size for this study was determined using Taro Yamane (1967) method which is given as;  $n = \frac{N}{1+N(e)^2}$

Where;

n= Sample size

N= the population size (3125)

e= is the level of precision. (0.05)

$$n = \frac{3145}{1+3145(0.05)^2}$$

$$= \frac{3145}{1+3145(0.0025)}$$

$$= \frac{3145}{7.865}$$

$$= 399$$

**Source;** (Yamane, 1967)

The sampling techniques that were adopted in this study are cluster and simple random sampling. Three hundred and fifty-five respondents were drawn using lottery method to pick the sample size.

### Data Analysis and Results

Tables are used in presentation of the responses. The data collected were tabulated and worked out in percentage and degrees in order to reflect the proportion of the responses at a glance. Each table is titled with a subtopic relevant to the question to which responses was required.

The total copies of questionnaire administered were three hundred and ninety-nine (399). Three hundred and fifty (350) copies of questionnaire were properly filled and returned, while forty-nine (49) questionnaires were not returned.

**Table 1: Responses on the nature of Feeding condition of the Internally Displaced Persons in Durumi camp.**

Options	Frequency	Percentage
Adequate	36	10.3%
Inadequate	90	25.7%
Poor	203	58%
Undecided	21	6%
<b>Total</b>	<b>350</b>	<b>100</b>

**Source:** Field Survey, 2023

The table above reveals the state of food condition in the study area. It reveals that 36 respondents representing 10.3% agreed that feeding condition of the Internally Displaced Persons in Durumi is adequate, 25.7% of the respondents report inadequate feeding condition of the Internally Displaced Persons in the camp. Also, a majority of 203 respondents representing 58% said feeding condition in the Camp is poor while 6% reported undecided as it concerns feeding condition in the camp. This shows that feeding condition in IDP camp Durumi is poor. This was further reported by some of the respondents in the in-

depth interview. Using the words of some of the respondents; the first respondent said “some give us ones only and it use to be small”. Another one added that “it doesn't satisfy us”. They always provide us with type of food we don't like”.

Another added;

*“... Of the truth the feeding condition in this Camp is poor, the nutritional contents is inadequate. We can boost of having any good food as the condition is nothing to write home about.”*

*“...sustainable feeding condition in this camp should have been a safety net for the poor and eradicate malnutrition among us while stimulating the national economy, but reverse is the case...” (IDI)*

*Mr. Muhammed said that... “For the growing number of IDPs with a “double burden” of undernutrition and emerging obesity problems, well-designed feeding condition can help set people on the path towards healthier diets as dietary habits developed among individuals.*

**Table 2: Response on the feeding condition of the Internally Displaced Persons in Durumi camp**

Options	Frequency	Percentage
They eat three times daily	46	13.1%
They eat twice daily	72	20.6%
They are served balanced diet	28	8%
The food saved is lacking basic nutrients	104	29.7%
Not sufficient	100	28.5%
<b>Total</b>	<b>350</b>	<b>100</b>

**Source: field Survey, 2023**

Table 2 reveals that 46 respondents representing 13.1% said that they eat three times daily, 72 respondents representing 20.6% said they eat twice daily. However, 28 respondents representing 8% said they are served balanced diet, a majority of 104 respondents representing 29.7% said that the food saved is lacking basic nutrients while 28.5% of the respondents reported that the feeding condition is not sufficient. This shows that the feeding condition of the Internally Displaced Persons in Durumi camp lack basic nutrients. From the in depth interview said

*“...Evidence suggests that well-designed feeding condition can promote macronutrient and micronutrient adequacy in peoples' diets leading to enhanced nutrition and health, decreased morbidity, and increased healthy living”. Austin said that “The Meals saved lacked basic nutrients, which makes it difficult to eliminated daily protein deficiency and decreased calorie deficiency by almost 30% and daily iron deficiency by nearly 10% in the camp”.*

**Table 3: Response on the standard of accommodation of the Internally Displaced Persons in Durumi camp?**

Standard of accommodation	Frequency	Percentage
Very good	0	0%
Good	0	0%
Manageable	291	83.1%
Poor	59	16.8%
Undecided	0	0%
Total	350	100

**Source: Field Survey, 2023**

The table shows that 291 respondents representing 83.1% said that the standard of accommodation of the Internally Displaced Persons in Durumi camp is manageable while 16.8% said that the standard of accommodation in the camp is poor. This shows that most of the respondents said they are just managing their accommodation. This can be attributed to the various donations from religious organizations, non-governmental organization and other government institutions in the camp.

Responses from the in depth interview also corroborates the table above. The first respondent postulated that:

*“... when my parents asked us to run, we could not pick most of our good clothes, reaching here we have only what is our bodies. And the accommodation is in adequate as almost all of us are just but managing what we have since we can't go back home. Some people brought some tents to us although they don't size us perfectly due to our numbers in the camps... Another added that... accommodations are build by some members of religious organizations like churches and mosque....” (IDI)*

One of the female adolescent respondent from the indepth interview said;

*“...sure there are many families whose family members have to be sleeping with other families or to sleep outside as the accommodation are just not enough and good for a population of this nature. Most of the families suffer in the hand of authority that controls the camp. They force us every day to sleep in our tents despite the fact the know that the accommodations are not enough to contain us and yet nothing is done about it...” (IDI)*

One of the participants said:

*“...how can this place where no windows or doors, no bed be compared with my home?...” (IDI)*

Others said that

*“we feel as if we are living in prison, no freedom”. While some opine that “we be too much for this place, plenty of us the sleep for one room including women, children and men”. (IDI)*

**Table 4: Response on the conditions of the health facilities in the IDPs in Durumi camp**

Option	Frequency	Percentage
Very good	0	0%
Good	39	11.1%
Manageable	125	35.7%
Poor	158	45.1%
Undecided	28	8.1%
<b>Total</b>	<b>350</b>	<b>100</b>

**Source: Field Survey, 2023**

The table reveals that 39 respondent representing 11.1% of the population said that the health facilities in the IDPs in Durumi camp is good, 125 disagree with the statement by saying that the health facilities in the IDPs in Durumi camp is manageable. However, a majority of 158 respondents representing 45.1% of the people said the health facilities are poor while 8.1% are undecided about the conditions of health facilities in the camp. This shows that the condition of health facilities in the IDP camp is not good but manageable. This was further reiterated by respondents from the interview.

One of the participants said:

*“...the health facility in this camp is nothing to be compared with what is outside, we are only managing what is available, as the facilities does not have good medicinal staff and drugs...” (IDI)*

Others said that

*“...we feel as if we are working in prison, the health condition of the IDPs seem very bad as most cases that are been reported here in the facility is above our capacity, the facility lack basic equipment to handle and treat the people”. While some opine that “despite all effort even if we request for medical support the response seems very poor, as such we have to manage what we have”(IDI).*

Tanko said,

*“we don't get what we are in the health facility for, as most times we are asked to pay for our treatment which is not suppose to be, because of these most families result in staying back in their tents rather than going to the facility to beg and at the end nothing is done to help them as they can't afford for the treatment”.*



### **Major Findings**

From the above analysis the following are the research findings.

- i. It was revealed by this study that feeding condition in IDP camp Durumi is poor as food saved is lacking basic nutrients.
- ii. It was revealed by this study that the standard of accommodation of the Internally Displaced Persons in Durumi camp is manageable.
- iii. It was further revealed by this study that health facilities in the IDPs in Durumi camp are poor.

### **Conclusion**

This study has enhanced our understanding on the living conditions of internally displaced persons in Durumi Camp, and in view of findings of this study, it is clear that internally displaced persons have suddenly become a socio-economic problem which has thrown a lot of humanitarian challenge for our collective humanity.

Based on this, a conclusion could be made that, there is need for researchers to develop research problems that are grounded in the perspectives and experiences of people affected by displacement and whose findings remain relevant to policy. In other words, they must identify not only the right solutions but also the right questions that will put an end to internal displacement in Nigeria and the rest of the world.

Based on the research findings above, this study work recommends that:

From the above analysis the following are the research findings.

- i. The Nigerian state should put modalities in place towards checkmating the feeding condition of the Internally Displaced Persons in Durumi camp as lack of basic nutrients has led to many complications among family members. The government should provide basic feeding support such as rich food with good nutrient to support the growth and health of the people as lack of it may result to death.
- ii. The Federal Government of Nigeria and supporting agencies should put intensive policies in order to checkmate the excesses of government officials vested with the responsibilities of managing the IDPs in order to address the standard of accommodation of the Internally Displaced Persons in Durumi camp which is only manageable. There should be proper documentation of the IDPs to enable the government and other agencies know the nature of interventions and aids needed most especially as its concerns accommodation of the people.
- iii. The Federal Government of Nigeria in collaboration with the state government should build permanent health facility in the camps for the registered IDPs in order to facilitate healthy life and skillful human being among the internally displaced persons for the betterment of their life and the general society.

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## USING RADIATION DOSE PARAMETERS TO ASSESS RADIOLOGICAL HEALTH RISK IN NASARAWA STATE, NIGERIA

<sup>1</sup>Ocheje, J. A. <sup>2</sup>Ezekiel Y. A., <sup>3</sup>Alumuku L. C., & <sup>4</sup>Odoh C

<sup>1,2,3&4</sup>Department of Pure and Applied Physics,  
Federal University Wukari, Taraba State, Nigeria.

### **Abstract**

*In many developing countries like Nigeria, farmlands are contaminated by human activities like; mining, waste disposal, industrial waste, agricultural practices, use of inorganic fertilizers, sewage, sludge, and other anthropogenic activities that have affected man and the environment. In this research work, the activity concentrations of natural radionuclides, transfer factors (TF) from soil to crops, absorbed dose rate (ADR), and excess lifetime cancer risk (ELTCR) have been evaluated in soil and crop samples from twenty places in Nasarawa state, Nigeria. High purity Germanium (HpGe) detector was used to determine the activity concentration of radionuclides. The absorbed dose rate and ELTCR. The mean activity concentrations of  $^{40}\text{K}$ ,  $^{232}\text{Th}$ , and  $^{238}\text{U}$  in the soil samples were 408.69, 24.08, and 30.71 Bq kg<sup>-1</sup>, respectively, while the average activity concentration of  $^{40}\text{K}$ ,  $^{232}\text{Th}$ , and  $^{238}\text{U}$  in crop samples were 142.63, 46.06, and 17.45 Bqkg<sup>-1</sup>, respectively. The Raeq concentration, the external, and internal hazard indices were evaluated and ranged from 81.77 to 159.09 Bqkg<sup>-1</sup>, 0.22 to 0.43, and 0.28 to 0.53, with average values of 115.50, 0.31, and 0.40 Bqkg<sup>-1</sup>, respectively. The mean TF for  $^{40}\text{K}$ ,  $^{232}\text{Th}$ , and  $^{238}\text{U}$  of the study area were 0.053, 0.369, and 0.366, respectively. The mean for the ADR and annual outdoor effective dose equivalent in soil samples were 105.88 nGyh<sup>-1</sup> and 0.13 mSvy<sup>-1</sup>. The mean AEDR for the study area is higher than the safety limit. The ELTCR ranged from  $0.17 \times 10^{-3}$  to  $1.16 \times 10^{-3}$ , with a mean of  $0.46 \times 10^{-3}$ . This value is above the average value approved by UNSCEAR 2000. Analysis of  $^{238}\text{U}$  and  $^{232}\text{Th}$  recorded the highest soil to crop TF compared to  $^{40}\text{K}$  in the area. Correlation analysis showed a strong positive correlation between activity concentration of radionuclides in*

soil and crop for  $^{40}\text{K}$  and  $^{232}\text{Th}$  and a weak correlation for  $^{238}\text{U}$  due to soil type and microbial activities in most of the study area. To save the farmland from further pollution, organic manure should be encouraged, and instructions on the usage of inorganic fertilizer and agrochemical should be held strictly to avoid over-usage.

**Keywords:** Radionuclide, absorbed dose, transfer factor, excess lifetime cancer risk, activity concentration.

### Background to the Study

Terrestrial and cosmogenic radiations are the major sources of radioactivity in our world today, and it has affected the soil, crops, human, air, and water (Otwama *et al.*, 2013; Yousif *et al.*, 2017). These radionuclides come from natural sources like  $^{40}\text{K}$ , thorium, and uranium series, other sources are due to the use of radionuclides by man in agriculture, mining, medical science, manufacturers, and the use of nuclear weapons. (Yousif *et al.*, 2017). Over time, the environment is beginning to suffer negative effects from these radionuclides due to an increase in several human activities to meet up with the daily increasing need of a man in various sectors. The soil-to-plant transfer factor (TF) is very important when it has to do with the evaluation of the radionuclide activity concentration in crops, and that of an internal and external radiation dose as a result of consumption of food crops. Radionuclide TF of different radionuclides is influenced by some factors such as the physicochemical properties of the soil, the form in which the activity enters the soil, duration of radionuclide in soil, nature of soil, kind of the crop, agricultural practices, climate condition of the area, and the way the root tubers are prepared after harvested, like peeling root crops, washing, and exposure to sunlight (Asaduzzman *et al.*, 2014; Qureshi *et al.*, 2014). The level of radionuclide deposits within the soil can predict the degree of contamination in crops planted in a polluted area based on some physicochemical parameters analyses, but it cannot inform on the health effects of radiation exposure on individuals who consume these crops that have been polluted. Hence, the evaluation of doses is typically administered in investigating the health safety of persons undergoing radiation exposure through consumption of food that has been contaminated (Qureshi *et al.*, 2014). The absorption rate of radionuclide by a human via food consumption is a function of the number of activity concentrations in crops via root uptake, and the quantity of contaminated food consumed over time which eventually deposits these radionuclides into organs and body parts, resulting in health challenges.

Nasarawa State is an agricultural state with increasing human activities and natural disasters that may have environmental pollution challenges because of the high level of mining activities within the area, use of agro-chemical, fertilizer application for agricultural purposes, indiscriminate waste disposal, and erosion. Agricultural produce like yam, maize, cassava, etc., from polluted areas, may accumulate to become an immediate source of radiation to the community if not checked (Ononugbo *et al.*, 2019). The State is rapidly growing in agriculture, industrialization, and human population (6). Hence, the knowledge of radioactivity levels in grown food crops within the study area is extremely important to determine the dose received by humans.

### **Study Areas**

Nasarawa State is located within the North central part of Nigeria. It is found on lat.  $7^{\circ} 45'$  and  $9^{\circ} 25'$  N of the equator, and long.  $7^{\circ}$ , and  $9^{\circ} 37'$  E of the GM. The state is surrounded by many States; Kaduna State, Plateau State, Taraba State, Federal Capital Territory, Benue State, and Kogi State. The State features a total acreage of 26,875.59 Km<sup>2</sup> and the population of people in the area according to the population census report 2006, was about 1,826,883 having a density of 67 persons/km<sup>2</sup>. The topography of the State is majorly hilly and plain lowlands. The climate condition of the area is typical of the Torrid Zone due to its location. The State has a high and low temperature of 81.7° F and 16.7° F respectively. The rainfall of the State ranges from 131.73 to 145cm, depending on the area.

### **Collection of Samples**

Soil samples were collected to a depth of about 20-30 centimeters following the generally accepted method by IAEA, 2010. This is often to incorporate the surface layer like the rooting zones. The soil mixed into a uniform sample for the entire zone. A total of forty (40) samples were collected for both soil and crops sample as well.

### **Soil Samples**

A total of twenty (20) different soil samples were collected. The topsoil samples were collected (about 20-30 cm deep) from each location. About one kilogram of soil sample was packed and put in a nylon bag tied and labeled with masking tape. The soil samples were pounded to fine particles, sieved (removing large pieces), and mixed for homogenization. The Samples were dried at about 110 °C for twenty-four hours to get a steady weight. A mass of about 0.5kg of the soil sample from each sampling point was placed using a Marinelli beaker, sealed, and stored for a period of twenty-eight days at 37°C to permit secular equilibrium between parent nuclides, and daughter nuclides before using the HPGe detector.

### **Crop Samples**

About one kilogram of every crop was collected from every location and put in nylon bags, labeled, and taken to the laboratory. These crops were collected as they mature. A total of twenty (20) food crops (yam, maize, beans, and cassava) were collected and emptied into a nylon bag, tied, and labeled. The food crop that is a tuber was first washed under running water to get rid of all the attached sand and mud particles before it was peeled and then dried in air. The Samples were further weighed and dried in the oven at about 110 °C for twenty-four hours to get constant dry weight. Samples were packed and grounded for homogenization. About 500 g of every sample were packed into one liter of Marinelli beaker and sealed for four (4) weeks to succeed in secular equilibrium between parent nuclei with their daughter nuclei. This was wiped out to permit all radionuclides and their short-lived progenies to succeed in secular radioactive equilibrium before gamma spectroscopy. Samples were placed within the HPGe detector for analysis to identify the varied energy levels within the spectrum. With the help of the detector, the activity concentrations of radionuclides were evaluated.

### Estimation of Soil-to-plant Transfer Factor (TF)

The depth of soil used ranges from 20 to 25 cm to cover the rooting zone. The transfer factor (TF) was estimated using (Tuovinen *et al.*, 2011):

$T_{fp} = \frac{\text{Activity concentration of radionuclides in plant dry matter}}{\text{Activity concentration of radionuclides deposit in soil dry mass}}$  (1)

Where  $T_{fp}$  is the transfer factor of activity to crop.

### Radiation Hazard Index

The internal and external hazard indices are defined (Alharbi and El-Taher, 2013) as;

Internal hazard index ( $H_{int}$ );  $H_{int} = A_k 4810 + A_u 185 + A_{th} 259 \leq 1$  (2a)

External hazard index ( $H_{ext}$ );  $H_{ext} = A_k 4810 + A_u 370 + A_{th} 259 \leq 1$  (2b)

The  $H_{ext}$  index is obtained from the expression of Raeq via the idea that its highest allowed values agree with the upper limit of Raeq ( $370 \text{ Bqkg}^{-1}$ ) to limit the radiation dose of  $1.5 \text{ mSv/y}$ . The radiation hazard is considered significant only when the index value is up to one.

### Dose evaluation

#### Absorbed dose rate (ADR)

The ADR in the air of farmlands was evaluated, considering the effect of radiation on humans above one meter from the ground of the polluted area. The expression used was given by (UNSCEAR, 2000);

$AD (nGyh^{-1}) = 0.462 A_u + 0.604 A_{th} + 0.0417 A_k$  (3)

where  $A_k$ ,  $A_u$ , and  $A_{th}$  are the specific activities ( $\text{Bqkg}^{-1}$ ) for  $^{40}\text{K}$ ,  $^{238}\text{U}$ , and  $^{232}\text{Th}$ , respectively. The conversion factors of concentration to dose are 0.0417, 0.462, and 0.604, respectively.

#### Annual effective dose rate (AEDR)

The yearly effective dose rate of any considered persons was estimated using the conversion coefficient from the absorbed dose rate in the air to the effective dose given as ( $0.7 \text{ SvG}^{-1}$ ) and taking into consideration the outdoor occupancy factor of (0.2), therefore the indoor occupancy factor (0.8) (UNSCEAR, 2000). The outdoor AED is obtained from the expression (UNSCEAR, 2000);

$\text{Outdoors AEDR (mSvy}^{-1}) = AD (nGyh^{-1}) \times (8760h) \times (0.7 \text{ SvG}^{-1}) \times (0.2)$  (4)

#### Excess lifetime cancer risk (ELTCR)

The ELTCR of a person living or working in a contaminated area is the probability of that person developing cancer over a lifetime considering the level of exposure to radionuclides. These determined using (Taskin, *et al.*, 2009);

$ELTCR = AED (usvy) \times AL \times RF$  (5)

where; ELTCR is the excess lifetime cancer risk, AEDR is the annual effective dose rate, AL is the average lifetime, RF is the risk factor (0.05). The world average of ELTCR was pegged at  $0.299 \times 10^{-3}$ .

### Statistical Analysis

Graphs of variations in the activity of crop and soil and transfer factors were plotted for the study area. Correlation analyses were also carried out between activity concentration in the



soil and the activity concentration in food samples using SPSS software to determine the extent to which the variations in activity concentration in the soil affects the variation of activity concentration in food crops using the coefficient of determination. Regression analyses were evaluated to ascertain the linearity of TF, and activity of radionuclide in soil.

## Results and discussion

### Activity concentration in Soil and Crop

The average activity concentration of  $^{40}\text{K}$  in soil shows wide distribution from the results of the study area. The activity concentration of  $^{40}\text{K}$  ranges from 309.4 to 569.3  $\text{BqKg}^{-1}$ , with an average value of 408.7  $\text{BqKg}^{-1}$ , which is a little above the world average value of 400  $\text{BqKg}^{-1}$ .  $^{232}\text{Th}$  ranges from 16.8 to 29.6  $\text{BqKg}^{-1}$  with an average value of 24.08  $\text{BqKg}^{-1}$ , which is below the world average. The activity concentration for  $^{238}\text{U}$  in the area ranges from 22.8 to 48.3  $\text{BqKg}^{-1}$ , with an average value of 30.70  $\text{BqKg}^{-1}$  (Table 2 and Figure 3), this is also below the world average value. The lower value of radionuclide ( $^{232}\text{Th}$ , and  $^{238}\text{U}$ ) observed in this zone could be as a result of frequent flooding and erosion as observed and complained by the farmers of the area during interactions with them. The washing away of the topsoil could also reduce the level of radionuclides in the soil.

Activity concentration of radionuclides in crops for  $^{40}\text{K}$  ranges from 16.56 to 298.22  $\text{BqKg}^{-1}$ , with an average value of 127.59  $\text{BqKg}^{-1}$ . The value for  $^{232}\text{Th}$  ranges from 8.67 to 288.66  $\text{BqKg}^{-1}$ , with an average value of 46.06  $\text{BqKg}^{-1}$ , and the activity concentration of  $^{238}\text{U}$  ranges from 16.24 to 19.23  $\text{BqKg}^{-1}$ , with an average value of 17.45  $\text{BqKg}^{-1}$  (Table 3). The activity concentrations in crops were all above the safety limit for Crops in the tropical environment. This could be a result of the use of agrochemicals and fertilizers in farmland and possible contamination of crops from the environment (ambient radiation) and the type of soil (Ocheje and Wansah, 2018), Doma area has more clay soils and that could contribute to uptake by Crops (Table 1). Comparing the output of the activity concentration in soil of the area to the activity concentration in crops with the approved limit by IAEA, the crops show higher values of radionuclide absorption. This implies that the levels of radioactivity in crop samples in the study areas may pose a radiological hazard when such food is ingested directly.

**Table 1: Physico-chemical Properties of Agricultural Soils in Nasarawa State Locations**

LGA	Clay(%)	Silt(%)	Sand(%)	pH level	Organic matter (%)
Lafia	14 - 25	20 - 35	70 - 78	5.6 - 6.8	0.48 - 1.06
Akwanga	20 - 26	32 - 41	55 - 72	5.6 - 6.2	0.88 - 1.26
N/Eggon	8 - 10	10 - 15	74 - 82	4.8 - 6.8	0.46 - 0.68
Doma	28 - 45	18 - 25	50 - 65	4.5 - 6.4	0.68 - 1.88

**Table 2: Average activity Concentration of Soil Sample in Nasarawa State**

LGA	N	<sup>238</sup> U(BqKg <sup>-1</sup> )	<sup>232</sup> Th(BqKg <sup>-1</sup> )	<sup>40</sup> K(BqKg <sup>-1</sup> )
Lafia	5	24.8007	16.75	309.395
Keffi	5	26.8233	22.115	569.33
N/eggong	5	22.91	27.82	389.7075
Doma	5	48.2967	29.6267	366.3375
Mean	30.7077 ± 5.92	24.0780 ± 2.92	408.6925 ± 56.14	

**Table 3: Average activity Concentration of Crop Sample in Nasarawa State**

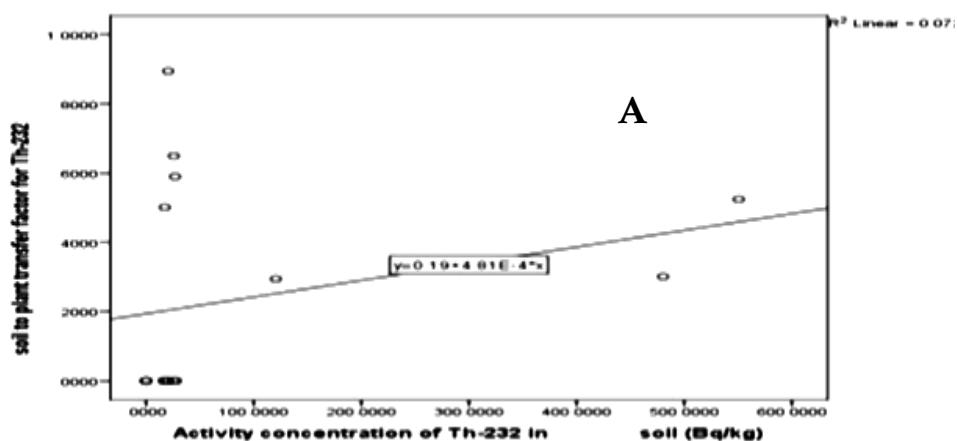
LGA	N	<sup>238</sup> U(BqKg <sup>-1</sup> )crp	<sup>232</sup> Th(BqKg <sup>-1</sup> )crp	<sup>40</sup> K(BqKg <sup>-1</sup> )crp
Lafia	5	16.78	8.67	142.6375
Keffi	5	17.28	16.67	221.135
N/eggong	5	18.045	17.08	126.975
Doma	5	17.7	141.8	19.6
Mean	17.4513 ± 0.27	46.055 ± 31.97	127.5869 ± 41.47	

**Table 4: Average Transfer Factor from Soil to Crops of the Sample Area LGA**

Location	TF(U)	TF(Th)	TF(K)
Lafia	0.73968	0.482202	0.329113
Keffi	0.644215	0.753787	0.388413
N/Eggong	0.453478	0.363288	0.335358
Doma	0.366485	0.369431	0.053503

**Table 5: Radiological hazard indices of soil Samples Nasarawa State**

Locations	Absorbed dose(nGy/h)	AEDR(uSv/h)x 10 <sup>-3</sup>	Raeq(Bq/kg)	ELTCR (x 10 <sup>-3</sup> )		
Lafia	40.063501	0.049161922	81.7687	0.2208	0.2822	0.172066727
Keffi	50.344896	0.061778222	102.2862	0.2763	0.3487	0.216223777
N/Eggong	63.13782906	0.07747643	159.0914	0.4296	0.5261	0.271167505
Doma	269.9741547	0.331285285	118.8708	0.3211	0.4516	1.159498498
mean	105.8801±	0.1299 ± 0.07	115.5043 ±	0.3120±0.04	0.4022±0.05	0.4547 ±
	4.9		16.39			0.23



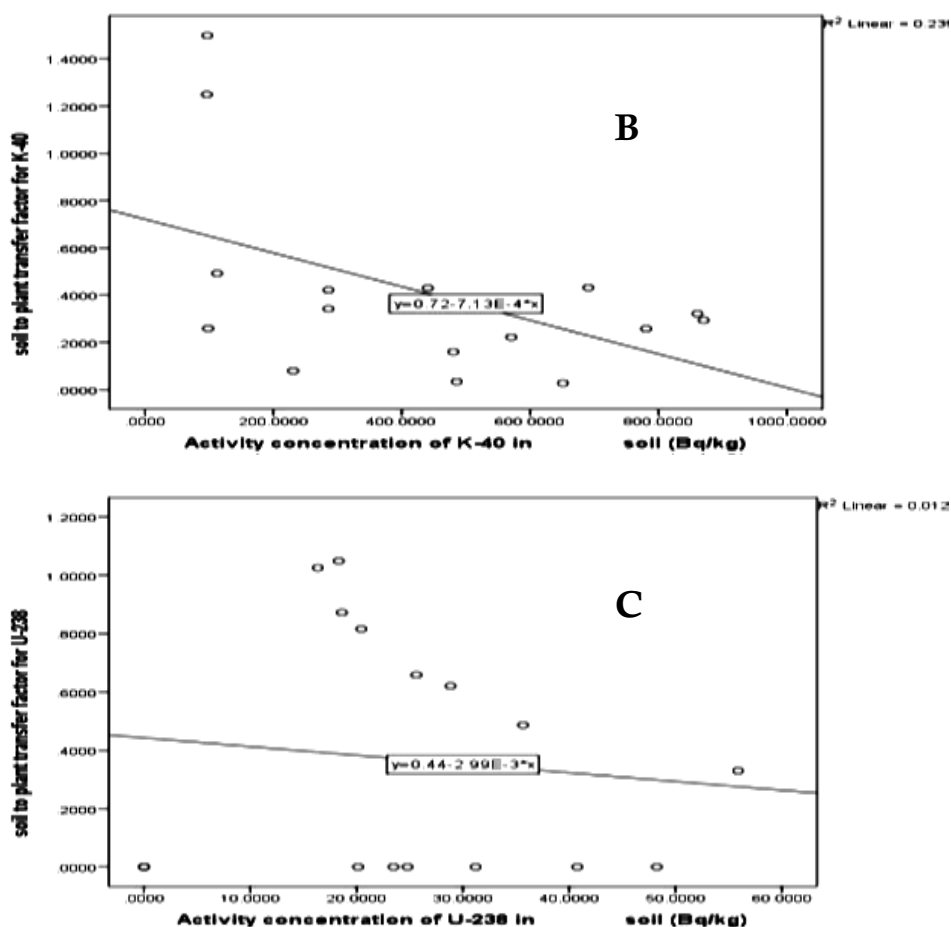


Figure 2: Regression linearity analyses of TF and activity of radionuclides (a, band c)

### Conclusion

The activity concentration in soil, and crop samples, and the TF of soil to the crop has been evaluated for 20 locations in Nasarawa state, Nigeria. The mean activity concentration of  $^{40}\text{K}$ ,  $^{232}\text{Th}$ , and  $^{238}\text{U}$  in the soil samples were 408.69, 24.08, and 30.71  $\text{Bq kg}^{-1}$ , respectively, while the average activity concentration of  $^{40}\text{K}$ ,  $^{232}\text{Th}$ , and  $^{238}\text{U}$  in crop samples were 142.63, 46.06, and 17.45  $\text{Bqkg}^{-1}$ , respectively. The  $R_{\text{req}}$  concentration, the  $H_{\text{ext}}$ , and  $H_{\text{int}}$ . Hazard indices were estimated and ranged from 81.77 to 159.09  $\text{Bqkg}^{-1}$ , 0.22 to 0.43, and 0.28 to 0.53, with average values of 115.50, 0.31, and 0.40  $\text{Bqkg}^{-1}$ , respectively. The average soil to crop TF for  $^{40}\text{K}$ ,  $^{232}\text{Th}$ , and  $^{238}\text{U}$  were 0.053, 0.369, and 0.366, respectively. The mean ADR and the mean AEDR in soil samples were 105.88  $\text{nGyh}^{-1}$  and 0.13  $\text{mSvy}^{-1}$ , respectively. The mean AEDR for the study area is higher than the world average (0.07  $\text{mSvy}^{-1}$ ) and 0.1  $\text{mSvy}^{-1}$  recommended by internal standards. The result available from this research work states that the activity concentration of radionuclides in crops is not solely a function of the number of radionuclide deposits in the soil. These imply that other factors contribute to the activity concentration of radionuclides in crops like ambient radiations, type of crops, climatic conditions, fertilizers

applied directly at the root region of crops, agrochemicals used for weeding, duration of crops in soil, and the type of crop (cereal, vegetable or tubers). Hazard indexes for both the external and internal indices evaluated show no significant radiation effect on farmers working in the farmlands of the study areas.

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## ASSESSMENT OF RADIONUCLIDE ACTIVITY CONCENTRATION OF CASSAVA (*MANIHOT ESCULENTA*) AND YAM (*DIOSCOREA ALATA*) OBTAINED FROM SOME FARM LANDS IN BENUE STATE, NIGERIA

<sup>1</sup>Ocheje J. A. & <sup>2</sup>Alumuku L. C

<sup>1&2</sup>Department of Pure and Applied Physics.

Federal University Wukari, Wukari, Taraba State, Nigeria

### **Abstract**

*One of the major sources of human exposure to radionuclides could be from ingestion of food crops grown on contaminated soil. This work is aimed at assessing the level of health risk associated with the intake of  $^{238}\text{U}$ ,  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$  in yam and cassava cultivated in farmlands in Ukum local Government area of Benue State. The activity concentration of naturally occurring radionuclides in the samples, were measured using a High Purity Germanium (HPGe) Detector. The mean activity concentrations of radionuclides in yam were  $2.81 \pm 0.42$  Bq/kg,  $1.02 \pm 0.36$  Bq/kg,  $0.82 \pm 0.15$  Bq/kg and  $335.23 \pm 17.20$  Bq/kg for  $^{238}\text{U}$ ,  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$  respectively. Mean activity concentrations of radionuclides in cassava were  $3.29 \pm 0.46$  Bq/kg,  $1.15 \pm 0.29$  Bq/kg,  $1.38 \pm 0.18$  Bq/kg and  $272.65 \pm 14.40$  Bq/kg for  $^{238}\text{U}$ ,  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$  respectively. The estimated mean values of external hazard index ( $H_{\text{ex}}$ ) and internal hazard index ( $H_{\text{in}}$ ) were 0.08, 0.07 and 0.11, 0.08 respectively in cassava and yam respectively. The estimated mean values of gamma absorbed dose rate in yam and cassava were  $15.71 \text{ nGy. yr}^{-1}$  and  $13.66 \text{ nGy. yr}^{-1}$  respectively. The mean values of Annual effective dose (AED) due to consumption of cassava and yam were  $0.070 \mu\text{Sv yr}^{-1}$  and  $0.186 \mu\text{Sv yr}^{-1}$ , respectively. The mean estimated values of excess lifetime cancer risk due to consumption of cassava and yam were 0.00019 and 0.00022, respectively. The values obtained for the radiological doses for the yam and cassava samples were below the world recommended values. It is recommended that farmers should be educated to only apply the right types and quantities of fertilizers to soil in order to check*

*further increases in concentration levels of these radionuclides in soil and plants.*

**Keywords:** Activity Concentration, Radionuclides, Health Risk, Yam, Cassava.

### **Background to the Study**

Radioactive materials circulate through the biosphere and end up in the air, water, grasses and vegetables. Plants are therefore exposed to radioactive substances through environmental contamination and grazing on contaminated forage (Ajayi *et al.*, 2009). Most human activities include the introduction of heavy metals into a plant environment in the form of phosphate fertilizers applied on lands. Rock phosphates contain high levels of uranium, radium and thorium which can result in higher soil, outdoor air, and groundwater content of radon which is a decay product of Uranium. Radionuclides accumulated in arable soil can be incorporated metabolically into plants and eventually get transferred into the bodies of animals when contaminated forages are eaten (Qureshi *et al.*, 2014)

Indirect sources of radiation can also result from the use of well or ground water that contains radon or any. Naturally occurring radionuclides of  $^{238}\text{U}$ ,  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$  have significant contributions in the ingestion dose and are present in the biotic system of plants, animals, soil, water and air. Distribution of radionuclides in different parts of the plant depends on the chemical characteristics and several parameters of the plants and soil (Markovic and Stevovic, 2019).

Contamination of the food chain occurs as a result of direct deposition of radionuclides on the plant leaves, root uptake from contaminated soil or water, and animals ingesting contaminated plants, soil or water. Ingestion of food crops grown in contaminated soil can be a major source of human exposure to radionuclides since it can lead to internal radiation doses.

Yam (*Dioscorea alata*) is a tuber commodity which is largely consumed by people living in Benue State. It is used to make different delicacies such as the common white soup and pounded yam within the study area. Cassava (*Manihot esculenta*) is a root crop that is commonly grown and it provides a major staple food in the study area. Cassava tubers in its raw form is processed into garri and other forms of delicacies which is a common food consumed by people living in Akwa Ibom State. Since radionuclides are naturally available in soil and can also be enhanced by man through activities such as successive application of phosphate fertilizers and pesticides, mining and milling operations, burning of fossil fuels amongst others, it is therefore necessary to know the uptake of natural radionuclides by the plant from the soil (Jibril *et al.*, 2007). Some works have been done on the level of radionuclide concentration in some consumables, but not much has been done on radionuclide uptake by yam and cassava from soils in Akwa Ibom State. This work is aimed at assessing the level of health risk associated with the intake of  $^{238}\text{U}$ ,  $^{226}\text{R}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$  in yam and cassava obtained from farmlands in Benue State.

## Materials and Method

### Study Area

The study area covered selected Local Government Areas (LGA) of Benue State. Benue State is one of the North Central states in Nigeria with a population of about 4,253,641 in 2006 census. The state derives its name from the Benue River which is the second largest river in Nigeria after the River Niger. The state borders Nasarawa State to the North; Taraba State to the East; Kogi State to the West; Enugu State to the South-West; Ebonyi and Cross River State to the South; and has an international border with Cameroon to the South-East. It is inhabited predominantly by the Tiv, Idoma and Iggede. Minority ethnic groups in Benue are Etulo, Igbo, Jukun peoples etc. Its capital is Makurdi.<sup>[7]</sup> Benue is a rich agricultural region; popularly grown crops include: oranges and mangoes, sweet potatoes, cassava, soya bean, guinea corn, flax, yams, sesame, rice, groundnuts, and Palm Tree.

### Sample Collection and Preparation

Sample sites were selected from cultivated farmlands in the study area. Some factors considered in selection of sample sites include: farmlands where highly-consumed crops were cultivated; and farmlands cultivated for both subsistence and small-scale commercial purposes. The type of pesticide used if any were noted, fertilizers used were also noted, whether organic or inorganic fertilizers.

Plant samples collected were thoroughly washed with tap water, cassava and yam samples were peeled, and then all plant samples were washed in distilled water to remove surface sand and debris (Jwanbot *et al.*, 2013). The samples were then cut into small pieces and exposed to ambient air in a dust-free environment before being dried to a constant weight for 48 hours in a monitored oven maintained at 150°C in the laboratory. The samples were then ground to powdery form, sieved and then weighed. The weight of the plant samples varied between 220g and 300g.

### Method for Sample Analysis

The prepared yam and cassava samples were taken to National Institute of Radiation Protection and Research in University of Ibadan for analysis. The activity concentration of naturally occurring radionuclides in the samples were measured using a High Purity Germanium (HPGe) Detector. The HPGe used was manufactured by Canberra, model GC 8023 with serial number 9744. It is coupled to a pre amplifier, model 2002CSL with serial number 13000742. The standard source used for calibration was Multi-Gamma Ray Standard (MGS6M315). The detector has a resolution (FWHM) of 2.3Kev, <sup>60</sup>Co at 1.33 Mev with relative efficiency of 80%. The software used for analysis was Genie 2K.

### Activity Concentration in Samples

The activity concentration (AC) in unit of Bq kg<sup>-1</sup>, for the radionuclides present in the yam and cassava samples with

$$C = \frac{N_t}{T P_y E M} \quad (1)$$



Where C is the activity concentration of radionuclides in Bq kg<sup>-1</sup>, N<sub>t</sub> is the net count under corresponding photo peak, T is the counting time in seconds, P<sub>r</sub> gamma intensity of specific gamma-ray, ε absolute efficiency, and M mass of sample in (kg), respectively. The world recommended value for AC in the samples for <sup>238</sup>U, <sup>226</sup>Ra, <sup>232</sup>Th, and <sup>40</sup>K are 35 Bq/kg, 35 Bq/kg, 30 Bq/kg and 400 Bq/kg, respectively (UNSCEAR, 2000)

### Annual Effective Dose

The Annual effective dose received by the public from the consumption of the cassava and yam samples was estimated using Equation (2) (Ajayi and Adesida, 2009).

$$\text{Total AED} = \sum A_i \times \text{DCf}_i \times C_r \quad (2)$$

A<sub>i</sub>(Bq/kg) is the specific activity of radionuclide i, DCf<sub>i</sub> (mSv/Bq) is the dose conversion factor of radionuclide i, C<sub>r</sub> (kg.yr<sup>-1</sup>) is the annual consumption rate of the samples. The DCf values are 2.8 × 10<sup>-7</sup>; 4.5 × 10<sup>-8</sup>; 2.3 × 10<sup>-7</sup> and 6.2 × 10<sup>-9</sup> Sv/Bq for <sup>226</sup>Ra, <sup>238</sup>U, <sup>232</sup>Th and <sup>40</sup>K, respectively (IAEA, 1994)

### Excess lifetime Cancer Risk (ELCR)

The excess lifetime cancer risk (ELCR) associated with the consumption of the radionuclides in the cassava and yam samples were calculated using Equation (3) (Thabayneh and Jazzar, 2012). This was to determine the potential carcinogenic effects of the long-term consumption of these samples (UNSCEAR, 2000)

$$\text{ELCR} = \text{AED} \times \text{RF} \times \text{DL} \quad (3)$$

Where AED is the annual effective dose, DL is the duration of life (55 years) and RF is the fatal cancer risk factor which is 0.05 for the public (UNSCEAR,2000). The ELCR recommended world mean value is 0.0029 (UNSCEAR,2000).

### Gamma Absorbed Dose Rate (D)

The external terrestrial gamma absorbed dose rate in air was calculated by using (4) (ICRP,1994).

$$D (\text{nGy.y}^{-1}) = (R_K \times A_K) + (R_U \times A_U) + (R_{Th} \times A_{Th}) \quad (4)$$

Were R<sub>K</sub> (0.0414), R<sub>U</sub> (0.462) and R<sub>Th</sub> (0.604) are the conversion factors for <sup>40</sup>K, <sup>238</sup>U and <sup>232</sup>Th, respectively (ICRP, 1994). A<sub>K</sub>, A<sub>U</sub> and A<sub>Th</sub> are the activity concentrations of <sup>40</sup>K, <sup>238</sup>U and <sup>232</sup>Th, respectively, in Bq.kg<sup>-1</sup>.

### External (Hex) and Internal (Hin) Hazard Indices

The external hazard index (H<sub>ex</sub>) and internal hazard index (H<sub>in</sub>) values were calculated using Equations (5) and (6) (ICRP, 1996). These are hazard indicators that predict the external and internal detriment of natural radiation from <sup>40</sup>K, <sup>238</sup>U and <sup>232</sup>Th.

$$H_{\text{ex}} = 0.0027A_U + 0.00386A_{Th} + 0.000208A_K \quad (5)$$

$$H_{\text{in}} = 0.0054A_U + 0.00386A_{Th} + 0.000208A_K \quad (6)$$

Where A<sub>U</sub>, A<sub>Th</sub> and A<sub>K</sub> are the activity concentrations of <sup>238</sup>U, <sup>232</sup>Th and <sup>40</sup>K in Bq.kg<sup>-1</sup> respectively.

## Results and Discussion

### Activity Concentration in yam and cassava samples

The activity concentration of  $^{238}\text{U}$ ,  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$ , and  $^{40}\text{K}$  in the yam and cassava samples is presented in Tables 1 and 2 while the average annual consumption rates is presented in Table 3

**Table 1: Activity concentration of  $^{40}\text{K}$ ,  $^{226}\text{Ra}$ ,  $^{238}\text{U}$  and  $^{232}\text{Th}$  in  $\text{Bq.kg}^{-1}$  for the yam samples from the study areas.**

LGA	SAMPLE CODES	$^{238}\text{U}$	$^{232}\text{Th}$	$^{90}\text{K}$	
Gboko	Y <sub>1</sub>	BDL	BDL	261.20±13.82	
	Y <sub>2</sub>	BDL	0.66±0.07	175.23±9.27	
	Mean	BDL	0.33±0.03	218.21±11.54	
Ukum	Y <sub>3</sub>	7.42±1.53	1.00±0.19	566.30±29.96	
	Y <sub>4</sub>	4.10±0.60	BDL	473.56±25.05	
	Y <sub>5</sub>	11.44±1.25	3.95±0.73	0.33±0.13	355.77±18.82
Logo	Y <sub>6</sub>	BDL	2.44±1.08	1.16±0.30	371.86±19.67
	Mean	5.74±0.84	2.21±2.87	0.62±4.86	441.87±23.37
	Y <sub>7</sub>	BDL	ND	3.40±0.50	381.92±20.21
	Y <sub>8</sub>	BDL	BDL	BDL	95.97±5.08

**Table 2: Activity concentration of  $^{40}\text{K}$ ,  $^{226}\text{Ra}$ ,  $^{238}\text{U}$  and  $^{232}\text{Th}$  in  $\text{Bq.kg}^{-1}$  for the cassava samples from the study areas.**

LGA	SAMPLE CODES	$^{238}\text{U}$	$^{226}\text{Ra}$	$^{232}\text{Th}$	$^{90}\text{K}$
Gboko	C <sub>1</sub>	BDL	2.02±0.66	2.16±0.28	256.57±13.57
	C <sub>2</sub>	5.72±0.98	ND	0.32±0.09	137.55±7.32
	Mean	2.86±0.49	1.01±0.33	1.24±0.18	197.06±10.44
Ukum	C <sub>3</sub>	BDL	BDL	BDL	59.70±3.16
	C <sub>4</sub>	ND	ND	2.76±0.33	583.64±30.87
	Mean	BDL	BDL	1.38±0.16	321.67±17.01
Logo	C <sub>5</sub>	10.12±1.24	ND	0.96±0.21	228.88±12.11
	C <sub>6</sub>	BDL	3.21±0.93	2.70±0.33	426.37±22.55
	Mean	5.06±0.62	1.60±0.46	1.83±0.27	327.62±17.33

BDL = Below Detection Limit, ND= not detected

**Table 3: Average annual consumption rates of yam and cassava samples from the study areas.**

Samples	Daily Consumption (g)	Frequency per week	(frequency/7)	Annual Rate ( $\text{kg.yr}^{-1}$ )
Yam	250	2	0.28	26.00
Cassava	300	5	0.71	78.00

### Radiological Health Risk Assessment of $^{238}\text{U}$ , $^{226}\text{Ra}$ , $^{232}\text{Th}$ and $^{40}\text{K}$ in the yam and cassava Samples.

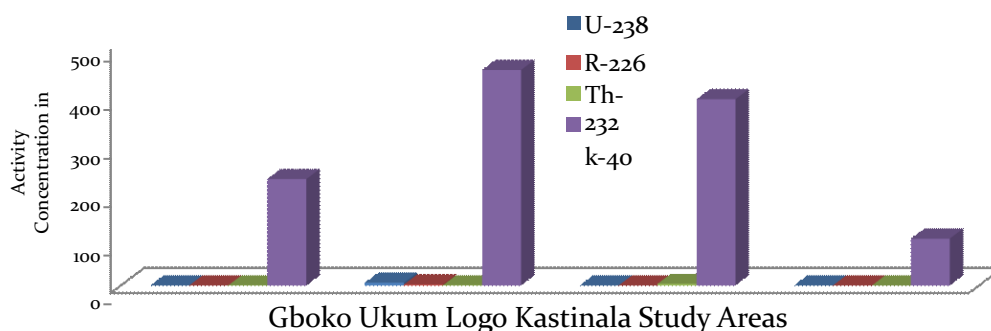
The health risk was assessed based on the estimated values of D, ELCR, Hex, Hin and Total AED for the yam and cassava samples as presented in Tables 4 and 5 respectively. Figures 1 through 8, shows the level of distribution of the various radiological doses in the yam and cassava samples.

**Table 4: Estimated values of D, ELCR, Hex , Hin and Total AED for the yam samples from the study areas.**

SAMPLE CODES	D (nGy.y <sup>-1</sup> )	ELCR	Hex	Hin	Total AED (μSv.yr <sup>-1</sup> )
Y1	10.84	0.00012	0.05	0.23	0.042
Y2	7.66	0.00009	0.04	0.05	0.032
Y3	27.48	0.00029	0.14	0.04	0.106
Y4	21.52	0.00027	0.11	0.16	0.099
Y5	20.21	0.00028	0.10	0.12	0.101
Y6	16.10	0.00023	0.08	0.13	0.085
Y7	17.87	0.00024	0.09	0.08	0.082
Y8	3.99	0.00004	0.02	0.09	0.016
Mean	15.71	0.00019	0.08	0.11	0.070

**Table 5: Estimated values of D, ELCR, Hex, Hin and Total AED for the cassava samples from the study areas.**

SAMPLE CODES	D (nGY. y <sup>-1</sup> )	ELCR	Hex	Hin	Total AED (μSv.yr <sup>-1</sup> )
C1	11.93	0.00057	0.06	0.02	0.207
C2	8.53	0.00026	0.04	0.06	0.093
C3	2.49	0.00008	0.01	0.06	0.030
C4	25.83	0.00091	0.13	0.01	0.332
C5	14.73	0.00045	0.08	0.13	0.164
C6	19.29	0.00089	0.10	0.10	0.325
C7	15.40	0.00068	0.08	0.10	0.249
C8	22.30	0.00101	0.12	0.11	0.369
C9	7.31	0.00026	0.04	0.15	0.096
C10	15.05	0.00051	0.08	0.04	0.184
C11	7.45	0.00024	0.04	0.08	0.088
Mean	13.66	0.00022	0.07	0.08	0.186



**Figure 1: Distribution of the mean activity concentration in Bq.kg<sup>-1</sup> of the yam Samples from the study areas.**

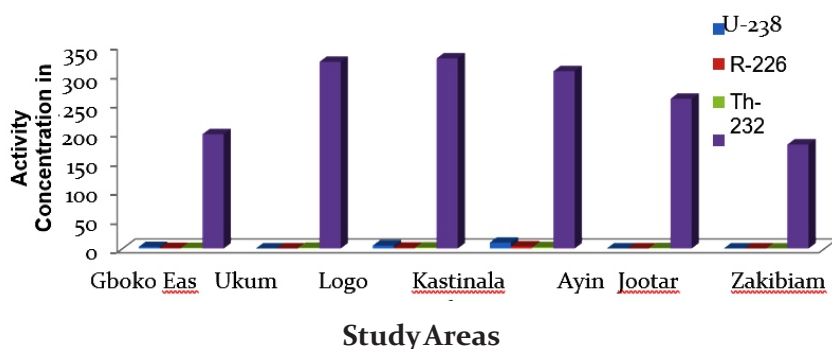


Figure 2: Distribution of the mean activity concentration in Bq.kg<sup>-1</sup> of the cassava Samples from the study areas.

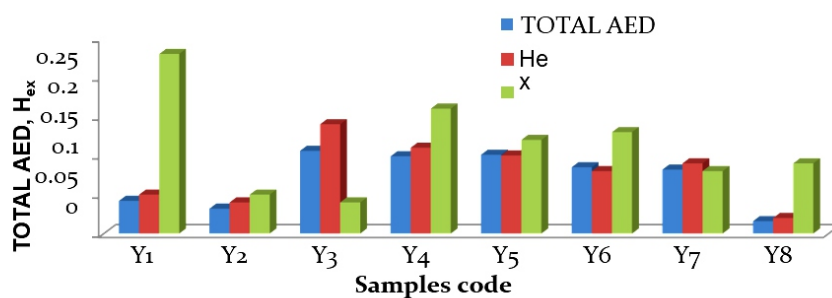


Figure 3: Distribution of the total AED ( $\mu\text{Sv.yr}^{-1}$ ), Hex and Hin of the yam samples from the study areas.

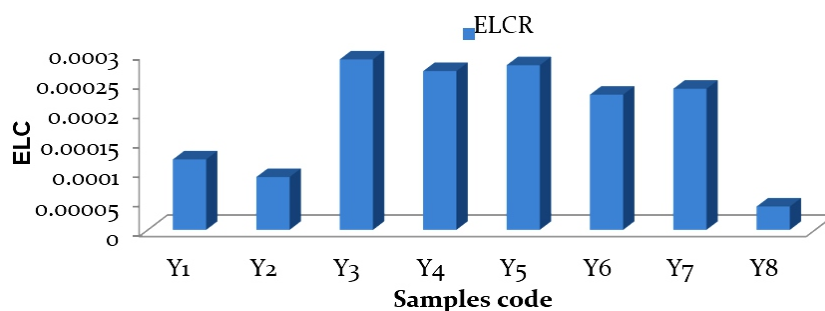


Figure 4: Distribution of the excessive life time cancer (ELCR) risk of the yam samples from the study areas.

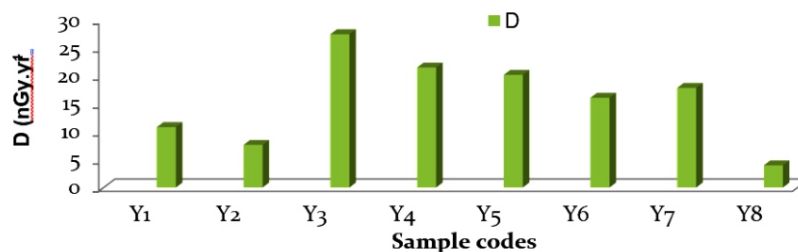


Figure 5: Distribution of the gamma dose rate (nGy.yr<sup>-1</sup>) of the yam samples from the study areas.

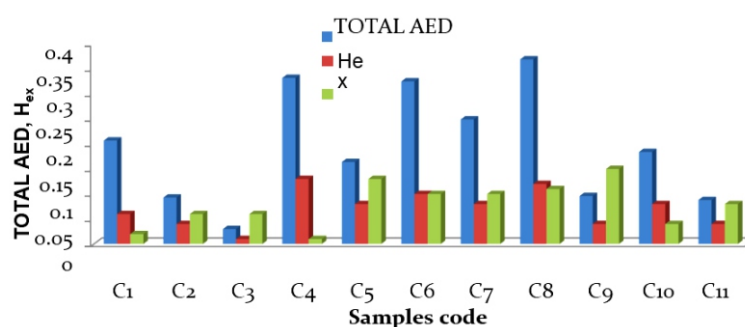


Figure 6: Distribution of the total AED (μSv.yr<sup>-1</sup>), Hex and Hin of the cassava samples from the study areas.

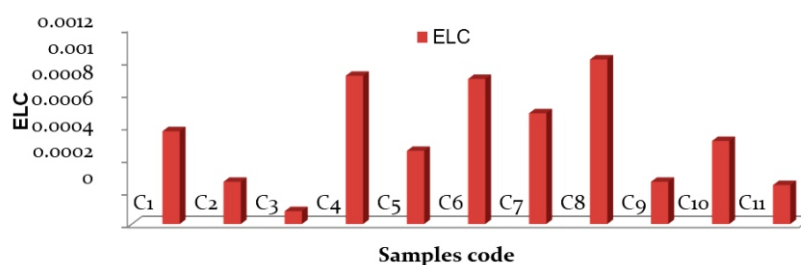


Figure 7: Distribution of the excessive life time cancer (ELCR) risk of the cassava samples from the study areas.

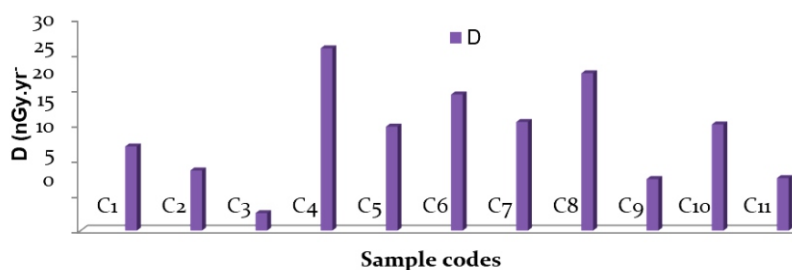


Figure 8: Distribution of the gamma dose rate (nGy.yr<sup>-1</sup>) of the cassava samples from the study areas.

## Discussion

The mean activity concentrations of radionuclides in yam were  $2.81 \pm 0.42$  Bq/kg,  $1.02 \pm 0.36$  Bq/kg,  $0.82 \pm 0.15$  Bq/kg and  $335.23 \pm 17.20$  Bq/kg for  $^{238}\text{U}$ ,  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$  respectively. Mean activity concentrations of radionuclides in cassava were  $3.29 \pm 0.46$  Bq/kg,  $1.15 \pm 0.29$  Bq/kg,  $1.38 \pm 0.18$  Bq/kg and  $272.65 \pm 14.40$  Bq/kg for  $^{238}\text{U}$ ,  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$  respectively. Activity concentration of  $^{238}\text{U}$ ,  $^{226}\text{Ra}$  and  $^{232}\text{Th}$  in yam and cassava were within the permissible maximum values (UNSCEAR, 2000) (UNSCEAR, 2013).

The results for radiological health risk assessment of  $^{238}\text{U}$ ,  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$  due to consumption of yam are presented in Table 4. The parameters presented are estimated values of gamma absorbed dose D, Excess lifetime cancer risk ELCR, External hazard index  $H_{\text{ex}}$ , Internal hazard index  $H_{\text{in}}$ , Annual effective dose (AED) due to consumption of yam. In yam the absorbed dose ranges from  $3.99$  nGy.yr<sup>-1</sup> to  $27.48$  nGy.yr<sup>-1</sup> with mean of  $15.71$  nGy.yr<sup>-1</sup> the values are within permissible limits. Estimated values of ELCR due to consumption of yam ranged from  $0.00004$  to  $0.00029$  with a mean of  $0.00019$ , these values are within the recommended limit of  $0.0029$  (UNSCEAR, 2000). The distribution of the excessive life time cancer (ELCR) risk due to consumption of yam from the study area is shown in Figure 4. The estimated annual effective doses due to consumption of yam ranged from  $0.016$   $\mu\text{Sv.y}^{-1}$  to  $0.106$   $\mu\text{Sv.y}^{-1}$  with mean of  $0.070$   $\mu\text{Sv.y}^{-1}$  these values are well below the recommended reference limit. For the yam samples,  $H_{\text{ex}}$  ranged from  $0.02$  to  $0.14$  with a mean of  $0.08$  while  $H_{\text{in}}$  ranged from  $0.04$  to  $0.23$  with mean of  $0.11$  these values are all within the world reference limit of 1 (UNSCEAR, 2000).

The results for radiological health risk assessment of  $^{238}\text{U}$ ,  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$  due to consumption of cassava are presented in Table 5. The parameters presented are estimated values of gamma absorbed dose D, Excess lifetime cancer risk ELCR, External hazard index  $H_{\text{ex}}$ , Internal hazard index  $H_{\text{in}}$ , Annual effective dose (AED) due to consumption of cassava. The estimated annual effective doses due to consumption of cassava ranged from  $0.030$   $\mu\text{Sv.y}^{-1}$  to  $0.369$   $\mu\text{Sv.y}^{-1}$  with a mean of  $0.186$   $\mu\text{Sv.y}^{-1}$ . These values are well below the recommended reference limit. The  $H_{\text{ex}}$  ranged from  $0.01$  to  $0.13$  with a mean of  $0.08$  while the  $H_{\text{in}}$  ranged from  $0.01$  to  $0.15$  with mean of  $0.08$  these values are all within the world reference limit of 1. In cassava samples, the absorbed dose ranged from  $2.49$  nGy.yr<sup>-1</sup> to  $25.83$  nGy.yr<sup>-1</sup> with mean of  $13.66$  nGy.yr<sup>-1</sup> the values are within permissible limits. Estimated values of ELCR due to consumption of cassava ranged from  $0.00008$  to  $0.00091$  with a mean of  $0.00022$ , these values are within the recommended limit of  $0.0029$  (UNSCEAR, 2000).

## Conclusion

In conclusion, the estimated values of the gamma absorbed dose rate (D), Excess lifetime cancer risk (ELCR), External hazard index ( $H_{\text{ex}}$ ), Internal hazard index ( $H_{\text{in}}$ ), Annual effective dose (AED) due to consumption of yam and cassava are presented in Tables 4 and 5 respectively. The estimated mean values of absorbed dose in yam and cassava were  $15.71$  nGy.yr<sup>-1</sup> and  $13.66$  nGy.yr<sup>-1</sup> respectively. It was observed that in this study that the yam and cassava samples had absorbed dose rate lower than the world reference limit of  $55$  nGy.yr<sup>-1</sup>. Mean estimated values of excess lifetime cancer risk due to consumption of cassava and yam were

0.00019 and 0.00022, respectively. All the samples had ECLR values within permissible limit of 0.0029 (UNSCEAR, 2000).

Estimated mean values of external hazard index were 0.08 and 0.07 in the cassava and yam samples respectively, these were all within the world reference value of 1. Internal hazard index estimated mean values were 0.11 and 0.08 in cassava and yam respectively, these were all also within permissible limit of 1. The mean values of Annual effective dose (AED) due to consumption of cassava and yam were 0.070 and 0.186  $\mu\text{Sv yr}^{-1}$ , respectively. These values are within and well below recommended reference value of 1000  $\mu\text{Sv yr}^{-1}$  or 1  $\text{mSv yr}^{-1}$  (UNSCEAR, 2000).

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# APPLICATION OF CONVOLUTIONAL NEURAL NETWORK TO CLASSIFY TONE FREQUENCY

<sup>1</sup>Agu, Edward Onyebueke & <sup>2</sup>Oladunjoye John Abiodun

<sup>1&2</sup>Computer Science Department.

Federal University Wukari, Taraba, Nigeria

## **Abstract**

*In order to obtain Tone frequency classification from computers and other intelligent machines, the first and decisive step is for accurate Tone frequency classification. This project presents the implementation of this function with the deep learning model of Convolutional Neural Networks (CNN). The architecture with adaptation of an image processing CNN, programmed in Python using Keras model-level library and TensorFlow backend. The theoretical background that lays the foundation of the classification of tone based on voice parameters is briefly presented. According to the obtained results, the model achieves the mean accuracy of 93% for eight words (down, go, left, no, right, stop, up, yes), which is comparable with performances reported in scientific literature. The original contributions of the paper are: the adaptation of the deep learning model for processing the audio files, the training of the CNN with a set of recordings in English language and an experimental software environment for generating test files.*

**Keywords:** TensorFlow, Freq CNN, Keras, Audio, Tone, Recordings.

## **Background to the Study**

In tone languages, such as English language, there are different variation of tone pattern i.e., the fundamental frequency and its harmonics of each syllable containing lexical meaning. There are four different patterns which are: Flat and High, Rising, Low and Dipping, and falling. To build a model for audio tasks the first step is to decide what kind of representation to use for the data. The tone frequency classification models can be built using raw audio waveform (Lee et al, 2017), 2- D representation of the audio like Spectrograms (Choi et al. 2016), (Wu et al. 2018). Spectrograms have become increasingly popular in recent times

because they work well with Convolutional Neural Networks (CNN) (Ciresan et al, 2011). The accuracy of speech recognition has been improved in recent years using context-based optimization, as seen in commercial products such as Apple Siri, Google Now, and Microsoft Cortana. This is the focus of our present research. In this study, the use of supervised feature learning techniques was used for the tone frequency classification model. The resulting feature maps are down-sampled through max-pooling and used as input to a SoftMax classifier. Tone classification is a sub-problem of the overall speech recognition problem and high accuracy of tone classification of monosyllabic words without contextual speech is still a unique problem that has not been solved yet. It is therefore important to develop a tone frequency classification model that is robust and accurate in the presence of noise (Xu et al., 2007). The proposed model to be used is CNN, which is trained using audio data. The project main focus is on minimizing the information loss while extracting features from audio signal for better prediction and accuracy of the model. Appropriate techniques for efficient feature accuracy will be investigated.

### **Review of Related Work**

Convolutional neural networks date back as far as the 1980s, yet only recently have they been adopted as a method of choice for various object classification tasks. The work of (Krizhevsky et al., 2012), marked a turning point in large scale visual recognition. Since then, by replacing techniques relying on manually engineered features, convolutional neural networks allowed for significant progress in numerous pattern recognition tasks, including classification of traffic signs (Ciresan. 2012), house numbers, and handwritten digits, pedestrian detection and electron microscopy image processing (Sermanet et al., 2013).

### **Machine Learning**

Machine Learning (ML) in the field of computer science with the help of which computer systems can provide sense to data in much the same way as human beings do. In simple words, ML is a type of artificial intelligence that extracts patterns out of raw data by using an algorithm or method. The main focus of ML is to allow computer systems to learn from experience without being explicitly programmed or human intervention (Zaïane, 1999).

It is made up of three types which are supervised learning, unsupervised learning, and reinforcement learning. There are two types of machine learning namely:

- i. **Supervised learning:** this is the act of training the machine by using label data to predict an output of two different labeled classes.
- ii. **Unsupervised learning:** this type of machine learning, feeds the machine with unlabeled data

The considered algorithm falls under a classification which is one out of the two kinds of supervised learning which are:

- i. **Classification:** A technique that groups the output inside a class. If the algorithm tries to label input into two distinct classes, it is called binary classification. Selection between more than two classes is referred to as multiclass classification.

- ii. **Naive Bayes algorithm:** It is a classification technique based on Bayes' Theorem with an assumption of independence among predictors. In simple terms, a Naive Bayes classifier assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature. Even if these features depend on each other or upon the existence of the other features, all of these properties independently contribute to the probability. The Naive Bayes model is easy to build and particularly useful for very large data sets. Along with simplicity, Naive Bayes is known to outperform even highly sophisticated classification methods.

Lee et al., (2009), applied convolutional belief network to classify audio data which obtained a performance in the audio classification tasks with 76% accuracy. Thomas Lidy and Alexander Schindler (2016). applied cqt-based convolutional neural networks for audio scene Classification The sounds were recorded from different locations and use 44.1 kHz sampling rate and a 24-bit resolution. For each location, a 3-5-minute-long audio recording was captured. The original recordings were then split into 30-second segments for the prediction. Hinton et al., (2012) In recent years have shown that Deep neural networks is highly effective in acoustic modeling in speech recognition.

Ryant et al., (2014). applied a deep neural network for frame-level 5-tone classification and a single-layer neural network at syllable level. The segment-level models are trained to classify syllables from the 1997 Mandarin Broadcast News Speech corpus, using co-articulation features. When provided with only raw MFCCs as input, the method obtains an error rate of 16.86%. Wu et al., (2018). proposed a Freq CNN model on "Audio classification using attention-augmented convolutional neural network" based on frequency-distributed spectrogram which is combined with CNN attention mechanism for feature learning. Spectrograms are extracted from audio signals as the input for the subsequent CNN blocks.

Wu et al., (2013). Has train a neural network with two hidden layers on the RASC863 dataset (Li et al., 2014), using manually engineered features. Which has the overall tone classification accuracy as 76%, using a combination of spectral and temporal features such as pitch contours (Fo), Discrete Cosine Transform Coefficients (DCTCs), and Discrete Cosine Series Coefficients (DCSCs). Kamalesh et al., (2020). Has train the ESC-50 dataset and use Rethinking CNN Models for Audio Classification with an accuracy of 90%. The evaluate based on effectiveness of pre-trained weights and effectiveness of deep ensemble.

Venkatesh Boddapatia et al., (2017). Develop a model using image recognition networks for Environmental Sound Classification which has an accuracy of 67.8%. Karol J. Piczak., (2015). Has classified a short audio clip of environmental sounds. A deep model consisting of 2 convolutional layers with max-pooling and 2 fully connected layers is trained on a low-level representation of audio data (segmented spectrograms) with deltas. The accuracy of the network is 64.5% on 3 public datasets of environmental and urban recordings.

### **Analysis of the Existing System**

The weakness of the existing system was observed by the low accuracy. Wu et al., Has train a

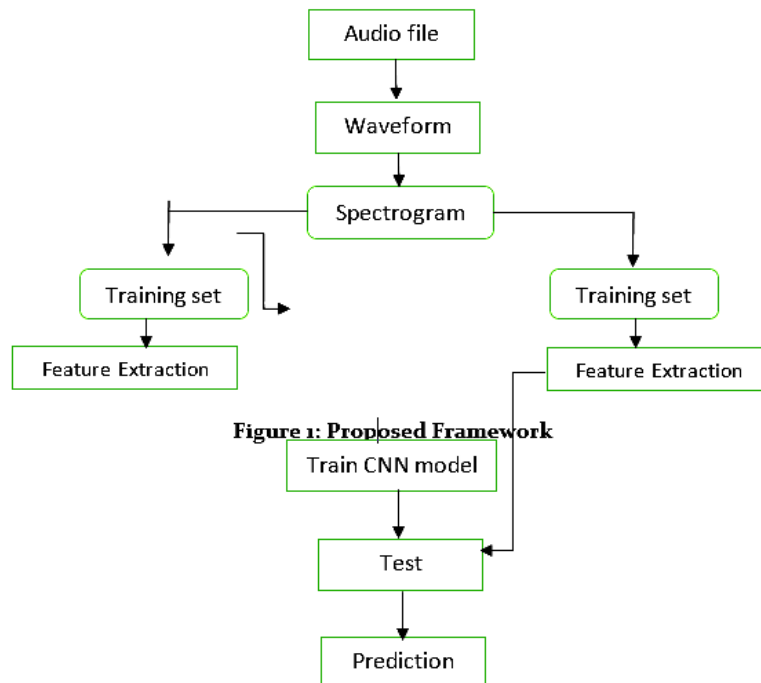
neural network with two hidden layers on the RASC863 dataset using manually engineered features. The analysis is evident in the tabulation on table 3.0.

**Table 1 Existing system**

Author	Published	Method	Dataset	Result
Wu et al.	2013	DCTCs	RASC863	76%
Kamalesh et al	2020	DenseNet (CNN)	ESC-50 dataset	84.2%
Lee et al	2009	DCL (image recognition)	ESC-50 dataset	76%

**Analysis of the Proposed System**

The figure below shows the process that will be used to train the model using the mini speech dataset.



**Figure 1: Proposed Framework**

**Problem Design**

The Implementation of the current project is to implement a model where some specific word would be predicted and the required model will be implemented using the python which has been discussed in the below parameters.

**Working of Convolutional Neural Network (CNN)**

Convolutional Neural Networks (CNNs) are attractive for keyword spotting (KWS) task, so a convolutional architecture with two convolutional layers is implemented. The Spectrogram which was generated from the audio data was fed into basic neural network as input with three dense layers. CNN use additional layers at the beginning of the neural network to reduce the size and preprocess an image.

### **The basic architecture of CNN includes**

**Convolutional Layer**– uses convolutional layer to filter required input signal and extract some more additional image features from the audio data. Convolutional layers often use a relatively small filter sizes, which allows detection of local features which for data such as images and sound are crucial. Filters in stacked convolutional layers operate on the feature map from the previous layer, combining features to detect higher order features. (LeCun, Bengio & Hinton 2015)

**Activation Function** – applies non-linear function to the given data such as rectifier Linear Unit (ReLU), which is a function that takes input  $x$  and returns  $\max(0, x)$ . This is due to much greater training efficiency compared to the older activation functions. (Krizhevsky et al., 2012).

### **ReLU (Rectified Linear Unit) Activation Function**

The ReLU is defined by  $\sigma(x) = \max(0, x)$ , It is not differentiable at 0, but in practice this is not a problem. The main disadvantage of the ReLU function is that it can cause nodes to die because the gradients for  $x < 0$  are always zero. The leaky ReLU is designed to fix this.

**Pooling Layer** – It performs a down sampling operation reducing the size of an input with  $\max()$  or  $\text{sum}()$  operation. Pooling layers are used after one or a few convolutional layers, continuously reducing the size of the input as the network gets deeper. Every reduction in the input size followed by the pooling operation also reduces the amount of computation needed in the network. (LeCun et al. 1998)

**Fully-Connected Layer** – each neuron in the previous layer is connected to each neuron on the next layer with last such layer producing outputs of neural network. In other words, convolutional and pooling layers represent high-level features of the input image. The pooling layer reduces the size of an image to control overfitting. Moreover, convolutional and pooling layers are still valid to use during backpropagation algorithm so that the neural network can be still trained using gradient descent approaches.

### **Dropout**

Dropout is a regularization technique where a percentage of connections between units in a layer are dropped before the following layer. Randomly dropping a set of units for each training iteration prevents co-adaptation by making the presence of other units in the network unreliable. This forces the network to learn a more general representation, rather than learning specific connections.

The methods for speaker identification task can be divided into two mainly processes, which are the training process and the testing (identification or matching) process.

The training process can also be separated into 4 stages as follow:

- i. Inputting the speech signal
- ii. Pre-processing of the speech

- iii. Normalization
- iv. Feature extraction

As mentions previously, feature extraction is the most significant stage for speaker identification. As a result, most research tried to explore the varieties of techniques for extracting the feature from speech data aims at identifying of each speaker. Because MFCCs based feature extraction approaches have been tentatively used more than any others did, therefore, we can category the methods for feature extraction of speaker identification task in to MFCC-based approach and non-MFCC-based approach.

### Training Deep Neural Networks

Neural networks are trained using backpropagation and gradient descent. Backpropagation is used to compute the gradients in respect to each weight in the network based on the error of the output. In classification tasks, the error is commonly the cross-entropy loss between the output of the network and the target. The gradients are used to give a direction in which to adjust the weights so that the error is minimized. (LeCun et al., 2015)

### Spectrogram Image

A spectrogram is a visual representation of the spectrum of frequencies of sound or other signal as they vary with time. Spectrograms are sometimes called sonographs, voiceprints, or voicegrams. When the data is represented in a 3D plot, they may be called waterfalls (<https://en.wikipedia.org/wiki/Spectrogram>). It is a spectrogram transformed from the signal wave in 2 seconds of speech depicted. It can be inferred that spectrogram is an image of its spectrum.

### Dataset Description

There are not so many publicly available datasets that can be used for simple audio recognition problems. Luckily, Google's TensorFlow and AIY teams have created freely available Speech Commands Dataset. This contains around 64000 one-second sound files with commands like Go, Yes or Stop. In the Experiment only 8 speech commands to train convolutional neural network. The availability of large public datasets such as ImageNet for image classification and Microsoft COCO for object detection, segmentation and captioning have accelerated the advancements in deep learning.

This thesis uses the Speech Commands dataset. The dataset consists of 64000 one-second-long utterances of 30 short words such as "yes", "no", "up", "down", "right" and "left". The dataset aims to help with building voice interfaces for applications with key-word detection, which can be useful on mobile devices and microcontrollers.

Dataset Characteristic	Attribute Characteristics	Associated Task	Number of Instances	Number of Attributes
multivariate	Strings	CNN (Conv2D)	8000	Seven (8)

Table 2: Dataset Description

**Waveform**

A waveform is a two-dimensional representation of a sound. The two-dimensional in a waveform display time and intensity.

**Adam optimization**

Adaptive Moment Estimation is an algorithm for optimization technique for gradient descent. It is really efficient and require less memory when working with large problem involving lot of data or parameters. Adam optimizers inherit strength from two methods (Momentum and root means propagation) and build upon them to give a more optimized gradient descent.

**Performance metrics**

This paper optimized the viability of different performance evaluation parameters including precision, F-measure, recall, and accuracy are calculated. Precision measures the classifier's accuracy. It is the percentage of the number of correctly predicted positive reviews divided by the total number of predicted as positive reviews:

$$precision = \frac{TP}{TP + FP}$$

Recall measures the classifier's completeness. It is the percentage of correctly predicted positive reviews to the actual number of positive reviews on the corpus. Therefore, recall indicates the number of related items that are identified:

$$Recall = \frac{TP}{TP + FN}$$

F-measure (or F-score) is defined as the harmonic mean of precision and recall, which combines recall and precision to output a single score. F-measure therefore might have the best value as 1 and the worst value as 0:

$$F - Measure = 2 \times \frac{Precision \times Recall}{Precision + Recall}$$

Accuracy is one of the most important metrics of performance evaluation and is measured as a percentage of the number of correctly predicted reviews to the total number of reviews present in the dataset. Thus, the accuracy calculates the ratio of inputs in the test set correctly labeled by the classifier:

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

**Loss Evaluation**

To evaluate the log loss on the prediction of the adopted model, the study incorporates the Binary-Cross-Entropy. Binary-Cross-Entropy was chosen due to its suitability in determining loss in classification models where the outcome is either 0 or 1 which corresponds to the class of benign and malignant class of diabetes. The loss function defines the negative average of the log of corrected predicted probabilities as against its labeled data.

The mathematical representation is given as:

$$\log loss = \frac{1}{N} \sum_{i=1}^N -(y_i * \log(p_i) + (1 - y_i) * \log(1 - p_i))$$

Here,  $p_i$  is the probability of class 1 that correspond to the malignant diabetes class, and  $(1 - p_i)$  is the probability of class 0 that corresponds to the benign diabetes class.

**Word Error Rate (WER):** The WER is calculated by comparing the test set to the computer-generated document and then counting the number of substitutions (S), deletions (D), and insertions (I) and dividing by the total number of words in the test set. e. g. REF: Misunderstandings | usually | develop. S1: Misunderstandings | using | develop. The substitution error of the word *using* for the word *usually* would be scored as one substitution error, as opposed to one error of deletion (*usually*) and one error of insertion (*using*) Single Word Error Rate (SWER) and Command Success Rate (CSR)

### Methodology

In this project, the issue of speaker recognition is studied, and a speaker independent system is implemented using Convolutional Neural Network (CNN) with ReLu activation and the well-known Mel Frequency Cepstral coefficients -MFCC's- have been used for features extraction and vector quantization technique is used to minimize the amount of data to be handled.

### Implementation

Taking into cognizance the effect good of speech recognition in Natural Language Processing, this study towards the tone frequency classification using convolutional neural network (CNN). A CNN is a variant of a DNN commonly utilized for image classification problems. CNNs integrate three architectural ideas to ensure spatial invariance: local receptive fields, shared weights, and spatial subsampling. Accordingly, CNNs are advantageous compared with ordinary fully connected feed-forward networks. The convolutional layers used is two-dimensional convolutions with the relu activation function, pooling which is a procedure that reduces the input over a certain area to a single value (subsampling) and using the Adam optimization technique.

### Importing and Preparing Working Environment

The code below list of imported libraries used in the following research processes.

```
In [1]: import os
import pathlib

import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
import tensorflow as tf

from tensorflow.keras import layers
from tensorflow.keras import models
from IPython import display

# Set the seed value for experiment reproducibility.
seed = 42
tf.random.set_seed(seed)
np.random.seed(seed)
```

**Figure 2:** Import Packages



### Importing the Dataset

The snippet below shows the process of accessing the root folder containing the individual spoken words. And then getting each of the samples in the folder.

```
In [2]: DATASET_PATH = 'data/mini_speech_commands'
        data_dir = pathlib.Path(DATASET_PATH)

In [4]: #Extract the audio clips
        filenames = tf.io.gfile.glob(str(data_dir) + '/*/*')
        filenames = tf.random.shuffle(filenames)
        num_samples = len(filenames)
        print('Number of total examples:', num_samples)
        print('Number of examples per label:',
              len(tf.io.gfile.listdir(str(data_dir/commands[0]))))

Number of total examples: 8000
Number of examples per label: 1000
```

**Figure 3:** Read Audio Files

### Splitting Dataset

The data is split into training, validation and test sets using a 80:10:10 ratio, respectively:

```
In [5]: train_files = filenames[:6400]
        val_files = filenames[6400: 6400 + 800]
        test_files = filenames[-800:]

        print('Training set size', len(train_files))
        print('Validation set size', len(val_files))
        print('Test set size', len(test_files))

Training set size 6400
Validation set size 800
Test set size 800
```

**Figure 4:** Splitting Dataset

### Read the Audio Files

In this section the dataset is preprocess, then creating decoded tensors for the waveforms and the corresponding labels. Note that:

- i. Each WAV file contains time-series data with a set number of samples per second.
- ii. Each sample represents the amplitude of the audio signal at that specific time.
- iii. In a 16-bit system, like the WAV files in the mini-Speech Commands dataset, the amplitude values range from -32,768 to 32,767.
- iv. The sample rate for this dataset is 16kHz.

The shape of the tensor returned by `tf.audio.decode_wav` is [samples, channels], where channels is 1 for mono or 2 for stereo. The mini-Speech Commands dataset only contains mono recordings. A sample of the dataset is accessed in figure 4.5

```
In [6]: test_file = tf.io.read_file(DATASET_PATH+'down/0a9f9af7_nohash_0.wav')
        test_audio, _ = tf.audio.decode_wav(contents=test_file)
        test_audio.shape

Out[6]: TensorShape([13654, 1])
```

**Figure 5:** Reading Audio Files

### Data Preprocessing

Here, a function is defined that preprocesses the dataset's raw WAV audio files into audio tensors:

```
In [7]: def decode_audio(audio_binary):
# Decode WAV-encoded audio files to 'float32' tensors, normalized
# to the [-1.0, 1.0] range. Return 'float32' audio and a sample rate.
audio, _ = tf.audio.decode_wav(contents=audio_binary)
# Since all the data is single channel (mono), drop the 'channels'
# axis from the array.
return tf.squeeze(audio, axis=-1)
```

Figure 6: Decoding Audio

### Convert Waveforms into Spectrograms

Here is a visual on the various waveform which is converted to spectrograms in order to be processed by the Convolutional Neural Network.

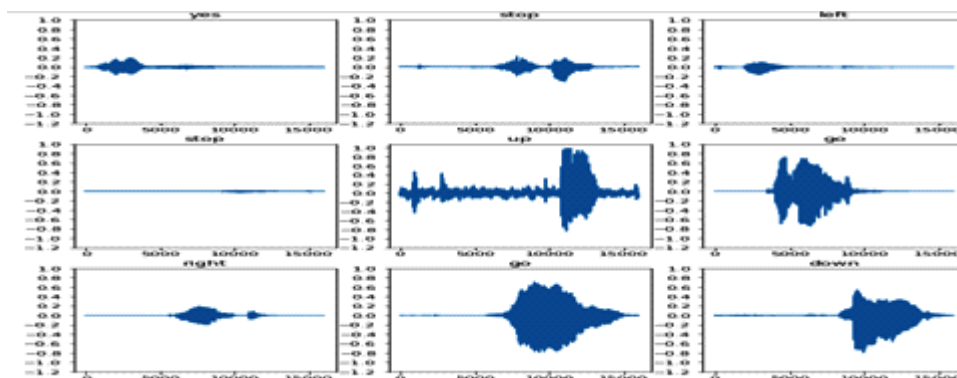


Figure 7: Visual of waveforms for each word

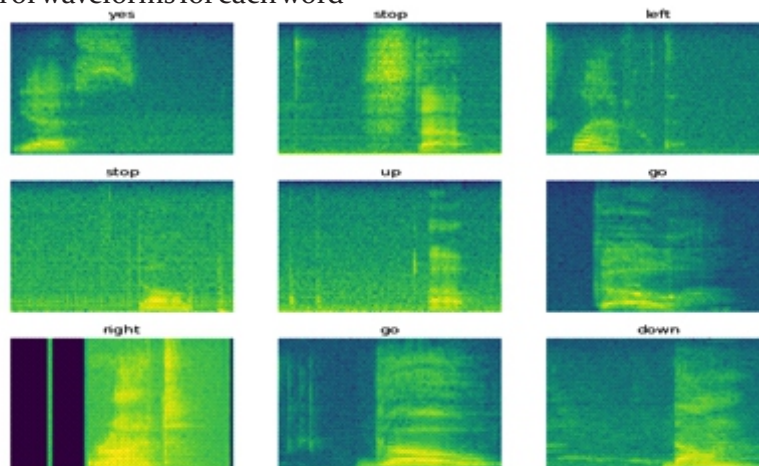


Figure 8: Spectrogram of converted waveform

### Build Model

For the model, a simple convolutional neural network (CNN), then the audio files are transformed into spectrogram images.

tf.keras.Sequential model will use the following Keras preprocessing layers:

- tf.keras.layers.Resizing: to down sample the input to enable the model to train faster.

- `tf.keras.layers.Normalization`: to normalize each pixel in the image based on its mean and standard deviation.

For the Normalization layer, its adapted method would first need to be called on the training data in order to compute aggregate statistics (that is, the mean and the standard deviation)

## Train Model

Train the model over 10 epochs.

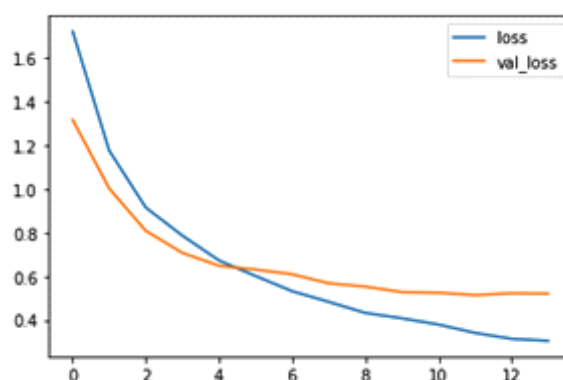
```
In [24]: EPOCHS = 50
history = model.fit(
    train_ds,
    validation_data=val_ds,
    epochs=EPOCHS,
    callbacks=tf.keras.callbacks.EarlyStopping(verbose=1, patience=2),
)

Epoch 1/50
100/100 [-----] - 29s 287ms/step - loss: 1.7237 - accuracy: 0.3817 - val_loss: 1.3183 - val_accuracy:
0.5738
Epoch 2/50
100/100 [=====] - 23s 238ms/step - loss: 1.1765 - accuracy: 0.5892 - val_loss: 1.0029 - val_accuracy:
0.6700
```

**Figure 10: Train model**

## Result and Discussion

The dataset is gotten from UCI repertory, which is imported to the model. The total sample extracted is 8000 and a number of 1000 per each label sample. Then the dataset is splitted into training, validation and test set with a ratio of 80:10:10 respectively. The dataset is preprocessed creating a decode tensor for the waveform of the corresponding label, where each wav file contains time-series of data with a set of samples per second. The audio rate for each sample is 16KHz. The waveform is converted into spectrogram, the CNN model uses some keras preprocessing layer which are `tf.keras.layer.Resizing`; it help the model to train faster and `tf.keras.layer.Normalization`; it normalize the each pixel of the image, the model is built using 2 dimensional convolutional neural network with ReLu activation and Adams optimization for efficient and optimize model. The model is trained over 10 epochs, after passing the audio to the model, it then predicts and compile the overall prediction of 0.9675 which is equivalent 96% with a loss metric of 0.6%. 4.7 below captured from the Jupyter notebook which was the coding environment.



**Figure 10: Loss to Validation loss**

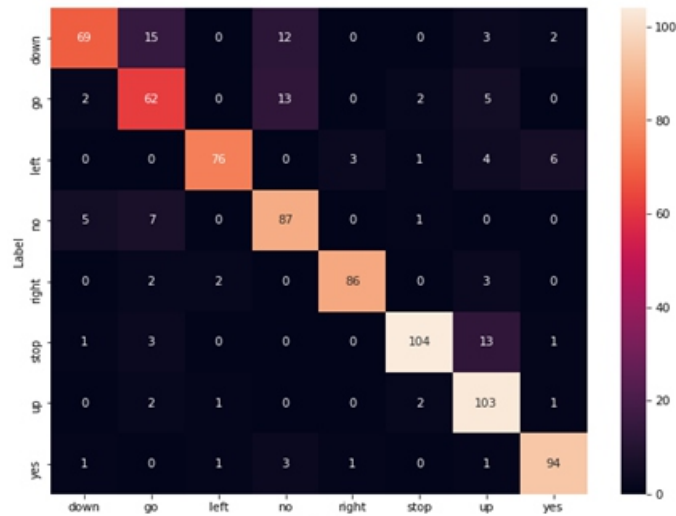


Figure 12: Confusion matrix

```
In [27]: M y_pred = np.argmax(model.predict(test_audio), axis=1)
y_true = test_labels

test_acc = sum(y_pred == y_true) / len(y_true)
print(f'Test set accuracy: {test_acc:.8%}')

Test set accuracy: 93%
```

Figure 13: Accuracy Evaluation

### Conclusion and Recommendation

This work has shown that a model using two-dimensional convolutions along with sensible training techniques can effectively be used for tone frequency classification. The application of this model helps in the right prediction, the accuracy of the model was 93% which showed that the model classified 93% of the dataset correctly which in turn proved that convolutional neural network CNN with ReLU activation and Adams optimization performs well.

### Recommendations

For future work, the number of samples per word in the dataset should be increased and also expanded. Other training techniques and feature extraction should be used for more accurate and efficient results. Other algorithms are to be used.

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## DETECTION AND BLOCKING OF SPAM SMS ON ANDROID PHONE

<sup>1</sup>Agu, Edward O. & <sup>2</sup>Okeke Kenekwukwu K.

<sup>1</sup>Computer Science Department,  
Federal University Wukari, Taraba, Nigeria  
<sup>2</sup>81 Pond Street, Quincy, MA. 02169

### **Abstract**

*This work examined a solution to the growing problem of spam and fraudulent messages that are prevalent in the mobile phone industry today. It focuses on the Naive-Bayes classifier for categorizing messages based on their resemblance with words that feature in spam and non-spam messages which is in the training set, thereby reducing the number of spams that get through to the end user and completely eliminate false positives (messages that are misclassified as spam). Incorporated in the dataset for this research is a list of spam and ham messages tested with naïve bayes algorithm. For the initial training and testing of the Naive-Bayes classifier, Python 3.7 interpreter, Visual Studio Code Text editor, (with python extension installed) were used and the results were then implemented. Java Development Kit, Android SDK, Android Studio and Android Emulator were used for deployment. It can be concluded that after testing data set with the Naive Bayes algorithm, a desirable result was obtained. Finally, it was implemented on an android platform and succeeded in detecting and blocking spam text message(s) from coming into a mobile users' inbox.*

**Keywords:** Spam, SMS, Ham, Blackberry, Spamicity, Inbox.

### **Background to the Study**

Spam has been a large problem on the internet for as long as e-mail and personal computers have been ubiquitous. As a result, numerous methods have been proposed to reduce the ease at which spammers can get messages across to their targets. Nowadays text messaging has become the main target of spammers to reach users that do not make use of the electronic

mail and its functionalities in their daily social activities. These efforts to fight spam on the internet have not been totally eradicated yet but have made it increasingly difficult for those in the business of SMS (Short Message Service) spamming to function hassle free. (Yoon, 2013). In recent years, there has been tremendous growth in the mobile phone industry globally, replacing personal computers and fixed phones (land-lines) with portable smart phones of various shapes and sizes according to a users' preference or taste.

This new, large market, coupled with the decreasing charges for SMS (especially in bulk) worldwide presents a great opportunity for spammers and fraudsters alike to reach their unsuspecting targets easily, and at little cost without the resistance they were met with on the web. As a result of this, SMS spam has become very popular in many parts of the world (Azeez, Iyamu and Venter, 2011). A number of people are involved in generating spam messages ranging from legitimate businesses and organizations trying to market their products and services to fraudulent individuals who aim to deceive people to make a profit. Many network providers are also involved in generating these unsolicited, marketing messages. A few factors that differentiate spam SMS from their counterparts and make them a lot more difficult to detect are:

- i. Their short length (usually 140 - 160 characters).
- ii. Absence of headers.
- iii. Misspelt words, etc. (Azeez and Ademolu, 2016).

Short Message Service (SMS) has become the most frequently and widely used communication medium. The term "SMS" is used for both the user activity and all types of short text messaging in many parts of the world. It has become a medium of advertisement and promotion of products, banking updates, agricultural information, flight updates and internet offers. SMS is also employed in direct marketing known as SMS marketing. Sometimes SMS marketing is a matter of disturbance to users. These kinds of SMSs are called spam SMS. Spam is one or more unsolicited messages, which is unwanted to the users, sent or posted as part of a larger collection of messages, all having substantially identical content. The objectives of SMS spam are to advertise and market various products (mostly out of a user's field and interests), sending political issues, spreading inappropriate adult content and commercial or business offers all to lure and deceive potential victims to suffer loss, data theft etc. Thus, spam flooding has become a serious problem and needs to be tackled. (Lutfun, 2007).

### **The Problem State**

Spam SMS is a nuisance that will clog up your inboxes and overload your memory. Spam is very dangerous. It is the entry point for serious attacks that could damage your mobile devices, corrupt data and important files, spread malware or even pornographic content. Thus, the need for a spam filter with an efficient algorithm to tackle such spam messages will act as a defense against such text messages.



### **Aim and Objectives**

This research aims to implement a Naïve Bayes Algorithm that will be able to detect, and block received spam text message from coming into a mobile user's inbox efficiently with the following objectives:

- i. A set of data will be tested using machine learning (Naïve Bayes Algorithm). To show differences and similarities between a spam and a ham text message.
- ii. The Naïve bayes algorithm data set will be implemented on Android platform which will detect received spam messages.
- iii. Spam message received by either an unknown or an acquainted contact will be blocked from coming into the users' inbox.

### **Theoretical review of Naïve Bayes Classifier**

In Naïve Bayes, the textual content of the messages is being focused on. Filters such as operational filters would also consider information such as the presence of suspicious headers or token obfuscation (Hershkop and Sakkis, 2001) which can be added as additional attributes in the message representation discussed below. Alternatively, separate classifiers can be trained for textual and other attributes, and then form an ensemble (Hershkop and Stolfo, 2005) combining SMS models for false positive reduction. In an experiment conducted with Naïve bayes algorithm, each message is ultimately represented as a vector  $\mathbf{hx}_1, \dots, \mathbf{x}_m$ , where  $\mathbf{X}_1, \dots, \mathbf{X}_m$  are the values of attributes  $\mathbf{X}_1, \dots, \mathbf{X}_m$ , and each attribute provides information about a particular token of the message. In the simplest case, all the attributes are Boolean:  $\mathbf{X}_i = \mathbf{1}$  if the message contains the token; otherwise,  $\mathbf{X}_i = \mathbf{0}$ . Alternatively, their values may be term frequencies (**tf**), showing how many times the corresponding token occurs in the message. Four attributes with **tf** values carry more information than Boolean ones. Hence, one might expect **nb** versions that use **tf** attributes to perform better than those with Boolean attributes, an expectation that is not always confirmed, as already mentioned. A third alternative was employed, hereafter called normalized **tf**, which is to divide the term frequencies by the total number of token occurrences in the message, to take into account the message's length. For example, that "rich" occurs three times in a message may be a good indication that the message is spam if it is only two paragraphs long, but not if the message is much longer. Following common text classification practice, we do not assign attributes to tokens that are too rare (we discard tokens that do not occur in at least five messages of the training data). We also rank the remaining attributes by information gain, and use only the best (Androutsopoulos, Paliouras & Sahami, 1998-2004). Note that the information gain ranking treats the attributes as Boolean, which may not be entirely satisfactory when employing a **nb** version with non-Boolean attributes.

### **Review of Related Works**

Lutfun et al (2017), in his work presents the results of the systematic literature review on SMS spam detection techniques. He chose a total of 17 research papers on this field and reviewed their proposed techniques, advantages and disadvantages they imposed. He also examined their evaluation procedures and made publicly available the dataset information which is a prior need for a spam filtering algorithm. Also discussed in his work was the background and

literature review, which showed the search and selection procedure used in implementation. The results show the summary of the used techniques and advantages and disadvantages of the approaches. A performance comparison on the studied literature was made and found out that none of the studies solve the challenges of use of regional contents and shortcut words and the limitation of traditional machine learning algorithms and its efficiency in detecting spam SMS.

Mark Sokolov, et al (2020) presents a new security insight of the two areas that seemed to be solved but there are still vulnerabilities in the defense mechanisms that could be easily exploited. First, he presented one such vulnerability, in which one could replace some characters with corresponding characters from a different alphabet. He also showed how substituting letters with their corresponding confusable, tricks spam filters into classifying spam emails as ham emails and show methods to address this threat. This will protect people from cybercriminals and losing personal information such as bank account and card data, logins and passwords of Internet services, and so on. Second, he proposed a model that achieves an increase in accuracy over Auto AI on the Microsoft Kaggle's Malware Prediction dataset, i.e., the probability of a Windows machine being infected by different malware families, based on different properties such as defender state information, number of logical cores in the processor, amount of disk space on primary disk of the machine in MB and etc. in comparison to text messages. With the increase of malware threats in our world, a lot of companies use Auto AI to help protect their systems. However, when the dataset is large and sparse, conventional machine learning algorithms and Auto AI have limitations and they don't generate the best results.

Gaurav Sethi et al (2014) shows how Spam filtering has become a challenging task because there are lot of difficulties with it. Most of spam detection techniques are unable to find these spam's because regular training of these classifiers is not done yet, database of spam should be updated all the time dynamical which is tiring. In his work he was able to show how existing spam filters are static in nature, because of that these spam filter shows false positive or false negative results thus limiting Naïve Bayes and proving Dynamic training can accurately filter spam with an accuracy of 91% to 94% respectively.

Aryo Pinandito et al (2017), proposed a google Android mobile application, which implements the designed application framework was successfully developed. The design allows one Android application to utilizes more than one spam classification method to detect spam specifically in Twitter contents. The methods are implemented in form of class library that extends Classifier class as its blueprint. The library should accept Twitter contents, classify the contents into spam or ham, and return them. The framework design allows spam classification method being implemented as a framework library and utilized as an Android Studio application project module to provide spam filtering functionality inside of Android application. His results showed that Naïve Bayes classification tend to have better accuracy in detecting ham over spam than K-Nearest Neighbor classification method. Conversely, K-Nearest Neighbor classification using TF-IDF weighting method have better accuracy in detecting spam than Naïve Bayes classification. Azeez et al (2017) created a spam

filtering application for mobile devices using Naive Bayes algorithm as proposed and it correctly classified incoming messages received by users. The application categorizes messages based on their resemblance with words that feature in other spam and non-spam messages in the training set. Given the test dataset, it was concluded that using a spam threshold of 0.7 along with adjustments to the Naive Bayes algorithm as proposed by Paul Graham the results returned were desirable but with an efficiency of 89% in detecting spam SMS.

### **Analysis of the Existing System**

In the existing system, the mechanism of Naïve Bayes' algorithm was primarily implemented into the system.

The steps taken for the implementation of the system were as follows:

- i. Dataset and Data collection.
- ii. Feature extraction.
- iii. Testing the data set with Naive Bayes algorithm.
- iv. Classifying incoming messages as spam or non-spam using the Naïve Bayes algorithm.

Dataset collection: The data used for this research is one composed of a data set amount of 1,002 SMS ham (legitimate) messages and 322 spam messages. Feature extraction: Features were extracted by scanning the messages for alphanumeric characters, currency signs, dashes, apostrophes and misspelt words. All other tokens considered as separators were ignored. The number of times every token appears in each corpus was then computed. This step produced two tables, one for each corpus, mapping tokens to their frequency of occurrence. After the data set was tokenized, experiments were then carried out to arrive at the optimal result (no false positives and a high percentage of correctly classified spam). These experiments were carried out using varying multiplier values with varying spam city thresholds (the probability that an SMS is spam) in an attempt to slightly bias the probabilities and reduce false positives to 0. While calculating the probability of a token being spam or ham (legitimate) using the Naïve Bayes formula, tokens that occurred in one corpus but not in the other were assigned a probability of 0.99. Results of data set and Naïve bayes classifier: Given a base training data set, the system successfully detects spam received to a user. Over time, any false positives that find their way through can be detected and used again to train the data set implemented to detect messages like the one missed. This led to a more efficient spam detection over time.

The first major suggestion before results were achieved is doubling the appearance of words classified as ham to bias the probabilities slightly and avoid false positives. The second suggestion is that a threshold of 0.9 be set to determine if a message should be classified as spam or not. Below, the results for the test carried out using different values for both the multiplier and the thresholds are shown. The data in Table 1 shows that the optimal threshold value for determining if a message is spam is 0.7 with no false positives and a large number of correctly classified spam messages. Table 2 shows that the optimal threshold

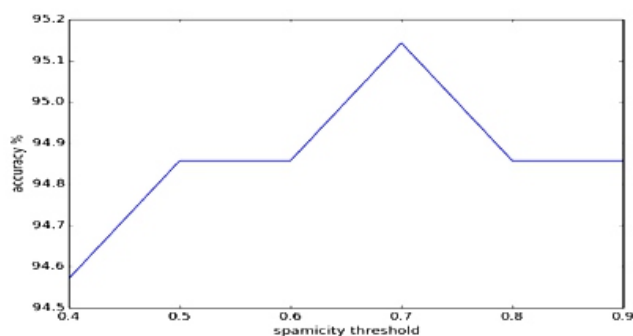
value for determining if a message is spam given a multiplier of 2 is between 0.5 and 0.6 for this data set. It also shows that higher thresholds yield smaller numbers of false positives (which is highly desirable) and smaller number of correctly classified spam (which is less desirable). It can be observed that from all the tables below, even though the number of false positives is greatly reduced by adding a multiplier value, the accuracy of the classifier in detecting spam is also greatly affected.

The table below shows the accuracy of a classifier given varying spamicity threshold as explained above.

**Table 1: Accuracy of classifier given varying Spamicity threshold**

Ham (200)		Spam (150)		Total (350)		Threshold
%	correct	%	correct	%	correct	
99	198	88.6667	133	94.5714	331	0.4
99.5	199	88.6667	133	94.8571	332	0.5
99.5	199	88.6667	133	94.8571	332	0.6
100	200	88.6667	133	95.1428	333	0.7
100	200	88	132	94.8571	332	0.8
100	200	88	132	94.8571	332	0.9

The figure below shows the graphical representation of accuracy for different Spamicity



**Fig 1: Spamicity accuracy**

**Table 2. Accuracy of classifier given varying Spamicity thresholds and a multiplier of 2.**

Ham (200)		Spam (150)		Total (350)		Threshold
%	correct	%	correct	%	correct	
99.5	199	87.3333	131	94.2857	330	0.4
100	200	87.3333	131	94.5714	331	0.5
100	200	87.3333	131	94.5714	331	0.6
100	200	86.6667	130	94.2857	330	0.7
100	200	85.3333	128	93.7142	328	0.8
100	200	84.6667	127	93.4285	327	0.9

The figure below shows the result of graphical representation of accuracy of NB classifier given varying Spamicity thresholds and a multiplier of 2.

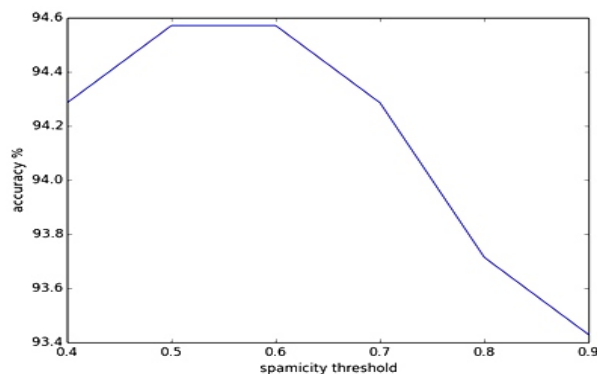


Fig. 2: NB classifier Accuracy

The multiplier used in this case provides a better and greater final increase in the accuracy of Naïve Bayes classification and also assists in the readability of values obtained.

Table 3: Showing Accuracy of NB classifier given varying values of the multiplier and a threshold of 0.9

Ham (200)		Spam (150)		Total (350)		Multiplier
%	correct	%	correct	%	correct	
99.5	200	88	131	94.29	332	1
100	200	84.67	131	93.43	327	2
100	200	84	131	93.14	326	3
100	200	82	130	92.29	325	4
100	200	82	128	92	323	5

The figure below shows the result of graphical representation of accuracy for different spamicity thresholds given a multiplier of 2.

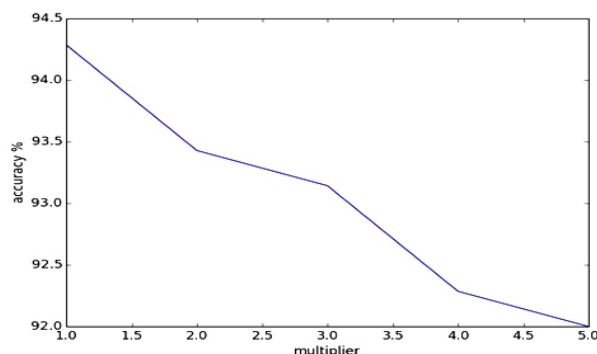
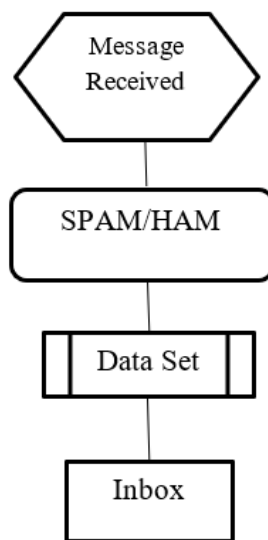


Fig.3: Accuracy for Different Spamicity Thresholds

### Analysis of the Proposed System

From the analysis carried out on the classifying process and results obtained from the existing system, it has shown that there is a clear need to build a system that would enhance detection and the assurance that trivial and irrelevant text messages does not disturb a user. SMS Spam filter application being the name of the proposed system, is an android-based application which uses Naïve Bayes Algorithm to classify data sets that are similar to spam. In the proposed system, the Mobile User API will request permission to use application as the default messaging application, which overrides the in-built messaging application. Upon granting permission, enables the application to function as the primary messaging application and enabling its spam filtering program. The diagram below shows the overview for the proposed system:



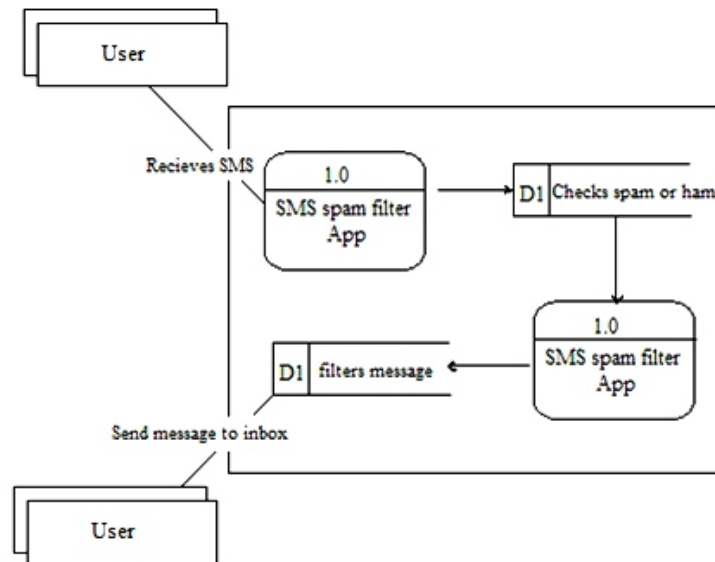
**Fig. 5: Overview for the proposed system**

Its process in relation to the waterfall methodology being applied:

- i. Requirement Gathering process: Without the text message being received, the system cannot execute its function thus the need for a text message of unknown content.
- ii. System Design process: In the design process the data sets are tested and trained with the naïve Bayes algorithm for detecting and classifying spam messages from ham messages.
- iii. Implementation Stage: Once implemented using suitable programming language and application in android, the system checks to see compatibility with device.
- iv. Testing and Verification stage: After successful implementation into an Android device, series of message were sent to user and spam were differentiated from ham messages.
- v. Software Maintenance stage: The application in its finished stage may not be able to support recent and updated android operating system versions and needs to be updated upon new OS release to ensure compatibility rate.

### DFD of the Proposed System

The data flow diagram (DFD) depicts more detailed description of the system as a whole. It breaks down the main process into sub processes that can be analyzed and improve upon.



**Fig. 6: Data Flow Diagram of the System**

As seen in the figure above, the message is being received by a user which has the SMS spam filter application installed into a mobile phone. The system checks ham or spam content in the message and after determining it, sends ham messages to the user's inbox or blocks spam message from coming into users' inbox.

### Methodology

Waterfall model is the methodology that would be used in the development of the proposed system. Waterfall consists of several discrete phases. No phase begins until the prior phase is complete, and each phase's completion is terminal; that implies that it does not allow you to return to a previous phase. The only way to revisit a phase is to start over at phase one. The methodology is broken down into the following stages in the system analysis:

- Requirement gathering: Having in mind the aim and objective of developing the system, the basic requirement such as Service Provider (to enable sending text message), data set (for testing Naïve bayes algorithm), Android mobile OS, Android studio IDE, Python Programming language and Visual Studio Code is required.
- System design: In this stage, the data sets are being collected and classified as well as the algorithm being used is examined for testing and training of the data set(s).
- Implementation: In this stage, the compiled data is being trained and tested in the Visual Studio Code environment (with the aid of pre-installed python and extensions in the environment). After successful testing it is then implemented into the building of an application with android SDK.

- d. Testing and Verification: After successful implementation into Android SDK the results were successful thus proving it function as intended.
- e. Maintenance: The application may require an update of its version in which improvements to user interface and an upgrade to the package to support a new operating system is made.

### Implementation

The compiled data is being trained and tested in the Visual Studio Code environment (with the aid of pre-installed python and extensions in the environment).

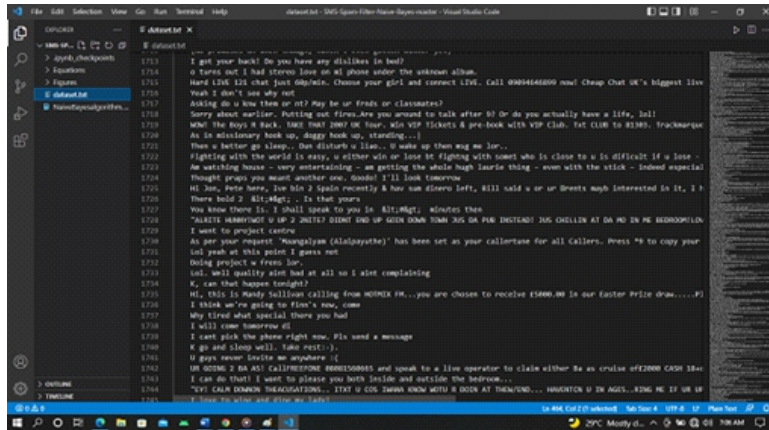


Fig. 7: Image Showing the dataset

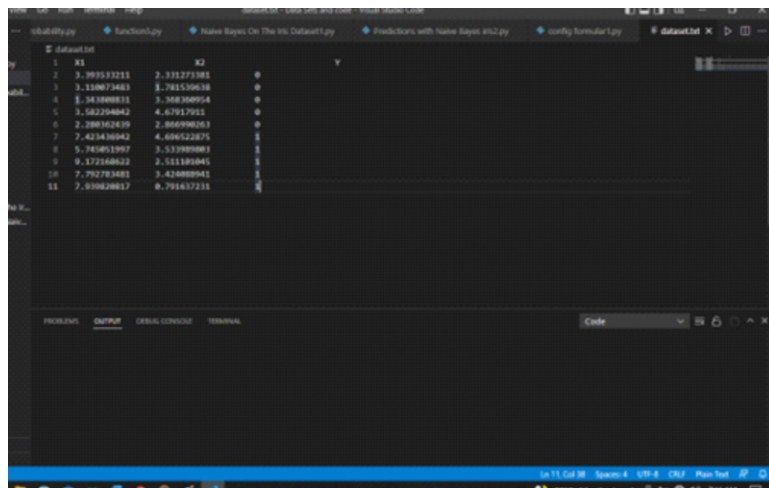


Fig. 8: Image. showing set of datasets



```

Naive Bayes On The Iris Dataset.py | cross_validation_split
41 for _ in range(n_folds):
42     fold = split()
43     while len(fold) < fold_size:
44         index = randomrange(len(dataset_copy))
45         fold.append(dataset_copy.pop(index))
46     dataset_split.append(fold)
47     return dataset_split
48
49 # calculate accuracy percentage
50 def accuracy_metrics(actuals, predicted):
51     correct = 0
52     for i in range(len(actuals)):
53         if actuals[i] == predicted[i]:
54             correct += 1
55     return correct / float(len(actuals)) * 100.0
56
57 # evaluate an algorithm using a cross validation split
58 def evaluate_algorithm(dataset, algorithm, n_folds, *args):
59     folds = cross_validation_split(dataset, n_folds)
60     scores = []

```

[Running] python -u "C:\Users\james\Desktop\Iris\Iris Data Sets and code\Naive Bayes On The Iris Dataset.py"  
Scores: [95.33333333333333, 96.66666666666667, 100.0, 95.33333333333333, 95.33333333333333]  
Mean Accuracy: 95.3325  
[Done] exited with code=0 in 0.429 seconds

Fig. 9: Image showing the implementation of the naïve bayes algorithm in Visual studio.

### Result

The figure 9 shows the result after successful testing of the data set implemented with the aid of the naïve bayes algorithm. It has a good efficiency and can be able to successfully differentiate a spam SMS from a legitimate text message.

```

... Results
-----
Valid: 1087
Invalid: 27
Accuracy: 0.9758

```

Fig. 10: Image showing the result with an accuracy of 0.9758.

The figure above shows the result after successful testing of the data set implemented with the aid of the naïve bayes algorithm. It has a good efficiency and can be able to successfully differentiate a spam SMS from a legitimate text message.

### Discussion

As seen from the results with an accuracy of approximately 97%, the data set implemented has proven to be efficient and will detect a spam SMS upon receipt. The data set used contains one of 5,532 text messages which contains sample of text content containing both spam SMS and ham messages. It was tested with the naïve bayes algorithm in the Visual Studio Code environment with yielded positive results. After successful results an android

application is used with the data set to detect spam SMS being received from coming into one's inbox.

### Conclusion

A spam SMS detection application for mobile devices using Naive Bayes algorithm was proposed and it successfully and correctly classified incoming messages received by users to be either spam or ham. The application categorizes messages based on their resemblance with words that feature in other spam and non-spam messages content due to data set being used.

### Recommendations

In an attempt to improve on the methodology used in this works, personal study has shown that hybridized machine learning algorithms for detecting Spam messages in mobile devices that can be super-efficient in detecting spam sms.

1. In addition, we would like to investigate the impact of this method with other applications used for text communication (SMS).
2. Emails should not also be exempted because of its similarity with Text Message in further improving the research and will go a long way in incorporating both machine learning algorithms and deep learning algorithms.

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