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Book Series on Sustainable Development II

Attaining Sustainable Development Goals in Families, Companies and Communities

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Felicia Azuoma Anyogu, PhD
Cecilia Amaoge Eme, PhD
John Agbo Ogbodo, MSc.

Attaining Sustainable Development Goals in Families, Companies and Communities

Nnamdi Azikiwe University Book Series
on Sustainable Development

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Cecilia Amaoge Eme, PhD
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Preface to the Second Edition

The Centre for Sustainable Development, Nnamdi Azikiwe University, Awka (CSD, NAU) has continued without relenting in the pursuit of her core objective which is "to undertake a strong policy advocacy on sustainable development based on empirical, evidence-based results, in order to influence Government action and public opinions in these domains; thereby making the University system an effective and result-oriented player in public policy articulation". The publication of her first edition in the Book Series entitled: *University-Led Knowledge and Innovation for Sustainable Development* – a product of the contributions from the Research Associates of the Centre and other distinguished academics from within and outside Nnamdi Azikiwe University – is a means to better inform, educate and or update the public on ways of contributing to the actualization of the Sustainable Development Goals (SDGs). The importance of the SDGs and the roles of the family, the communities and the industries in attaining them cannot be over emphasized; hence the decision to package this second edition of our publication with the theme, *Attaining Sustainable Development Goals In Families, Companies And Communities In Nigeria.*

This second edition is a follow-up to the first edition adding great value to the sustained chain of knowledge offered by these intellectual products. Presented herein are original research findings, short communications and review articles bothering on topics like: Achieving inclusiveness through digital resource applications in skill development; Clean energy and SDGs; Food expenditure and consumption pattern in non-farm and farm households; Government expenditure and economic growth; Geographic Information System (GIS) and Sustainable Landuse Restoration in Communities; Contribution of Forestry to Sustainable Development; and the role of federal competition in consumer protection among other wonderful study outputs which were encapsulated in this edition to suitably address the theme.

This publication is garnished with a lot of mind blowing findings buttressing the fact that direct participation by individuals, families, communities and the industries foster inclusive development among all the stakeholders. Consequently, great economic progress, social change, access to better education and healthcare, infrastructural growth and sustainable lifestyle becomes achievable through the hitch-free implementation of eco-friendly practices and environmental management principles generally acceptable by all.

To key into this public participation aspect of sustainable development attainment, this second edition of the NAU's Book Series on Sustainable Development becomes an essential commodity for everyone as we all are stakeholders in this business of achieving a sustainable future as contained in the seventeen Sustainable Development Goals (SDGs). I therefore recommend without any reservation that this laudable intellectual resource be utilized by all.

The inexorable support of our indefatigable Vice Chancellor, Prof. Charles Esimone and the School Management to the CSD NAU family is greatly appreciated. We also admire the assiduous commitment of erudite intellectual giants like the Emeritus Professor of Chemistry, Ikenna Onyido, the members of the editorial board, and all the associates and staff of the Centre; and they are herein acknowledged and appreciated.

Have a great reading experience as we hope to bring you our next improved edition in line with our commitment to painstakingly pursue the SDGs through research for development.

Prof. Felicia Anyogu, FCAI
Director, Centre for Sustainable Development,
Nnamdi Azikiwe University,Awka, Nigeria

Foreword

This book, Attaining Sustainable Development Goals in Families, Companies and Communities, is the second in the series of treatises planned by the Centre for Sustainable Development, Nnamdi Azikiwe University, Awka on the various aspects of the Sustainable Development Goals (SDGs), the global agenda for equitable economic development that is anchored on responsible environmental stewardship and good governance that fosters inclusivity. Coming right on the heels of the first volume in the book series titled, University-Led Knowledge and Innovation for Sustainable Development, the Centre for Sustainable Development is demonstrating the fact that it has rapidly grown to function as the intellectual hub of the University for articulating issues of sustainability and sustainable development and for driving the diffusion and permeation of these concepts into the institution's fabric for teaching, research and community engagement. It also speaks eloquently of purpose-driven leadership of the Centre by the Director, Professor Felicia Azuoma Anyogu, and the creative, diligent, and supportive output emanating from her team at the Centre.

The title of the book, while recognizing the comprehensiveness and cross-cutting nature of the concept of sustainable development, forehandedly shows its focus on the roles to be played by three of the building blocks of society namely, the families, the corporate world, and the communities in achieving the SDGs. The family, being the elementary component of society, should be the focus of policies that deal with, for example poverty reduction, food security gender equality, protection of the child from abuse and education and health outcomes, youth employment, etc. A number of chapters raise issues that impinge on these and other family-focussed themes.

Several outcomes of the industrial activities of the corporate world, including environmental degradation and the social tensions caused by the displacement of communities and the deprivations arising from loss of livelihoods are issues requiring urgent attention if the associated SDGs are to be realized. COVID-19 has exposed how the disruption of the supply chains that stretch across the world can lead to economic stagnation and inflationary trends that threaten the vulnerable. It is common knowledge that the revenues of some global behemoths outpace the Gross Domestic Products (GDPs) of many countries. The discussion of these issues in this book not only call attention to threats to the environment, social cohesion, and planetary boundaries resulting from the activities of the corporate world, empirical studies and the conclusions they convey in this book form part of the contribution to knowledge required for achieving the SDGs in these domains.

The organization of local communities and the mobilization of the local government machinery to tackle the problems of the communities through the application of available knowledge in the form of affordable, low-cost technologies are critical elements in the use of the SDGs to improve the lives of the members of the involved communities. Empirical studies and examples where the improvement of agronomic practices, the use of simple irrigation to cultivate vegetables in the dry season, simple techniques for the improvement of

water quality for domestic consumption, etc. are areas where intervention by and cooperation between local authorities in a targeted manner can reap spectacular benefits in terms of achieving the relevant SDGs. Some chapters in the book deal with these issues and related ones.

The Editors have done an excellent job in organizing the chapters in such a way that the fluidity of thought and process is not broken. The logic of the book is that the SDGs are comprehensive and cross-cutting – yes, so is the knowledge for achieving them. It would involve transdisciplinary responses that pool knowledge from different domains to solve the problems that must be solved for the quality of life of human beings to improve while maintaining sustainable environmental stewardship and fostering inclusivity. In a sense, the book is an illustration of the Centre for Sustainable Development is all about – the stretching of hands across disciplinary boundaries to engage with urgent problems that stare society in its face. The philosophy of this book emphasises one more thing – every one of us should be and could be involved in sustainable development. It is this all-embracing stance, that sustainable development requires action from you and I, that recommends this book to all and sundry in the university system and to the politician, the policy maker, and the professional as well.

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This book, the second in the series, owes its success to the combined efforts of many. The editorial team members are grateful to all. We thank, especially, the authors for their chapter contributions, and our reviewers for their valuable comments and suggestions that improved the quality of the chapters. Thanks to the staff of the Centre for Sustainable Development, Nnamdi Azikiwe University, Awka, for their dedication to duty. Our special thanks go to the Director of the Centre, Prof. Felicia Anyogu FCAI, and the Former and Pioneer Director, Emeritus Prof. Ikenna Onyido FAS, for consenting to write the Preface and Foreword respectively. We sincerely appreciate the Vice-Chancellor, Prof. Charles O. Esimone FAS for providing the enabling support.

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Chapter One

Evaluating the Role of Federal Competition Consumer Protection Commission in Response to Covid-19 Related Crisis in Nigeria

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ABSTRACT

The Covid-19 pandemic is the greatest challenge faced by the entire globe. Since its emergence in China in 2019, it has spread around the world and has adversely affected the economy of the world and Nigeria is not left out. The objectives of the work are to analyse the steps taken by the Federal Competition Consumer Protection Commission in tackling the impact of this global pandemic on the Nigerian consumers and the sustainability of such measures and to consider how effective the Federal Competition Consumer Protection Commission in tackling this global challenge in protecting the consumers. This research work used the doctrinal method of legal research and accordingly gathered data from primary and secondary sources of law, namely, legislations and journal articles as well as internet source respectively. It was found that the commission has made great progress in curbing the effect of the pandemic, which include issuing of 2020 business guidelines, prosecution of companies engaged in illegal activities and temporal sealing of such companies etc. It is recommended that for there to be lasting measures, the commission should ensure that there is a dialogue on the relationship between competition policy and sustainability of such policy.

Keywords: Covid-19, Consumer protection, Sustainability, Development

Introduction:

Coronavirus disease 2019 (Covid-19) is a respiratory illness that can spread from person to person. The virus that causes Covid-19 is a novel coronavirus that was first identified during an investigation into an outbreak in Wuhan, China (Henry Ajibo, 2020). Symptoms of Covid-19 infection includes: fever, dry cough, shortness of breath or difficulty in breathing, muscle aches, headache, sore throat, diarrhea, runny nose and tiredness(Henry Ajibo, 2020).This novel coronavirus virus outbreak was declared a pandemic on March 12, 2020, by the World Health Organization (WHO) (A Mohsin; L Hongzhen; SFA Hossain, 2021).

This COVID-19 pandemic has brought economic activities to a near standstill, leading to the most significant economic shock the world has experienced in decades. United Nations Conference on Trade and Development (UNCTAD) predicted the fall of gross domestic

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product by 4.3 percent in 2020, with an expected global recovery of 4.1 percent in 2021, and it also estimated that 34.3 million additional people, including millions working in the informal sector, will fall below the extreme poverty line in 2020, with countries in Africa accounting for 56 percent of this increase.(UNCTAD, 2020).

According to the World Bank, the pandemic will cause the first increase in global poverty since 1998. As at October 2020, the rate of extreme poverty, measured as the share of the world's population living on less than $1.90 per day, was projected to be at 9.1–9.4 per cent in 2020, while as at 2021, the poverty rate has increased beyond 9.4 percent(UNCTAD, 2020).

The pandemic has severely impacted consumers due to the disruption of supply chains and the subsequent shortages of essential products, causing price increases; deceptive and misleading advertising which capitalizes on the pandemic has been widespread; and low-income consumers have become more vulnerable to financial scams and fraud (UNCTAD, 2020).

Since the advent of the COVID-19 pandemic, major economic activities have been crippled worldwide, owing to the lockdown in major economies of the world. The implication is that the circular flow of income has been significantly constrained since a reasonable proportion of the productive factors are currently lying idle (H Inegbedion, 2021).

Nigeria has been adversely affected by Covid-19 pandemic after the index case of the Italian man that tested positive on 25th February 2020. In other to mitigate this adverse effect, a range of measures were implemented to contain the spread of the virus, these measures include: closure of international airports, public and private schools, universities, stores and markets, and suspension of public gatherings (IMF, 2021). After the full lockdown that was placed on March 30, 2020, Nigeria's economy reopened gradually in three phases with incremental reductions of traveling and gathering restrictions. Phase 1 started on May 4, phase 2 on June 2, and phase 3 on September 4(IMF, 2021). In December 2020, Nigeria had entered the second wave of the COVID-19 pandemic, with daily new cases doubling the peak of the first wave at end-January, restrictions on mass gathering were reinstated and public servants were ordered to stay at home and await further directives (IMF, 2021). The Federal Competition Consumer Protection Commission on their own part released business guidance relating to COVID-19 on business co-operation/collaboration and certain consumer rights under the Federal Competition and Consumer Protection Act (FCCPA) in April 2020.

The aim of this study is to analyse the steps taken by the Federal Competition Consumer Protection Commission in tackling this global pandemic and to consider the sustainability of such development.

This research work used the doctrinal method of legal research and accordingly gathered data from primary and secondary sources of law, namely, legislation and journal articles as well asinternet sources.

This work is divided into five parts. Part 1 is the introduction. Part 2 deals with the conceptual framework and the business guidance relating to COVID-19 on business co-operation/collaboration and certain consumer rights, while Part 3 also deals with the measures taken by the commission in tackling the impact of Covid -19 pandemic. Part 4 deasl with the sustainability of the measures taken by the commission while Part 5 is conclusion and recommendations.

2.0 Conceptual Framework and Federal Competition Consumer Protection Commission Business Guidelines

Consumer

There has been a series of discussions on the actual definition of the word 'consumer'. However, a consumer is any person who purchases or is supplied goods, or uses or consumes goods and services at the end of a chain of production.(KB Bello 2012) Two salient features can be pointed out from this definition, the first is that the consumer is a buyer and/or user of a product or service and the second is that the consumer is a member (in fact, at the end) of the production chain. These features underscore the importance of the consumer in both economics and marketing theories, that is, without the consumers there cannot be any basis for production (KB Bello 2012).

A consumer is further defined as one who consumes, individuals who purchase, use, maintain and dispose of products and services; users of final products: a member of the broad class of people, who is affected by pricing policies, financing practices, quality of goods and services, credit reporting, debt collection, and other trade practices for which the state and general consumer protection laws are enacted (MA Henry Campbell Black, 1990). The term is further defined as a buyer of any consumer product; any person to whom such product is transferred during the duration of an implied or written warranty applicable to the product, and any other person who is entitled by the terms of such warranty or under applicable state law to enforce against the warrantor the obligations of the warranty (MA Henry Campbell Black, 1990). Chambers English Dictionary simply defines a consumer as one who consumes; as oopposed to the producer, one who used an article produced.(DS Schwarz and Tebbit, 1990)

The new Federal Competition and Consumer Protection Act, 2018 unlike the repealed Consumer Protection Act gave an elaborate definition of a consumerby including any person who purchases or offer to purchase goods otherwise than for the purpose of resale but does not include a person who purchases any goods for the purpose of using them in the production or manufacture of any other goods or articles for sale; or to whom a service is rendered(FCCPA, 2018).

Consumer Protection

In Nigeria, like in other parts of the world, consumer protection is the concept designed to protect consumers from unscrupulous producers and service providers. It denotes the attempt

by governments to provide a regulatory framework to protect and enforce the rights of people who pay for goods and services. Therefore, the law of Consumer protection has a two-fold purpose. On the one hand, it protects the interests, rights, and safety of end-users of products and services; and on the other hand, to the extent that it derives from and relates to contractual transactions.(EC Uwadi**,** 2020)

The concept of consumer protection is generally used to classify measures that seek to ensure that consumers are fairly treated and that their rights are protected in commercial transactions that involve the supply of goods or services.(EC Uwadi**,** 2020)

The Federal Competition Consumer Protection Act

The President, General Muhammadu Buhari, GCFR on February 2019, signed the Federal Competition and Consumer Protection Act (FCCPA) 2019 into Law, which repealed the Consumer Protection Council Act.

The Act applies to all commercial activities and undertakings conducted or having effect within Nigeria. It also extends its applicability to conducts outside Nigeria by a citizen of Nigeria or a person ordinarily resident in Nigeria, a body corporate incorporated or carrying on business in Nigeria, any person in relation to the acquisition of shares or other assets outside Nigeria resulting in the change of control of a business, part of a business or any asset of a business in Nigeria(E Aniekpeno, 2018).

Before the FCCPA, mergers and acquisitions in Nigeria were mainly regulated by the Investments and Securities Act, 2007 (ISA) with the Securities and Exchange Commission (SEC) having general regulatory oversight. The FCCPA has now repealed individual sections of the ISA dealing with mergers and acquisitions. The supervisory control for mergers and acquisitions in Nigeria is now vested in the FCCPC and not the SEC. (E Aniekpeno, 2018)

Federal Competition and Consumer Protection Commission Business Guidelines 2020

Ever since the Federal Competition Consumer Protection Commission was established as the agency responsible for safeguarding the rights of consumers, it has been so proactive in protecting Nigerian consumers. During a recent webinar on “Competition and Consumer Protection in Times of Covid-19”, the United Nations Conference on Trade and Development (UNCTAD) commended Nigeria for taking proactive and effective action against price gouging and other anti-consumer activities during the ongoing global Coronavirus pandemic(FCCPC, 2020)

The Federal Ministry of Industry, Trade, and Investment (FMITI) also has given the Federal Competition and Consumer Protection Commission (FCCPC) an award which was received by its chief executive officer, Babatunde Irukera, for outstanding performance during the COVID-19 pandemic(Adegboyega, 2020).

The main attention of the Federal Competition and Consumer ProtectionCommission (FCCPC) is to continue topromote and maintain competitive markets as well as to protect consumersfrom the adverse consequences of the COVID-19 pandemic to the greatestextent possible. In this extraordinary situation, the FCCPC is providing aframework to legally assure businesses that need to coordinate or combineefforts to ensure the supply and distribution of scare products and services thatattend to the health, safety and subsistence needs of consumers(FCCPC Business guideline, 2020).

The FCCPC issued the Business Guidance which reiterates certain consumer rights, and generally aims at ensuring compliance with consumer protection laws and the reason why FCCPC issued this 2020 business guideline is to provide clarity for businesses and consumers in relation to authorize cooperation among businesses during Covid-19 and to reinstate certain consumer rights provided under Part XV of the FCCP Act.

Under the FCCP Act, businesses cannot enter into agreements that prevent, restrict or distort competition. Coordination and cooperation among companies to fix prices, allocate markets, limit production or engage in collusive tendering are unlawful. However, the business guidelines which the Commission issued exempted a category of practices between companies that supply and distribute essential services from the application of Section 59 of the Act in response to the Covid-19 Pandemic.

Effect of Covid 19 on Consumers

Barely 24 hours after Nigeria recorded its first case of coronavirus, protective apparels like face masks, hand gloves, hand sanitizers became scarce as suppliers and retailers hoarded the items to be sold at higher prices.The commission railed against the exploitation in a release at the time, citing the Federal Competition and Consumer Protection Act (FCCPA) that prohibits “obnoxious trade practices”, or the “unscrupulous exploitation of consumers.”, he further stated that he intends to strongly enforce the full letter of the law, including the fullest extent of penalties associated with this conduct. (A Adegboyega, 2020)

As a result of FCCPC warning to sellers who engaged in price gouging and arbitrary increases in prices of protective and hygiene products, Jumia Nigeria delisted 390 products belonging to 168 sellers of hand sanitizers and face masks from its online platform. (A Adegboyega, 2020)

This global pandemic which has affected various facets of the life of a consumer has led to a widespread of health and economic decline, as several persons died as a result of this pandemic. It also affected global trade and investment as all the industries were hit by this global crisis, which led to loss of jobs and the unemployment rate increased to its peak. For instance, China’s economy is the largest contributing economy, while the United States’s economy is the second-largest, but due to COVID-19, most factories are moving toward closure and stopping the production of goods. This lack of production of goods and services has a great impact on the consumers, and no significant purchasing practices have been

recorded since the spread of COVID-19. In the same context, declining sales are forcing the international market to face the situation. Brands like Apple, Toyota, Jaguar, Land Rover, and many more are facing the loss of investors and consumers, Hyundai has shut down its business services and supply operations due to a lack of consumer purchases. Starbucks has shut outlets as consumers cannot purchase. A reduction in the import rate of oil by China resulted in a decline in international oil prices. Multiple uncertainties have been observed in the consumption of smartphones as both demand and supplies are worsening. (FPSYG, 2021) All these instances are the adverse effect of the global pandemic on consumers.

Measures Taken by FCCPC During the Pandemic

Several countries have taken specific action to address this pandemic problem. Some, like South Africa, have introduced restrictions on the enforcement of debts. In the United Kingdom (UK), similar results have been achieved by the Financial Conduct Authority (FCA) in fine-tuning its Rules (COVID-19: Consumer Law Research Group, 2020)

Nigeria is not left out as there are several efforts by the FCCPC in curbing the impact of Covid 19 on Nigerian consumers. One of such efforts by the commission was made on 1 March 2020, where the Commission issued a press release stating that the unusual and inordinate practice of unreasonably increasing the price of these products in an indiscriminate manner, on account of Covid 19 violates both moral codes and extant law. Specifically, S. 17(s) of the Federal Competition and Consumer Protection Act prohibits "obnoxious trade practices", or the "unscrupulous exploitation of consumers" (FCCPC, 2020).

There are other commendable efforts made by FCCPC to curb the effect of Covid 19 which are listed below:

1) FCCPC in June 2020 arraigned four major pharmacies and supermarkets at the Federal High Court, Abuja, for allegedly taking advantage of the COVID-19 outbreak in the country to increase the prices of key hygiene products, contrary to law. (A Adegboyega, 2020)

2) The commission sealed Med Contour cosmetic surgery clinic in Lagos, following an open investigation, on reasonable suspicion of illegal activities, and in an abundance of caution and consumer safety, pending further inquiry. (A Adegboyega, 2020)

3) Anu Adepoju, the plastic surgeon in charge of the Med Contour cosmetic surgery clinic, was arraigned at the Federal High Court, Lagos, on criminal charges for alleged failure to appear and provide information relevant to FCCPC's investigation. (A Adegboyega, 2020)

4) The commission also set up a COVID-19 response team and created a dedicated platform through which it received information and complaints or intelligence. (A Adegboyega, 2020)

5) The commission sealed up a number of companies whose warehouses it uncovered large quantities of expired productsin the course of its surveillance and enforcement operations. (A Adegboyega, 2020)

6) As part of its continuing oversight and in response to multiple social media posts about what appeared to be excessive and imprudent pricing of potentially vital medication, Hydroxychloroquine, that is perceived or presented as efficacious therapy in addressing COVID-19, FCCPC conducted simultaneous on-site investigations in pharmaceutical companies in Port-Harcourt, in Lagos and Abuja and it discovered inconsistent pricing of Hydroxychloroquine and other products that are considered relevant to managing COVID-19. (A Adegboyega, 2020)

7) The Commission also prioritized key competition and consumer protection issues related to and arising from the pandemic, particularly prevalent complaints, which included failed electronic banking transactions and associated delays in restoration, reconciliation or resolution, slow speed internet connectivity, as well as arbitrary and inexplicable charges for data and restricted access or delayed signal release after payment for pay TV services. (A Adegboyega, 2020)

8) The commission has received thousands of consumer complaints in the aforementioned areas, which it continues to resolve since February. (A Adegboyega, 2020)

9) Another recent enforcement trend is the FCCPC inauguration of the Task Force on Sustainable Consumption charged with developing an enforceable framework from the self-regulatory and public regulation perspectives. However, the Task Force is yet to issue the enforcement framework. Information on the website of the FCCPC indicates that it has successfully protected consumers who have lodged complaints against banks, electricity service providers as well as telecommunication providers.(Banwo Ighodalo, 2021)

10) During the lockdown order by the President of the Federal Republic of Nigeria, the FCCPC, like other businesses, introduced remote working to its operations. They encouraged consumers to be vigilant, and report unreasonable, arbitrary, or exploitative price increases or trade practices to the Commission by telephone or by email, which yielded great result.(Olaniwun Ajayi, 2020)

11) The Director General of the Commission, Babatunde Irukera spoke to Premium Times in an Interview that the commission is receiving approximately 1,000 complaints in a week from multiple channels, including Twitter, Facebook, WhatsApp, telephone lines, complaints resolution portal online, emails. (Bassey Udo, 2020)

The Commission, irrespective of all the measures taken to curb the effect of the pandemic on the consumers has taken a major step in order to promote consumer protection. In October 2020, the FCCPC signed an updated tripartite Memorandum of Understanding (“MOU”) with the Nigerian Economic and Financial Crimes Commission(EFCC), and the United States

Federal Trade Commission (USFTC) for the purpose of strengthening cooperation and collaboration in addressing mutual cross-border consumer protection/fraud concerns and problems. The updated MOU seeks to reaffirm the parties' intention to work together and establish a Joint Implementation Committee to develop joint training programmes and provide assistance on specific investigations (Banwo Ighodalo, 2021). Moreover, the FCCPC participated in the African Consumer Protection Dialogue Conference which is a joint initiative of African Competition and Consumer Protection regulators and the USFTC. The Conference provides a platform to promote consumer protection and cross-border cooperation as well as to discuss ongoing work on consumer complaint sharing, business education and consumer protection. Once more, the FCCPC participates in the activities of and has served on technical committees to review relevant guidelines of the United Nations Conference on Trade and Development which is the focal point in the United Nations for competition law and policy, and consumer protection issues(Banwo Ighodalo, 2021).

The Sustainability of the Measures Taken by the Commission

In other to sustain the measures taken, the Commission has to aggressively educate consumers and also send consumers business alerts on COVID-related scams like obnoxious trade practices, unscrupulous exploitation of consumers etc.

In the United Kingdom Competition and Markets Authority(CMA) annual plan 2021/22 which was presented to UK Parliament pursuant to paragraph 13(2) of schedule 4 to the Enterprise and Regulatory Reform Act 2013, the sustainability measures listed in the CMA annual plan are as followings:

1) Protection of vulnerable consumers from breaches of competition and consumer protection laws and poorly functioning markets.

2) Supporting the UK economy by fostering competition to promote innovation, productivity and growth

3) Fostering effective competition in digital markets.

4) Supporting the transition to a low carbon economy(CMA, 2021)

Taking a glue from the CMA annual plan, in Protecting consumers and driving recovery during and after the coronavirus pandemic, the FCCPC can punish and deter anyone who attempt to fix prices or dampen competition, they can enforce the FCCP Act to the later, so that people can have confident to go out and spend money, knowing that they are protected from unfair trading. They can help the Nigerian government to design and implement policy that can harness the benefits of competition, protect and promote the interest of consumers.

Secondly, the commission should also respond swiftly to unscrupulous and harmful practices and also ensure that the consumers get their remedies adequately and also continue to publish a general statement of erring companies that has been sealed up or fined.

The Commission in sustaining their effort should support the federal Government to regulate digital markets, since digital market is the most dynamic and innovative areas of most economies, so as to ensure that these markets continue to deliver benefits to consumers, businesses and the economy as a whole.

The commission has to foster competition in order to promote innovation, productivity and growth in the economy and also develop capability to ensure that when carrying out their statutory functions, they will act in a way which supports indigenous companies, small scale business and agro farm enterprises, with a view to prevent misleading claims which could erode consumers' trust.

Finally, the commission should ensure that there is a dialogue on the relationship between competition policy and sustainability of such policy(CMA, 2021).

Conclusion

It is expected that the FCCPC in addressing consumer protection challenges arising from COVID-19 pandemic should ensure that they issue several guidance notes and regulations to fill some of the gaps in the FCCPA and provide more clarity on the provisions of the FCCPA and also ensure sustainability in the measures taken to cushion the effect of this global pandemic.

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Chapter Two

Geospatial Terrain Data for Sustainable Landscape Restoration in Communities: Theories, Methods and Applications

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ABSTRACT

Paragraph 274 of the outcome document of the United Nations Conference on Sustainable Development, entitled "The future we want", emphasizes the significance of reliable data utilization towards attaining the defined Sustainable Development Goals (SDGs). Hence, Geospatial Terrain Data are highly important for monitoring and measuring landscape dynamics for sustainable communities. Previously, it was more challenging to gain access to landscape data. Nowadays, however, with increasing innovations in geospatial technologies and machine learning, there is lesser barriers to acquiring and modelling terrain data for sustainable landscape studies. Generally, landscape studies are necessary for identifying, analyzing, and mitigating problems in the fields of hydrology, forestry, geomorphology, ecology, hazard assessment, soil erosion studies, etcetera and etcetera. This chapter presents insights into the theories, methods, and applications of the various aspects of terrain data analyses as an aspect of geographic information system suitable for sustainable landscape restoration at national and local scales. The outcome of this present chapter is useful to beginners and inter-mediate users of GIS tools for sustainable landscape restoration and ecosystems management in communities.

Keywords: Sustainable communities, Sustainable development goals, Sustainable landscape restoration, Geospatial terrain data modeling

1. INTRODUCTION

The 2030 Agenda for Sustainable Development also seeks to conserve biodiversity, combat climate change and improve livelihoods for everyone, everywhere. The foregoing global objectives are among the 17 Sustainable Development Goals (SDGs). According to the United Nations Environment Programme (UNEP), the SDGs are unlikely to be met unless

ecosystem degradation is stopped, and ecosystem restoration is undertaken at the immense scale of hundreds of millions of hectares, globally (UNEP, 2021).

Consequently, sustainable landscape restoration is central to attaining the Principles of the United Nations (UN) Decade on Ecosystem Restoration that runs from 2021 to 2030. The UN Decade on Ecosystem Restoration aims to prevent, halt, and reverse the degradation of ecosystems on every land and in every ocean. It can help to end poverty, combat climate change, and prevent a mass extinction of natural resources (UNEP, 2021). By way of defination, landscape restoration is a process which can contribute to regaining ecological functionality and enhancing human well-being across degraded environments. Simply put, sustainable landscape restoration means reestablishing a whole landscape to meet the needs of both present and future human generations and to offer multiple benefits and land uses over time in communities.

Landcapes can positively impacton the Sustainable Development Goals (SDGs) because of their scale of local conditions and local characteristics. Landscapes entirely involves watersheds, forests, geomorphology, agrobiodiversity, and all other environmental ecosystems in which many land uses interact. However, the ongoing rates of global landscapes degradation are much higher than the rate of ecosystems restoration. Worse-still, the impacts of the rapidly degrading landscapes results into myriad of climate change challenges in the world. Hence, given the accelerated actions for landscape restorations at local, national, and global scales, land managers, policymakers, and other stakeholders need the best available environmental data to interpret, understand, plan, and manage ecosystem restoration projects; as well as to accurately estimate the carbon sequestration potentials of ecosystems towards mitigating the impacts of climate change in communities.

The foregoing analogy would have necessitated the development of Paragraph 274 of the Future We Want - Outcome document[2] of the United Nations Conference on Sustainable Development. This Paragraph 274 states: "*We recognize the importance of space-technology-based data, in situ monitoring and reliable geospatial information for sustainable development policymaking, programming and project operations. In this context, we note the relevance of global mapping and recognize the efforts in developing global environmental observing systems, including by the Eye on Earth Network and through the Global Earth Observation System of Systems. We recognize the need to support developing countries in their efforts to collect environmental data*." In a nutshell, the UN's Paragraph 274 outcome document emphasizes the significance of reliable data utilization towards attaining the defined Sustainable Development Goals (SDGs). Consequently, accurate geospatial terrain information is petinent for a wide range of development projects relating to poverty reduction, food security, urban development, sustainable forestry, water resources management and other development concerns.

Therefore, data obtained through the combined approaches of remote sensing and geographic information system (otherwise known as geosptail data) are highly important for monitoring and measuring landscape dynamics within the context of the sustainable development

goals.Hence, a more powerful and scalable way to generate data to manage and monitor landscape ecosystems restoration is through terrain modelling (i.e., surface analysis). Terrain (Landscape) data can enable communities and non-profit organizations to make informed decisions for their sustainable landscape planning. Previously, it used to be difficult and expensive to gain access to landscape data. Nowadays, however, with increasing innovations in geospatial technologies and machine learning, there is lesser barriers to acquiring and modelling terrain data for sustainable landscape studies. This is because, terrain models is capable of showing the regular patterns of arrangement and spatial structure of geographic complexes within a landscape. A terrain model is often a necessary requirement in identifying, analyzing, and mitigating problems in fields such as geomorphology, hydrology, forestry, and environmental modeling. Terrain models have been digitally used in remote sensing and geographic information systems (GIS) for terrain monitoring and representations (Figure 1).

Figure 1: Example of a terrain photo (surface of a real-world landscape)

A digitally represented terrain model is known as a digital terrain model (DTM). A DTM is a mathematical (or digital) model of the terrain surface. A digital terrain model (DTM) is an ordered set of sampled data points that represent the spatial distribution of various types of information on the terrain. It employs one or more mathematical functions to represent the surface according to some specific methods based on the set of measured data points (Llobera, 2003; Burrough et al., 2001). These mathematical functions are usually referred to as interpolation functions. The process by which the representation of the terrain surface is achieved is referred to as surface reconstruction or surface modeling and the actual reconstructed surface is often referred to as the DTM surface.

For the determination of a digital terrain model (DTM) different methods for data capturing do exist. There is terrain surface reconstruction method. Terrain surface reconstruction can

also be considered as DTM surface construction or DTM surface generation Li (1990)[3]. After reconstruction, height information for any point on the model can be extracted from the DTM surface. It is worth mentioning here that, the concept of interpolation in DTM (Briese, Pfeifer, and Dorninger, 2001) is a little different from that of surface reconstruction (Sohn & Dowman, n.d.). Interpolation includes the whole process of estimating the elevation values of new points, which may in turn be used for surface reconstruction, while the surface reconstruction emphasizes the process of reconstructing the surface, which may not involve interpolation (Thibault and Gold, 2000). To clarify this matter further, surface reconstruction only covers those topics concerned with "how the surface is reconstructed and what kind of surface will be constructed." For example, should it be a continuous curved surface, or should it consist of a linked series of planar facets? In contrast, interpolation has a much wider scope. Thus, surface modeling approaches may be classified based on various criteria, such as the basic geometric unit used for modeling, the type of source data used for modeling, and so on. For the basic geometric unit used in terrain modeling, the following three (3) basic modelling approaches, *viz*: (i) point-based modeling, (ii) triangle-based modeling and (iii) grid-based modeling; are identified (Peckham and Gyozo, 2007; El-Sheimy, Valeo, and Habib, 2005; Joseph, Peckham, Zhilin Li, Qing Zhu, 2004).

Based on the foregoing, this present Chapter is structured into six (6) Sections. The introductory Section 1 briefly highlights the explanations and representations of terrain surfaces. Sections 2 and 3 are about the theories of generation, compilation, and analysis. Section 4 discusses elevation data models within the scope of GIS and Section 5 highlights the various areas in which digital terrain and elevation models can be applied. Lastly, Section 6 contains the concluding remarks.

a. Meaning of a terrain

From literature reviews, it is understandable that the word 'terrain or landscape' cannot be fully described without a mention of some basic terminologies such as ground, height, and elevation. Thus, the definitions posited by Li (1990) have been adapted in this paper to explain ground, height, and elevation, as follows: *Ground* may be defined as the solid surface of the Earth, or a portion of the Earth surface, or a surface of the Earth. Similarly, the term *height* has different meanings such as 'measurement from base to top', or an 'elevation above the ground or recognized level'. Whereas an *elevation* is defined as a height that is above the horizon; or simply put, the height above a given level such as 'the sea level'. Based on the foregoing three (3) definitions of terrain associate terms, the word, *terrain* can be explained as an extent of ground, region, or territory considered in regard to a country's natural features. In other words, a terrain which is a derivative of the word "*terra"* meaning earth; can be referred to the horizontal and vertical versions of the land surface. Terrain of a land affects the flow and distribution of water. In extensive land tracts, the terrain of land often affects the weather pattern and climate of an area.

3

Ideally, people living on Planet Earth, learn how to cope with the terrains that are found within their natural surroundings. For examples (Ackermann, 1992), professionals such as civil engineers design and construct buildings on terrains; geologists try to study its underlying construction; geomorphologists are interested in its shape and the processes by which the landscape was formed; and topographic scientists including surveyors, are concerned with measuring, and describing its surface and presenting it in different ways, such as, using maps, orthoimages, perspective views, etcetera (etc.). Despite these differences in emphasis and interest, the afore-listed specialists have a common interest, and that is, to conveniently represent the surface of the terrain with a certain accuracy.

b. Representation of Terrain Surfaces

People have tried every means to represent phenomena on the terrain that they have been familiar with since ancient times (Mahdi et al., 2015; Ojha, 2009), as briefly highlighted below[4]:

a. Painting may be the oldest representation (Zhilin et al., 2004). A painting offers some general information (e.g., shape and color) about the terrain which it depicts; however, the metric quality (or accuracy) is extremely low and, thus, it cannot be used for engineering purposes.

b. In ancient times, semi-symbolic and semi-pictorial descriptions were used to depict the actual three-dimensional (3-D) terrain surface. Again, the metric quality (or accuracy) was very low. Modern maps employ a well-designed symbol system and a well-established mathematical basis for representation so that they possess three major characteristics: (i) measurability warranted by the mathematical rules, (ii) overview provided by generalization, and (iii) intuition by symbolization.

c. Contoured topographic map is perhaps the most familiar way of representing terrain. On a topographic map, all features present on the terrain are projected orthogonally onto a 2-D horizontal datum. Detail is then reduced in scale and represented by lines and symbols. Terrain height and morphological information are represented by contour lines. The use of such maps can be traced back to the 18th century. It is believed by many that the contour map is one of the most important inventions in the history of mapping due to its convenience and intuition to perceive. Apart from DTM (Digital Terrain Model) contour maps can also be obtained from terrestrial measurements. Figure 2 shows some contours lines around an area of interest (AOI) in Anambra State, Nigeria.

d. Another ancient but effective terrain representation is maps, which are still widely used today. Maps have played as important a role in the development of society as language. Indeed, maps have been used to represent the environments during the history of civilization. Essentially, a map is a scientific generalization and abstraction of features on the terrain. Typically, and perhaps most importantly, topographic maps make use of 2-D representation for 3-D reality. There is always a gulf between the 2-D representation and

the 3-D reality. Because of this gulf, cartographers have been devoting themselves to the 3-D representation of terrain topography for years. Scenography, hachuring, shading and hypermetric tints (color layers) have been traditionally used on topographic maps; however, only shading is still widely in use because it can be easily generated by computers.

e. Satellite images have been used to complement aerial photography since the 1970s. Many satellite systems take overlapping images of the terrain so that these images can also be used to construct 3-D models. SPOT and IKONOS are two examples. However, the resolution of satellite images is still not compatible with aerial images.

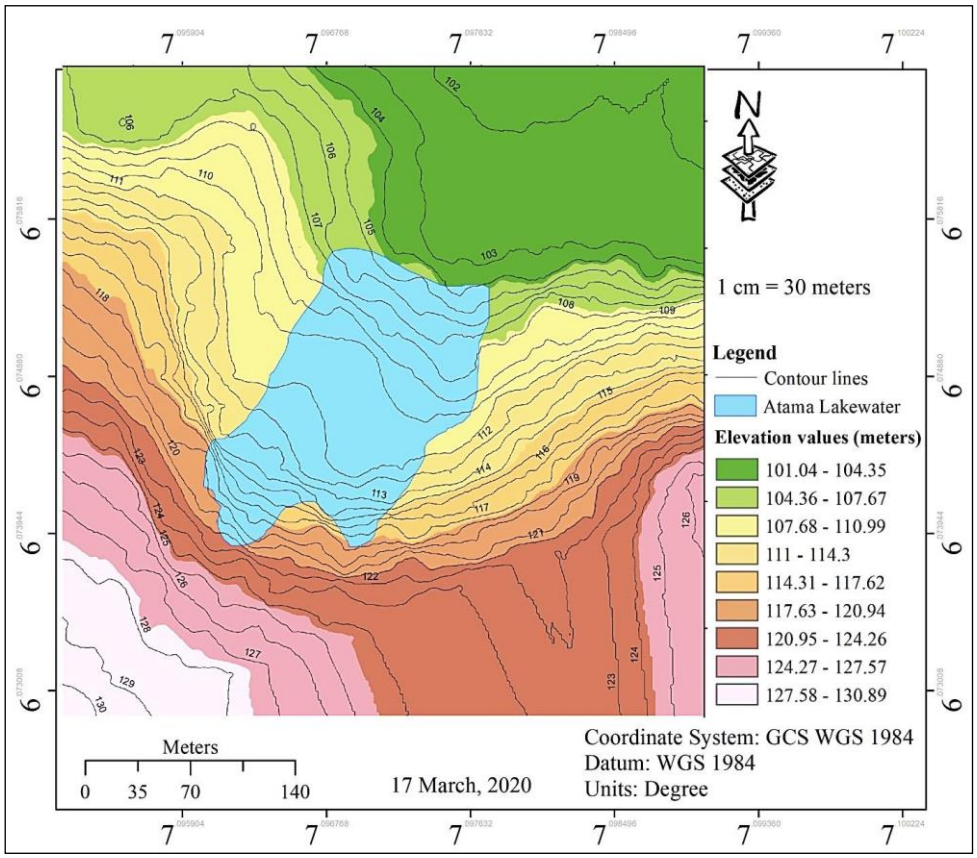

Figure 2: An example of elevation map showing contour lines around Lake Atama in Anambra State

f. Lastly, terrain surfaces can also be represented digitally. Digital terrain representations are done mathematically and graphically. Fourier series and polynomials are common mathematic representations; while regular grid, irregular grid, contouring and the sectional diagram are common graphic representations. To represent terrain modelling, digitally, a relationship can be established among digital terrain model, digital surface model and digital height model (Figure 3).

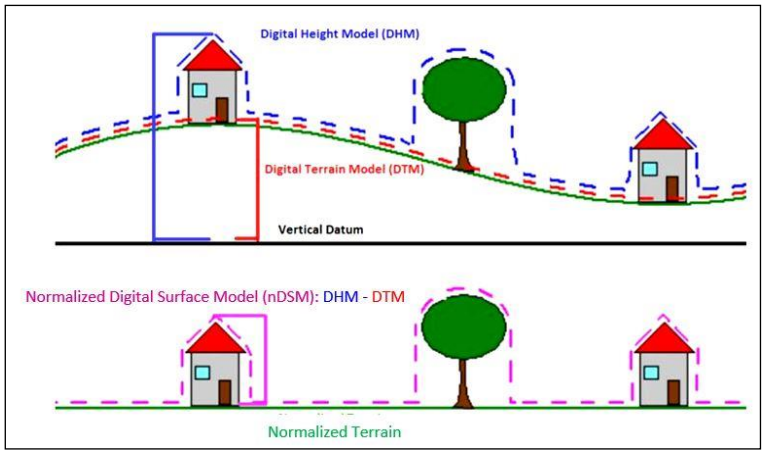

Figure 3: A pictorial representation of digital terrain model (red line), digital surface model (pink colour)

and digital height model (blue line) with the normalized terrain (green line) as adopted from Dunne, 2015.

2. THEORIES FOR GENERATION OF TERRAIN MODELS

Nowadays, it is important to know the physical nature of the earth surface which is increasing degraded through anthropogenic activities that are changing the shape, texture, and pattern of natural resources in an unsustainable manner. This present sub-section will briefly highlight some theories relating to generation of terrain and elevation models, as below.

i. Mapping texture onto digital terrain surfaces

Clarke and Archer, (2007) expressed that texture and other attributes can be mapped onto the terrain surface through a virtual landscape method. The basic idea is to add image-based information to the rendered primitives. The most used technique is called texture mapping that is, mapping a function of texture onto a 3-D surface (Caldwell, 2001). Texture mapping enhances the visual richness of raster images while entailing only a relatively small increase in computation. The first step in texture mapping is to map the texture onto the 3-D terrain surface; the second is to map the 3-D surface with texture onto the screen. To map from the texture space to the 3-D terrain, the most accurate method is to establish direct mapping between the texture coordinate system (U, V) and the 3-D viewpoint-centered eye-coordinate system (ECS) (Xe, Ye, Ze) based on central projective principles (Caldwell, 2001).

ii. Mapping other terrain attributes with Digital Terrain Model (DTM) and Digital Elevation Model (DEM)

Digital form of terrain (ground level, excluding objects above) is known as DTM (Digital Terrain Model)[5]. DTMdisplays more complete data about the Earth Surgact than digital elevation mode (DEM).

Digital Elevation Models (DEMs) in its most generic term implies elevation of the terrain devoid ofvegetation and manmade features (Louise et al, 2015). Therefore, represents theelevation of the earth's surface in the form of a digitalimage where each pixel1 contains an

elevation value ofthe center point of the pixel of the image data. On the other-hand, DTM is depicted as three representations of terrain surface dimensions consisting of X, Y, Z coordinates stored in digital form which not only include elevation and elevation of other geographical elements and natural features such as rivers, ridge paths etc. DTM[4] effectively DEM has been added with elements such as breaklines and observations other than the original data to correct the artifacts generated by using only the original data. With the increasing use of computers in environmental modelling and rapid development of three-dimensional (3D) computer graphics, DTM has become a powerful tool for a large number of applications relating to land resources management.

By mapping texture onto the digital terrain models (DTM), one obtains vivid details of the terrain surface. In fact, the visual effect can be enhanced by adding other information onto the model, for example, designed roads, river, land use, vegetation, and images. Aerial images can be mapped onto DTMs to produce realistic landscapes (Hoja, et al., 2006). In fact, images, vector data (lines), and 3-D objects on the ground (e.g., houses, trees), can also be mapped onto the DTM (digital terrain models) (Clarke and Archer, 2007). The filtering step is especially important for the terrain Modelling applications, since the errors will usually propagate and be enhanced in the elevation-derived variables (Hoja, et al., 2006; Woods, 1996). Nowadays, various techniques have been developed for the acquisition of elevation data, characterized by different resolutions and accuracies (Hu et al., 2009; Guoan, et al., 2001).

Likewise, there is a correlation between DTM and DSM (Digital Surface Model). Digital Surface Model) can be referred to as a model of digital surface. DTM only displays ground (ground surface without anything above it) and DSM displays any existing surface shapes like tree height, buildings and any object on the ground. Just like DTM, DSM is also an elevation model that displays surface height (Figure 4).

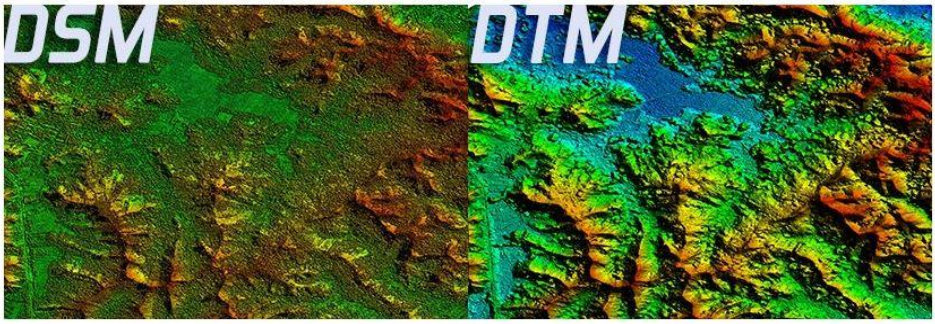

Figure 4: Example of DSM (Digital Surface Model) and DTM (Digital Terrain Model)

iii. Mapping elevation on earth surface

Elevation data are a critical element in any geoscience application. From the fundamentals of geological mapping to more advanced three-dimensional (3D) Modelling of Earth systems, there must be an understanding of the shape of the Earth's surface. Mathematical morphology can be defined as a theory for the analysis of spatial structures (Wecklich et al., 2015). It is called morphology because it concentrates on the form, shape, and size of the structures. It is mathematical in the sense that the analysis is based on set theory, integral geometry, and lattice algebra. When applied to digital spatial data, mathematical morphology

offers a wide variety of methods and algorithms to solve scientific and practical problems (Aziz, et al, 2009).

3. DIGITAL ELEVATION MODELLING

Digital Elevation Models (DEM) is a 3D representation of the earth's terrain. DEMs are most often used for making relief maps and they also useful for modeling the water flow and hydrology, surface analysis, and precision farming. In our time, digital elevation model (DEM) acts as an inevitable component in the field of remote sensing and GIS (geographic information systems). DEM (Figure 5) reflects the physical surface of the earth, and it helps us to understand the nature of terrain by means of interpreting the landscape using modern techniques and high-resolution satellite images (Sharma, 2010). With DEM, spatial analysts understand and analyze the nature of the terrain, better. Digital elevation models (DEMs) have been increasingly used for terrain monitoring and remote sensing applications. Moreover, elevation-derived parameters (such as slope, aspect and curvature) are often used as terrain variables for further analyses such as morphological analyses and drainage network investigations. However, artefacts, that is, artificial errors generated during the creation process of the DEM, often affect the DEMs (Ajayi et al., 2017; Bolstad and Stowe, 1994). There is thus a need for editing in order to improve the accuracy of the elevation values.

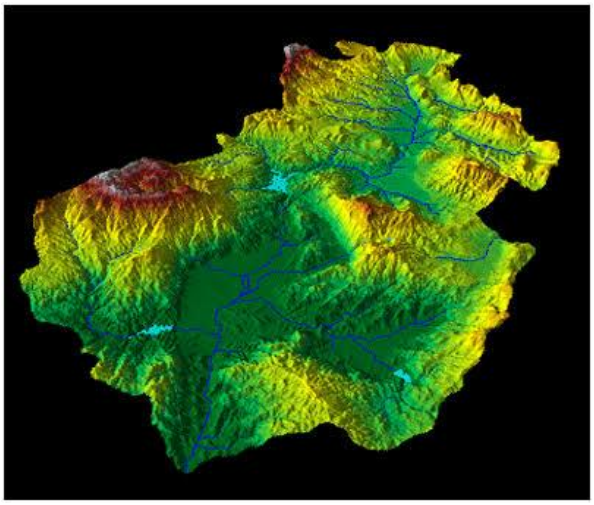

Figure 5: A typical example of a 3-D DEM

Analysis of Digital Elevation Models (DEMs) includes four (4) key steps, viz: (i) Acquisition of data (ii) Data modelling (iii) Data management and (iv) Application development. Acquisition of DEM data is capturing terrain images or scanning the earth surface, (Sharma, 2010). According to Richardson and van Oosterom (2002), quality of DEM data depends upon various interrelated factors such as methods of data acquisition, the nature of input data and techniques.

4. METHODS FOR COMPILATION OF TERRAIN DATA MODELS

i. Satellite remote sensing and DEMs

In 1970's, to complement aerial photography satellite images such as SPOT, IKONOS take overlapping images of the terrain have been used (Toutin, 2004). The resolution of satellite images is still not well matched with aerial images. El-Sheimy (2005) opined that, new

imaging resources such as radar, synthetic aperture radar, and laser altimetry, interferometry were developed to derive topographic information. Similarly, Smith (2010) said surveying became the familiar method to draw topographical information from the area, done by incorporating a significant number of points on the terrain but it consumes much time, and it is feasible only for small areas. Burrough et al. (2001) expressed that ground survey is very helpful in mapping ground elevation in wooded regions that are inaccessible to remote sensing. Later, total station and DGPS (differential Global Positioning System) receivers came into use for the collection of elevation data (Ravibabu and Kamal, 2008). Total station, DGPS and ground survey are slow, time-consuming, and too expensive to cover wide areas mentioned by Satheesh et al. (2008). Figure 6 illustrates the relationship of a highly precise orthophotos, DSMs, DTMs with slope and topographic maps.

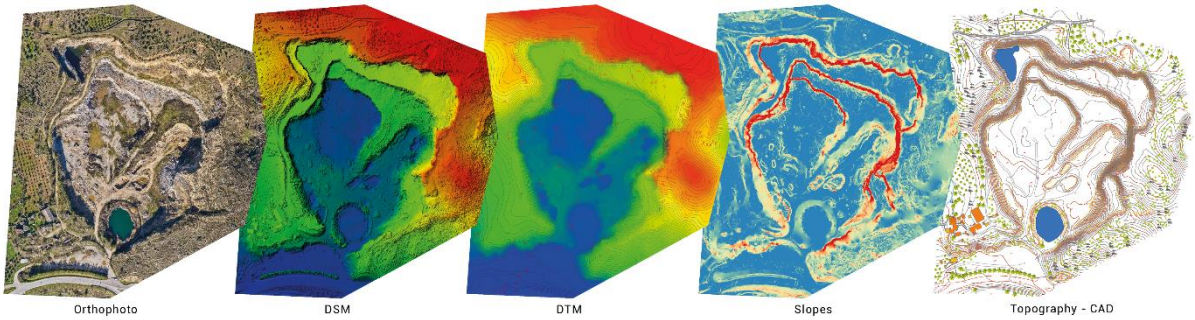

Figure 6: An example of the highly precise orthophotos, DSMs, DTMs and slope and topographic maps
Source: https://www.gim-international.com/files/53226f639121be56de593269efa806d3.png

ii. LIDAR and RADAR techniques for DEM creation

To develop DEM using LIDAR (Figure 7) method, some equipment is needed and arriving at some places and DEM generating can be troublesome (Kayadibi, 2009). Sasaki et al. (2008) measure the elevation under vegetation (Figure 6). This approach provides more detailed topographic information than maps drawn from aerial survey mapping. After, the DEM is generated using radar airborne (INSAR/IFSAR) technique. Data collection for IFSAR and LIDAR are based upon sampling as close to a regular raster grid as possible (Burrough et al., 2001). Yu et al. (2010) said the INSAR method is cost-effective, efficient and provides a wide coverage of DEM generation. Optical satellite system is also used to generate DEM.

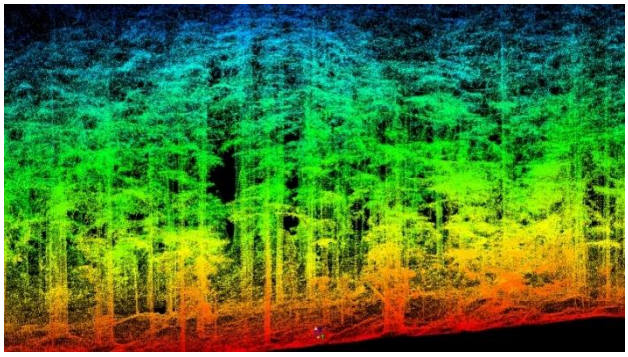

Figure 7: Example of LIDAR views over a forest[6]

iii. Optical imaging and DEMs

Nowadays, DEMs are generated using high resolution satellite data[7] like SRTM, CARTOSAT etc. High-resolution satellite data provide a lot of advantages with respect to accuracy, time, money and effort consuming. The accuracy of DEM developed using satellite-based imagery depends upon accuracy and density of the ground control points (Kayadibi, 2009). Newly emerging space technology results in the development of high-resolution satellites such as IRS-1C/1D, ASTER, IKONOS, SPOT, Quick bird etc., producing stereoscopic images facilitating the extraction of DEMs over large areas of the Earth's surface (Nikolakopoulos et al., 2006).

iv. Aerial Photography and Photogrammetry for Terrain modeling

Compared to various line drawings, images have some advantages: for instance, they are more detailed and easier to understand (Fabris and Pesci, 2005). Therefore, as soon as photography was invented, it was used extensively to record the colorful world we live in. Until date, photographs, and aerial photographs, are concurrently used for terrain representation. The rectified aerial images can be used as a plan in some sense (Clarke and Archer, 2007). However, 3-D surfaces can be reconstructed by using a pair of aerial photographs with a certain percentage of overlap (i.e., 60% normally) (Fabris and Pesci, 2005). This technique is called photogrammetry. Figure 8 shows an example of 1-meter DEM generated through Radargrammetry process in comparison with those of 90-meter resolution Shuttle Radar Topography Mission (SRTM) and 1-meter Lidar. Radargrammetry is a methodology to extract 3D geometric information from Synthetic Aperture Radar (SAR) imagery.

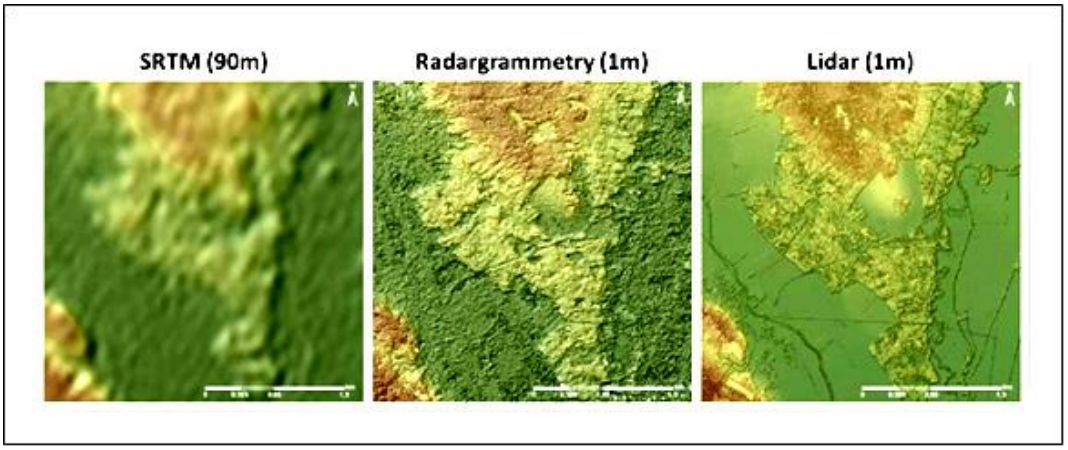

Figure 8: Comparison of SRTM, Radargrammetry DEM and Lidar-DEM[8]

A widely used technique for the generation of DEMs is digital photogrammetry, where elevation parallaxes are extracted by image matching of a pair of images with stereoscopic view (Aziz, et al, 2009). The spatial resolution of the created DEM is directly related to the spatial resolution of the stereoscopic images (aerial photographs or satellite images). The

height accuracy is dependent upon the ground pixel resolution, the base-to-height ratio of the acquisition system and the reliability of the correlation procedure (Athmania and Achour, 2014).

5. STORAGE FORMATS AND SOFTWARE FOR DIGITAL ELEVATION MODELLING

i. GIS storage formats for DEM

Generally, Digital Elevation Model (DEM) is a gridded array of elevations such as slope, aspect, contour and hillshade (Figure 9). According to Shingare and Kale (2013), to store the elevation information from various sources of DEMs, one can use different types of structures such as a) Regular grids of square b) Contours based structure or c) Triangulated irregular networks (TIN).

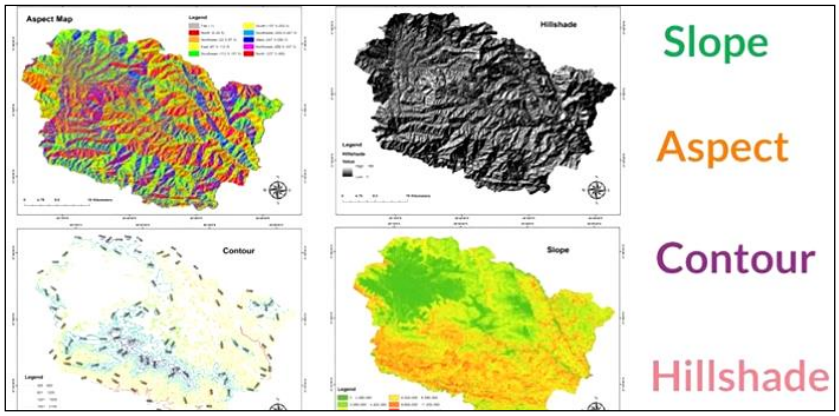

Figure 9: Examples of DEMs generated from Satellite Imagery showing slope, aspect, contour and hillshade

ii. Differentiating Triangular Irregular Networks from a Digital Elevation Model

At this juncture, it is important to note that, a Triangular Irregular Networks (TIN) data is basically different from DEM data model in two ways. One, in a TIN[9] data, every data point has x, y, h where h is the elevation, while in DEM, the x and y are hidden. Two, a TIN can include plain topographical relationships between points and their proximal triangles. TIN data have been used by the GIS community for many years and are a digital means to represent surface morphology. TINs are a form of vector-based digital geographic data and are constructed by triangulating a set of vertices (points). The vertices relate to a series of edges to form a network of triangles. There are different methods of interpolation to form these triangles, such as Delaunay triangulation or distance ordering. A TIN expects units to be in feet or meters, not decimal degrees.

In gridded models, elevation is estimated for each point in a grid. Gridded DEM (GDEM) stores the data in the form of the simple matrix, so the elevation values are easily accessed. The accuracy of the GDEM depends on the size of the data and the grid size. In case of TIN, Aziz et al., (2009) represented in a network of non-overlapping irregular networks. To capture the abrupt changes, TIN (Figure 10) uses a dense network of triangles in a rough

terrain, and a sparse network in a smooth terrain. TIN, DEM has been better than the GDEM because TIN has its capability to capture the topographic irregularity, without the significant increase in the data size in the case of hydrologic modeling. TIN and DEM do not appear natural due to an edge of triangle grid TIN. A disaster caused in mountainous areas mainly influenced by the pull of gravity is generally controlled by topography, i.e., slope gradient, aspect, etc.

To analyze, understand, and predict such phenomena, contour-based DEM mainly for deriving topographic attributes is essential to extract contributing attributes (Mizukoshi and Aniya, 2002). Furthermore, Mahdi (2015) said the contour lines are traced from the topographic maps and are stored with their location and elevation information. It is due to differences in map units and contour intervals between the existing base maps and the new maps. Hence, topographic mapping turns out to be error-prone and highly demanding in manpower resources (Ozah and Kufoniyi, 2006).

In a nutshell, TIN is a GIS method of constructing a surface from a set of irregularly spaced data points. In the TIN data model, the terrain is recorded as a continuous surface made up of a mosaic of non- overlapping triangular surfaces formed by connecting selectively sampled points of elevation data using a consistent method of triangle construction. For a terrain surface analysis that is as close to a real-world surface, sufficient numbers of sampling points are required from any area of interest. If the sampling points are not sufficient in number or at suitable locations, interpolation is used to fill the gaps and create the surface for analysis.

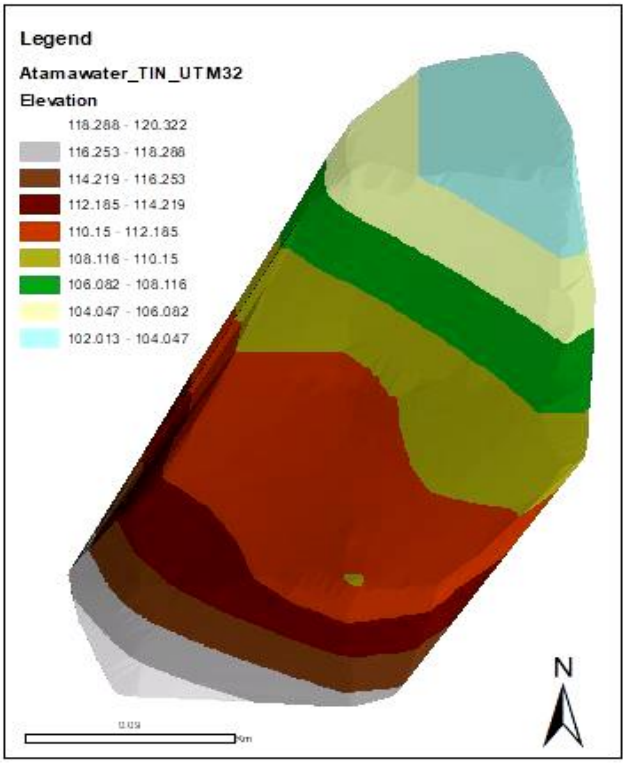

Figure 10: Example of a TIN map for Lake Atama in Anambra State

iii. **Assessment of GIS software for terrain analysis and validation**

Terrain surfaces can usually be analyzed in GIS software through a process known as spatial interpolation. Spatial interpolation is a process of estimating the value of attributes at unsampled locations within area covered by measurements made at certain points of locations. When the estimation is done for the sites lying outside the area covered by existing measurements, it is called extrapolation. The role of interpolation in GIS is to fill in the gaps between the observed data points, which may be having regular, clustered, or randomly spaced observed points. Interpolation is used to convert data from point values to continuous fields such that, the spatial patterns sampled can be compared with the spatial patterns of other spatial entities.

Based on the foregoing, to develop good quality DEMs, accuracy plays an important role because if the accuracy of DEM does not meet the requirements, redesign of the whole project is needed and thus, costs and efficiency are affected. The commercial and opensource software available in the market to generate DEM includes ERDAS IMAGINE, QGIS, VISUAL SFM, MICRODEM, SAGA GIS, Agisoft PhotoScan, ArcGIS, etc. The limited spatial resolution of DEMs, and different algorithms employed by different GIS packages suggested as possible sources for DEM inaccuracy and non-repeatability. The commercial software available for DEM generation has lack of quality assessment. The accuracy of DEM depends on the source and resolution of the data samples (Hanuphab et al., 2012).

To validate the accuracy of the results, the data extracted using satellite stereo images and from conventional techniques such as field measurements (Figure 11), global positioning system (GPS) and aerial photogrammetry as expressed by Shaker et al. (2010). The accuracy of the DEM generated from high-resolution satellite images or from other sources mainly depends on control points and on the method of collecting the control points. Global Position Systems (GPS) are used for collecting ground control points (GCPs), and these GPS values are fed as input then the accuracy of DEM is high and accurate; and this approach is highly cost effective. Satellite images and toposheet are also used to collect the ground control points (GCPs) if collections of samples are less reliable quality of DEM. The quality of DEM also depends mainly upon terrain roughness, grid resolution or pixel size, sampling density (Guoan et al., 2001). This expression means that, the method of collecting the data, interpolation algorithm, terrain analysis algorithm, and vertical resolution.

Accuracy of DEM is assessed by comparing the contour elevation values obtained from the DEM generated with elevation values of other satellite-based DEM, SOI toposheet. Yarrakula et al. (2016) carried out the high-resolution data provide good accuracy of DEM. The accuracy of DEM may also be affected by systematic errors associated with camera, topographic relief displacement, and earth curvature. Gooch and Chandler (2000) used Failure Warning Model (FWM) incorporated within ERDAS Imagine environment for the ERDAS OrthoMAX DEM generation to detect low accuracy areas and to make full use of the actual DEM output from the DPS.Hu et al. (2009) used approximation theory to assess the accuracy of DEM. They examined three interpolation methods namely linear interpolation in 1D, TIN interpolation, and bilinear interpolation in a rectangle. Chen and Yue (2010) used error propagation theorem to compute terrain representation error and DEM error using

surface modeling. The authors conclude that DEM error is due to not only sampling and interpolation error, but also evaluation of DEM accuracy depends on terrain representation error and used surface modeling based on the theorem of surfaces (SMTS). Another way of DEM generation and analysis of its accuracy is based on numerical test and real-world test to analyze SMTS and classical interpolation methods using ArcGIS software.

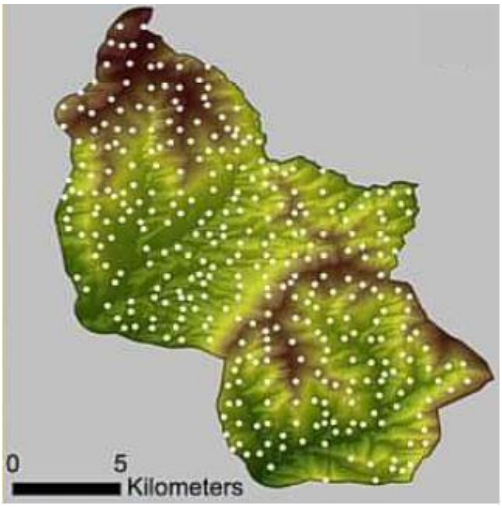

Figure 11: Example of a DEM with validation field points

6. APPLICATIONS OF TERRAIN DATA MODELS

Digital elevation models (DEMs) have been increasingly used for terrain monitoring and remote sensing applications. Moreover, elevation-derived parameters such as aspect, curvature and slope (Figure 12) can be derived from DEMs.These elevation-derived parameters are often used as terrain variables for further analyses such as morphological analyses and drainage network investigations (Yue, 2010) within a landscape. The filtering step is especially important for the terrain modelling applications, since the errors will usually propagate and be enhanced in the elevation-derived variables (San and Suzen, 2005 Application of DEM plays a vital role in several disciplines such as photogrammetry, remote sensing, mining engineering, urban planning, surveying, geomorphology, facility management, civil engineering, resource management, geological engineering, landscape design, environmental management, geography, tank route planning, cartography, computer games, battle simulation, missile and airplane navigation, flight simulation etc. (San and Suzen, 2005).

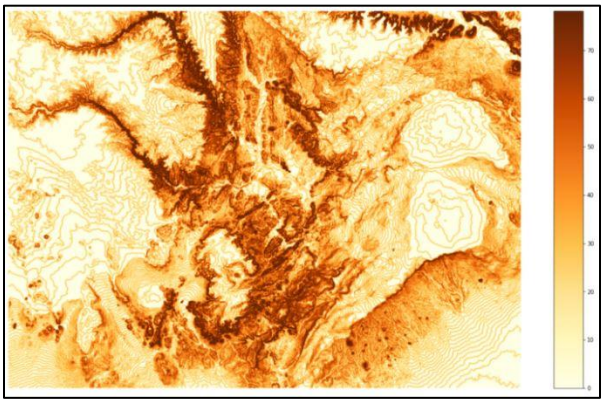

Figure 12: Slope Visualization from DEM (Source: https://medium.com/spatial-data-science/digital-elevation-model-dem-in-python-758f0ede3af8)

Likwise, TIN interpolation can be applied to assessing contaminated soils by zinc and the map can be visualized in a 3D orientation. Interpolation[10] in GIS, is the process of using points with known values or sample points to estimate values at other unknown points. It can be used to predict unknown values for any geographic point data, such as elevation, rainfall, chemical concentrations, noise levels, and so on.

7. CONCLUSION

This paper article explains terrain and elevation models and their development from the early stages. Also, the establishment of the name DEM was explained, as well as the different terminologies, structure and file formats in which DEMs can be saved using GIS. Various authors whose works were reviewed in this paper concluded that, accuracies of interpolation generated DEMs could be improved by developing linear interpolation in 1D (one-dimensional). Another way of DEM generation and analysis of its accuracy is based on numerical test and real-world test to analyze SMTS (surface modeling based on the theorem of surfaces) and classical interpolation methods using ArcGIS software. Nowadays, DEMs are generated using high resolution satellite data like SRTM, CARTOSAT. High-resolution satellite data provide a lot of advantages with respect to accuracy, time, money, and effort consuming.

In conclusion, with the increasing use of computers in environmental modelling and rapid development of three-dimensional (3D) computer graphics, digital terrain related models have become a powerful GIS tool for a large number of applications relating to land resources management towards contributing to ensuring environmental sustainability within communities. The outcome of this chapter is useful to beginners and inter-mediate users of Geographic Information Systems for sustainable land resources management within communities.

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COMPETING INTEREST DECLARATION

The authors declare that they have no known competing interests.

FOOTNOTES

[1]https://books.google.com.ng/books?id=JvEo41LqjtUC&pg=PA7&lpg=PA7&dq=Li+#v=onepage&q=Li&f=false

[2]http://www.charim.net/use/92

[3]http://www.geopranata.co.id/EN/Sampel/DSM-Digital-Surface-Model-and-DTM-Digital-Terrain-Model-.html

[4]https://andrewsforest.oregonstate.edu/event/monthly-meeting-nov-3-lidar-views-forest-above-and-below

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Chapter Three

Evaluating the Contribution of Forestry to Sustainable Development in Forest Communities in Africa

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ABSTRACT

Well managed forest ecosystems are important for achieving a sustainable livelihood in forest communities because of the numerous tangible and intangible benefits forests provide. However, the increasing rate of forest depletion has contributed immensely to hampering sustainable forest conservation, particularly in Africa. This chapter provides insights into the contributions of forest ecosystem to enhancing urban and rural livelihoods in Nigerian forest communities. The outcome of this chapter will serve as a baseline information that could promote the attainment of the fifteenth Sustainable Development Goal (SDG-15) in Africa.

Keywords: Forest depletion, forest ecosystem, Nigeria, SDG-15, sustainable rural livelihood

Introduction

West and Central Africa are rich in tropical forests and the forest resources have been utilized to meet a variety of human needs. African Forests contribute specific direct and indirect benefits that have social, economic and environmental relevance. African forests contribute to the economic growth of many countries, supporting timber and fuel wood production, enhancement of livelihoods that are dependent on farming and herding and gathering of non-wood products for nutrition, medicine, etc (FAO, 2016). In addition, West African moist tropical forests support high rainfall patterns and serve as the storehouses for round wood species such as *Entandrophragma utile,* African mahogany, and *Triplochiton scleroxylon* (obeche) (Chirwa and Adeyemi, 2018).

Thus, from time immemorial, people that live within forest communities or in close proximity to the forests depend greatly on forest products and services for their survival and

livelihoods (Chao, 2015). In the case of Nigeria, most rural and urban communities are inextricably linked to the forest resource for the daily livelihoods. For instance, the tropical forestsprovide land for farming, firewood, charcoal and other trade goods (Chirwa et al., 2017) particularly for the rural economy. Additionally, forests provide consumptive products, such as honey, wild fruits and foods, edible insects, game meat and herbs for both rural and urban dwellers (Adam et al., 2013). Moreover, forests provide wildlife habitats and have traditional, recreational and spiritual values that are important to various forest users (FAO, 2016). They are also important in reducing rainfall runoff and the risks and disasters from flooding and erosion (Arabomen et al., 2019). They help in the regulation of the water cycle thus boosting soil and underground water quality. This is critical in supporting the development and viability of other sectors, such as agriculture, hydro-power generations and portable water supply for domestic and other uses (FAO, 2016). Other studies (Aung, 2015; Bwalya, 2013) highlight the significant contributions of forest ecosystems in offering employment, contributing to household income thus alleviating poverty. Additionally, forests and trees provide aesthetic appeal in cityscapes that are highly valued for tourism and urban uses (Arabomen et al., 2020; 2019) and contribute to amelioration of climate in concrete environments.

Despite the relevance, forest ecosystems are being degraded and/or deforested as a result of anthropogenic factors including the effects of climate change (IPCC, 2007). Deforestation and forest degradation generally have negative consequences or effects on rural livelihoods in Africa, especially poor and marginalized communities whose livelihood are inextricably linked to forest and tree resources. Regrettably, the increasing rate of tropical deforestation and forest degradation greatly hampers attainable of sustainable forest availability in tropical countries. Deforestation and forest degradation contribute immensely to greenhouse gas emissions and global warming (FAO, 2016). It has been reported that the loss of forest coverage account for nearly seventeen percent of the worlds' carbon (CO^2) emissions (IPCC, 2007). Unfortunately, deforestation and forest degradation contribute immensely to the depletion of forest resources which hampers livelihood development. Advancing knowledge on the contribution of forest ecosystems to livelihood development could assist forest managers improve on existing forest management tools and prioritize a balanced forest management objectives amid the quest for physical infrastructural development (FAO, 2016).

To curb the above highlighted rate of tropical deforestation, the 2030 Agenda emphasizes on the need to achieving terrestrial biodiversity conservation, which is the fifteenth Goal of the Global Sustainable Development (SDG-15). In general, all the Sustainable Development Goals (SDGs) converge on three fulcrums of economic growth, social inclusion and environmental protection (MEA, 2015). Moreover, sustainable development requires balancing the needs of present human generation with those of future generations (Farley, 2019). Hence, when forest ecosystems are managed sustainably, they can provide both tangible and intangible services to millions of both present and future human generations.

Thus, the need for global cooperation in the green growth economy has resulted in increased attention to the role of forests in carbon sequestration and providing buffer against climate

change if deforestation was averted and/or controlled. Hence, the Parties to the United Nations Environment Program (UNEP) adopted a reporting framework towards attaining sustainable forest management (Jude et al., 2019). The Global Framework known as Reducing Emissions from Deforestation and Forest Degradation (REDD+) highlights the importance of tropical forest ecosystems to nationallivelihood development relating to SDG-1, attainment of Zero Hunger, SDG-2,enhancement of terrestrial biodiversity conservation and SDG-15, life on land (FAO, 2016). Hence, this chapter specifically provides an appraisal into the contribution of forestry to attaining the fifteenth Sustainable Development Goal (SDG-15) in forest communities toward providing baseline information of the forest ecosystem to a myriad of forestry stakeholders such as, communities, policy makers, and non-state actors in Africa.

Contribution of Forests to Rural Development

Scoones, (2008) and DFID, (2000) illustrated a conceptual framework on diversification of multiple benefits of forest ecosystem and its relevance to livelihood enhancement (see Figure 1).

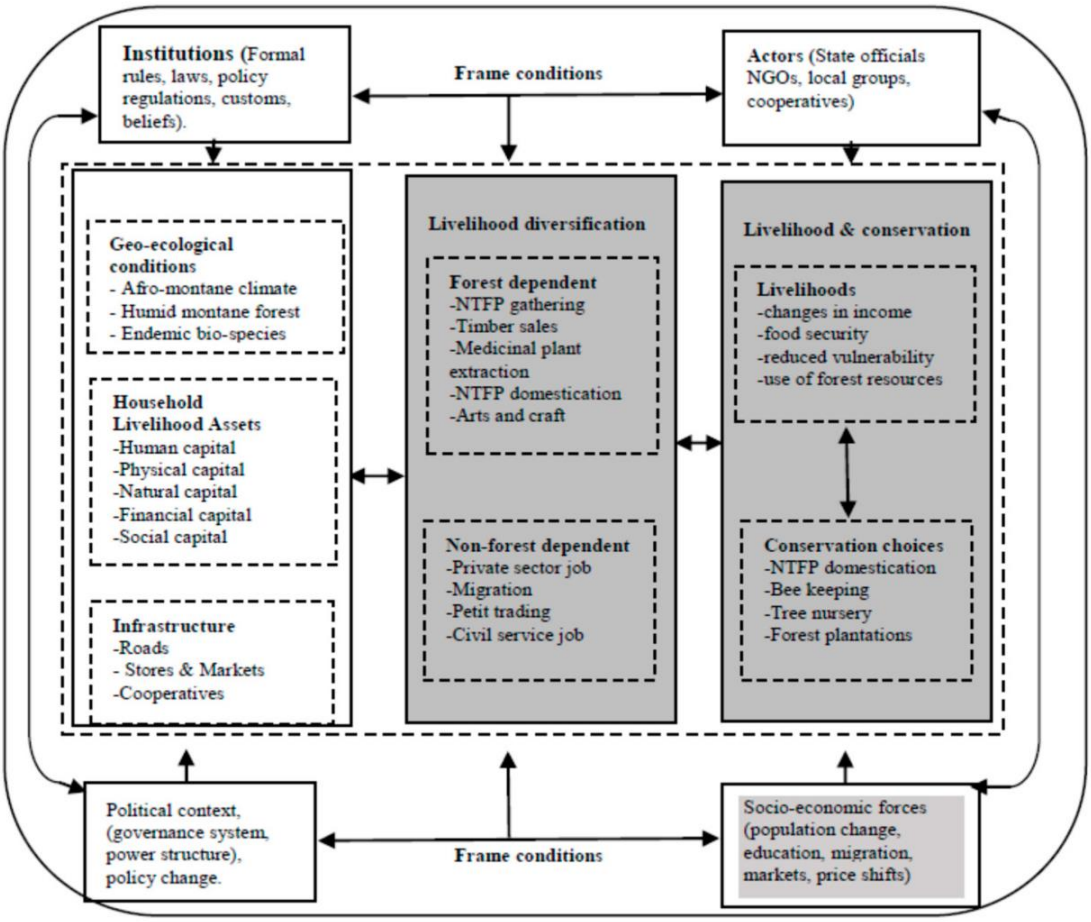

Figure 1 Framework on forest ecosystems and livelihood diversification (Scoones, 2008; DFID, 2000).

Rural households are often involved in harvesting, processing, and trade offorest resources to compliment outputs from farming activities. For some local people,forest-based activities can be a major contributor to householdemployment and income. For instance,the high

dependence on game meat has led to hunting and commercial trade, in many rural areas, especially in the Congo Basin and West Africa (Abernethy et al., 2013).In most rural communities across South Africa, forests provide socio-economic needs such as employment, food, medicine *inter alia*; and material needs like round wood, firewood, e.t.c. (Richardson, 2005).In some cases, forest resources provide 'natural insurance' for rural households to fall back on for either subsistence or income during hardships(Ofoegbu, 2010). Chamberlain et al.(2015) reiterated that forest-based companies provided local employment mostly in low-incomeareas where economicalternativesand skills were limited and/or lacking (Chamberlain et al.,2015).

Conversely, many studies (Chamberlain et al.,2015; Ham and Theron, 2011; Shackleton et al.,2007) have explored human dependency on forest resources as a significant contributor to household's welfare and livelihood in developing countries. In Nigeria, the forestry sector has been reported to play important roles in national economies, and the informal activities in the wood and non timber forest sectors contribute to household income and employment generation. For instance, rural dwellers depend on collection and trade of round wood, fuel wood, herbal plants and wild fruits for income opportunities. Additionally, charcoal, poles,mushroom, edible insect, fibre,fodderare some of the forest productsthat local people depend on for sustenance of livelihood (Shackleton et al.,2007).

Shackleton et al. (2007) showed that forest ecosystems provided around twenty percent of average total household income in South Africa. Cavendish (2000) reported that thirty-five percent of average total household income in form of cash and subsistence came from non-cultivated forest goods in Zimbabwe. Kalaba et al. (2013)and Angelsen et al. (2014)reported that forest income accounted forforty-three and twenty-eight percent of average household income in twenty-four developing countries, Nigeria and Zambia inclusive. Therefore, these findings corroborate the importance of forest ecosystems to livelihood of people in African regions. Additionally, forests foods and or fruitusage and tradehas formed a significant coping strategy for rural populations in Nigeria (Harris and Salisu, 2013). Moreover, many non-timber forest products (NTFPs)have become as important as forest crops for rural people, and ninety percent of the NTFPs collected are from the natural forests. Overall, the general view is that income from forest resources form the highest share of total income for rural poor households (Harris and Salisu, 2013).

Contribution of Forests to Urban Development

Forest ecosystems are important part of the green infrastructure in cities and are fast gaining prominence globally. They are infact unique features of the environment that provide services like other infrastructures in cities (Arabomen et al., 2020).In line with Sustainable Development Goals 11 (sustainable cities), 13 (climate action) and 15 (life on land), forest ecosystems provide services upon which human existence depends and are connected. Examples of ecosystem services provided include improved water quality, acting as air filters, providing habitats for birds and wildlife, reducing noise pollution, enhancing socio interaction, providing scenic appeal and recreational values in urban areas. In addition,forests

in cities (Figure 2) are estimated to remove up to 680 kg of carbon per hectare annually since the turn of the century (Arabomen et al., 2019;Susanna and Lundgren, 2016).

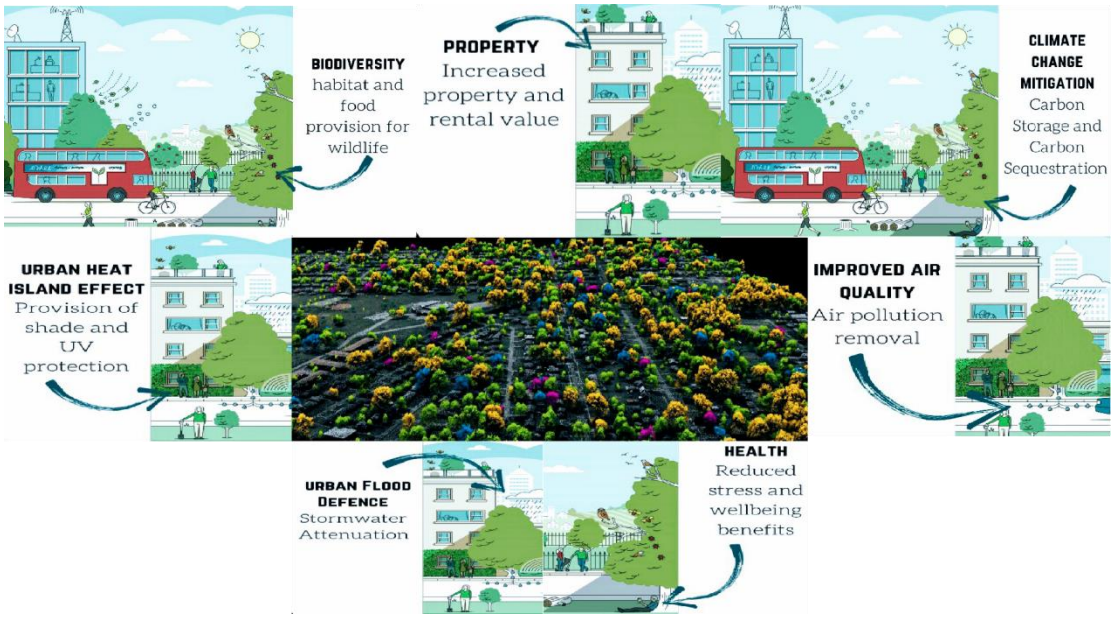

Figure 2 Schematic of ecosystem services from forests and green areas in cities

Although theforest ecosystems have for long been sources of numerous ecosystem services, the continued decline at alarming rates from continued deforestation could mean a precarious situation for Nigeria given the significance of forests and trees inhalting desertification, protecting biodiversity, watershed management and combating climate change (FAO, 2016). Hence, urgent measures are needed to control the over exploitation of forest resources to conserve and ensure the constant provision of these ecosystem values. Most importantly, the New Urban Agenda (NUA) calls for sustainable management of forest ecosystems and tree resources in cities and human settlements in a manner that protects and improves their numerous services (Arabomen et al., 2020).

Summary and Concluding Remarks

The Sustainable Development Goals (SDGs) has integrated the principles of sustainabledevelopment into country policies and programswith a conscious view to reducing and/or halting the loss of forests and trees. Notably, goal 15 sets to achieve by 2020 a significant improvement in the lives of many people, and to ensure environmental sustainability in a very broad sense as part of the environment and the forests. Additionally, the General Assembly of the United Nations established the World Environmental Dayto stimulate awareness and enhance political attention and publicaction.

Conversely, the importance of ecosystems to human society has many dimensions such as economic, socio, cultural, *amongst others.* It is suggested that expressing the true value of forest ecosystems could serve as an important tool to raise awareness and convey the importance of ecosystem services, especially the non-market values to policy makers

(Arabomen et al., 2020). It will enable more efficient use of limited funds (i.e. ecological funds) through identifying where protection and restoration is economically most important and can be achieved at lowest cost.

Furthermore, using 2020 as a reference year, the Food and Agriculture Organization (FAO, 2016) commissioned a series of efforts aimed to analyze the trends and driving forces that would shape the forestry sector during the next two decades and to identify policies, programs and investment options that could enhance the contribution of the forestry sectorto sustainable development. Among such thematic issues are policy and institutional changes andland-use dynamics; urban and peri-urban forestry; environmental aspects of forests and trees,forestry and poverty alleviation, *inter alia.*

In conclusion, this chapter underscores the importance of forest ecosystems to the socio, economic and environmental development of people both in cities and local communities through provisioning of ecosystem goods and services. However, changes in the forest ecosystem are inevitable. Such changes occur due to mismanagement and increasing pressure for land owing to widespread poverty and limited livelihood opportunities.It is imperative to emphasize the need to recognize Sustainable Forest Management (SFM) practices together with institutional frameworks that could halt deforestation and/or degradation as well as provide for the overall conservation of the forest resources in many African countries. Therefore, the highlighted outcomes in this chapter could provide valuable forestry information on the role of forest resources to livelihoods which enhances the review of policies on forest conservation for enhanced forest ecosystem services and livelihoods in Africa. Such, policies can provide a vision and direction for sustainable tropical forestry. Finally, able tropical forestry in Africa would not only provide access to forest resources and food but also contribute to ensuring biodiversity conservation and reduction in transmission of zoonotic diseases such as the ravaging coronavirus pandemic from wildlife to humans in Africa.

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Chapter Four

Achieving Inclusive TVE through Digital Resource Applications in Skill Development of University Undergraduates in Nigeria: Implications for Covid-19 Era

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ABSTRACT

Inclusive education as a manner of educating people equally brings positive academic and social outcomes in the society especially in the area of skill development among undergraduates of technology vocational education for youth employability in Nigeria. There is need to provide every youth with the knowledge, skills and attitudes as well as the lifelong learning opportunities required for living and working in an increasingly technology-driven environment.TVE programmes of our universities therefore have to make the best use of digital resources in the preparation of undergraduates, to enable students with and without special learning needs to participate and acquire skills necessary for entrance and sustainability in the present and future world of work. This paper focused on application of digital resources in the teaching of undergraduates in TVE programmes of Nigerian universities to achieve inclusiveness in skill development for employability in covid-19 pandemic era.

Key Words: TVE, inclusive education, digital resources, applications, skill development, employability and covid-19.

Introduction

Provision of education has been described as the key to all forms of development as it enables people to realize their potentials and improve their quality of life. It has been proven to be the most powerful vehicle to bringing positive changes in other facets of human existence and crucial in attaining the future. This is significant if of quality by providing the learners with the abilities to become economically productive through the development of relevant skills, attitudes and values for sustainable livelihood. Little wonder why it was one of the first groups of the sustainable development goals. Specially, the Sustainable Development Goal 4 (SDG4) aims to ensure inclusive and equitable quality education, and promotion of lifelong learning opportunities for all.

Inclusive education has been described as a manner of education that ensures access to quality education for all students by effectively meeting their diverse needs in a way that is responsive, accepting, respectful and supportive. This entails development and design of educational programmes and activities so that all students learn and participate together by removing barriers and obstacles that may lead to exclusion (Inclusive Education Canada, 2020). To achieve this, academic programmes, TVE inclusive are been instituted at different educational levels, at both formal and non-formal setting in a manner to support a common learning environment and to do away with discrimination in any form.

Inclusive education is crucial in TVE programme, an aspects of education in our tertiary institutions that is aimed at acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various aspects of economic and social life of citizens (Federal Republic of Nigeria (FRN), 2013).Worldwide, job market is continuously changing from knowledge-based to skill-based employment where employers seek for graduates with hands-on proficiency rather than their theoretical aptitude. This demand by employers is deepened by the outburst in technology that have changed the method of doing work in our industries and businesses thereby mounting pressure on TVE programmes of universities, to ensure employability of her graduates. Inclusiveness in TVE programmes therefore becomes very relevant. This involves a systematic review of programme procedures and standards, in terms of provisions and utilization of educational facilities and human resource to continuously improve the quality of its product. TVE programme is expected to take care of all impediments to accessibility to learning experiences packaged for undergraduates. Such impediments include poor teaching environment and strategies, distance, discriminations in gender, differences in learners' needs, capabilities and other challenges. These impediments are aggravated by Covid-19 pandemic lockdown and closure resulting from fear of spread of the disease and casualties in death of humans. Application of digital resources in TVE programmes therefore becomes imperative.

Prior to Covid-19, the level of performance of some graduates in Nigeria seems to be under controversy as employers consider the products of tertiary institutions unusable without further training due to lack of adequate practical experience (FRN, 2013). Okoli and Ibeh (2017) also identified a skills gap in TVE graduates entering the workplace. This has been attributed to inadequate provision of modern technological equipment in educational institution to match the increasing rate of technological changes in modern times, poor teaching methodologies and poor usage of facilities among instructors even when available (Okoli, 2012; Odu, nd). Others are lack of inclusion of many students and inaccessibility to learning experiences due to impediments from distance, location, gender and special education needs. These consequently results to many graduates being turned out without possession of adequate skills and competences which are required for employability in the country. Such scenario equally, increases the level of unemployment in Nigeria and its socio-economic consequences such as kidnapping, prostitution and armed robbery that results to insecurity and poverty among the populace. Nowadays, TVE programmes could be enhanced through digital resources.

Digital resources support students learning and provide accessibility to large number of learners to develop their employability skills. Technologies such as wikis, simulations, games, collaboration and social media tools can be used to develop required learning experiences among TVE undergraduates to showcase their employability skills. Posser (1982) in his Environmental theory of technology education provides the logic of providing individuals on training with an environment that is a replica of the real environment in which they must work after graduation. Learners should be made accessible to facilities and equipment which they will use in the real workplaces during training. Adequate provision, accessibility and application of these resources will enable the undergraduates acquire the required skills for effective performance in the world of work.

It is against this backdrop that this paper was conceived to x-ray ways for application of digital resources in the teaching of undergraduates in TVE programmes of Nigerian universities to achieve inclusiveness in skill development for employability, Covid-19 pandemic notwithstanding.

Inclusiveness and TVE

Inclusive education describes an education delivery whereby access to quality education for all students is effectively met by developing and designing our schools, classrooms, programs and activities so that all students learn and participate together. This entails achieving diverse needs of student in a way that is responsive, accepting, respectful and supportive. In inclusive education, students participate in education programme in a common learning environment with support to diminish and remove barriers and obstacles that may lead to exclusion (Inclusive Education Canada, 2020).

Inclusion ensures equal opportunity to all people and accommodates the interest of individuals with and without special learning needs. McManis (2017) noted that inclusive education values diversity and the unique contributions each student brings to the classroom. In a truly inclusive setting, every person feels safe and has a sense of belonging.When education is more inclusive, it becomes equitable, providing opportunities for civic participation, employment, and community life. Education that is inclusive also breeds respect and understanding as students of diverse abilities and backgrounds socialize and learn together in a common setting. McManis observed that education that excludes and segregates, perpetuates discrimination against traditionally marginalized groups like the disabled and learning challenged. TVE programmes is expected to make way for inclusiveness and accessibility to all boys and girls at primary and secondary school age, youths in tertiary institutions, at non - formal school settings and beyond as in lifelong learning.

Sustainable Development Goal 4 (SDG4) aims at inclusive and equitable quality education, and promotion of lifelong learning opportunities for all. This target area so much emphasized the need to reduce barriers to skill development, technical and vocational education training from secondary school level to tertiary education and provision of lifelong learning opportunities for youths and adults (SDG- Education 2030 Steering Committee Secretariat,

2019). Lifelong education permits training beyond the formal school setting, even at non-formal settings to accommodate studies for occupations and skill development for employability. In Nigeria as in other countries world over, TVE is used as a reliable instrument for propelling change, to impart on the human intellect, in development of skills, values and attitudes among the citizens for sustainable living. TVE as an occupational oriented programme that is life-long is provided beyond formal school setting. This accommodates learners of varying educational needs and special needs such as the gifted, the disabled or challenged, the vulnerable, people working and cannot afford regular programmes to upgrade their skills, and all with occupational needs to acquire knowledge and skills beyond the traditional classroom environment. The use of digital resources for inclusion in TVE is therefore crucial in producing skilled and competent graduates for successful entry into occupations and in the use of modern technologies in their operations to harness the resources available to the nation.

TVE in Nigerian Universities

Today's labour market is very dynamic and progressively changing into skill-based employment. Emphasis is now on work-based learning, that combines the process of knowledge acquisition with skill-building and practical experience. This framework has equally brought TVE to a limelight.

United Nations Educational Scientific and Cultural Organization (UNESCO) recommendation of TVE for the 21st century described it as all trainings resulting to the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various aspects of economic and social life (FRN, 2013; Okoli, Ogwa & Okoli, 2018). World over TVE is regarded as an instrument for empowering people especially youths for sustainable livelihood, socio-economic and industrial development. It is education for occupation and designed to prepare practically oriented technical and vocational teachers, entreprenuers and industrialists. Rufai, Bin Kamin, Bin Saud & Idris (2013) noted that TVE programme is conceptualized with the following;

- An integral part of general education
- A means of preparing for occupational fields and for effective participation in the world of work
- An aspect of lifelong learning and preparation for responsible citizenship
- An instrument for promoting environmentally sound suitable development
- A method of alleviating poverty.

At university level TVE is expected to provide individuals with knowledge, skills and competencies for self and paid employment.

Undergraduates are students found in our universities and account for over 60 percent of youths in Nigeria (Guardian Mobile, 2013). These youths are equally found as undergraduates in TVE. The ability of the Nigerian educational system to provide these undergraduates with knowledge, skills and competencies for employability therefore serves

as the key to improvement in the nation's standard of living. Countries with provision for skilled oriented programmes have few youths that are unemployed and with low poverty rate.

At university level, TVE programmes include technology education, business education, Home Economics Education and Agricultural Education. In line with the goals of university education, TVE programme is provided to undergraduates for the acquisition of Bachelor of Science Degree (B.Sc.) and to post graduates for the acquisition of Master of Science (M.Sc.) or Doctor of Philosophy (Ph.D.). Undergraduates in TVE programmes in universities are admitted through University Matriculation Examination (UME) and Direct Entry. The programme is for four- or five-year's duration. Students offering four years are required to pass courses totaling a minimum of 120 credits and 150 credits for students in five-year programme (NUC, 2008).

. VTE was ensured into the National Policy on Education with the following aims:

1. To provide trained manpower in applied science, technology, and commerce, particularly at sub professional grades.
2. To provide the technical knowledge and vocational skills necessary for agricultural, industrial, commercial and economic development
3. To provide an individual who can apply scientific knowledge in the improvement of environmental problems for the use and convenience of man.
4. To give training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant and
5. To enable our young men and women to have an intelligent understanding of the increasing complexity of technology (FRN, 2013).

The above aims were noted as the general goals of TVE wherever it is taught including at tertiary institutions. It is expected that an inclusive system of delivery should be incorporated with the use of digital resources for wide coverage and openness to learners to achieve these objectives.

Skill Development and Employability in TVE

Okoli and Ibeh (2017) noted employability as qualities that a person possesses which make one employable at job entry level and able to maintain the job subsequently. The Australian Council for Educational Research (2000) pointed such qualities as resourcefulness, adaptability and flexibility, which are needed for success at work and in life as a whole. The employability of a person depends on the knowledge, skills, abilities and attitudes possessed and the way such competencies are applied in line with the needs of the labour market. Skills encompass the abilities, capabilities, aptitude and expertise, acquired through deliberate, systematic and sustained training, and necessary to adaptively perform job functions effectively. Employability skills are the transferable skills that an individual need to make him employable and able to maintain a job (Okoli and Ibeh, 2017). These skills are regarded as generic because they are readily transferable across different work settings.

The employers of labour are on the demand side of labour and are the key stakeholders who identify the skills which people need to obtain, develop and maintain their jobs in the labour

market. They are equally expected to make these skills known to educational institutions, TVE teachers and other trainers; and to assist them ensure that those skills are acquired by their trainees. This is considered relevant due to the fast technological changes that has increased the demand for new additional competencies from individuals for employment. Job specific, technical skills are no longer enough as one needs to exhibit the generic skills to make one perform effectively in any job area. Developing employability skills is therefore vital for undergraduates in TVE programme.

Skill development as used in this paper means advancing in the ability to perform better and quality works through training. TVE programme is such that is designed to help an individual in strengthening his occupational interest and in acquisition of skills necessary to play his role effectively in the job market. These to be achieved mean that educators in TVE should strategize their teaching methods to help the undergraduates acquire the practical knowledge by doing. Digital resource applications in lesson delivery for inclusiveness, by creating a common learning environment, an educational setting where students with varied backgrounds and educational needs can learn together becomes crucial.

Digital Resource Applications in TVE for skill Development

Digital resources in learning refers to materials and a wide variety of technologies that include graphics, images, audio and visuals incorporated in the context of a course that support the learners for achievement of a described learning goals. Development of skills in VTE using digital resources describes a strategic approach in the use of materials, with application of technologies in lesson planning and delivery of learning experiences to support the development of employability skills among students in the programme. Teaching with digital resources also make way for accessibility and inclusion which provide better support for learners with additional educational needs using a wide range of technologies.Educators in TVE programmes need to make the best use of new technologies by applying and integrating them into the curriculum to provide adequate learning experiences to undergraduates.

Digital Resources in TVE

These are wide range of resources for teaching and learning in TVE programmes at formal and non-formal settings such as in classrooms, workshops, or within organizations. These resources range from digital textbooks to curricula, syllabi, course materials or lecture notes, assignments, tests, audio, video and multimedia presentations/animations.Digital technologies, internet inclusive allow for easy sharing of these resources. Such technologies include wikis, simulations, games, collaboration and social media tools that could be used to develop required learning experiences among TVE undergraduates.

Digital resources to achieve objectives of TVE programme especially in keeping pace with constant changes in the dynamic job market, to maintain a culture of openness and accessibility to trainers and varied learners must be properly developed and tactically applied. Singh (2020) noted that digital educational resources are open and accessible to learners if

such materials online could be retained, reused, revised and remixed. Retaining an online resource means that the material is there permanently. Re-use means using the material for one's own purpose. Revised is when the material could be reworked or modified for ones use and remixed if combined with another resource to create a new work (Singh, 2020). In an effort to achieve the 2030 Agenda for Sustainable Development Goal 4 on inclusive and equitable quality education, and promotion of lifelong learning opportunities for all, the World OER Congress in 2012 called on governments to ensure public spending results in the creation of public educational materials. Recommendation on Open Educational Resources (OER), was also adopted by the World OER Congress in 2019 as a new standard setting instrument for open access to digital resource applications in TVET (Singh,2020). UNESCO (2019) noted the objectives of OER which also applies to other digital resources to include:

1. Building capacity of stakeholders to create access, use, adapt and redistribute digital resources.
2. Developing supportive policy
3. Encouraging inclusive and equitable quality OER
4. Nurturing the creation of sustainability models for OER
5. Facilitating international cooperation for OER.

Government and competent authorities were encouraged to create substantial benefits of use of digital resources for their citizens by ensuring that educational materials developed with public funds are made available under open licenses in order to maximize the impact of their investment (2012 Paris OER Declaration).

Singh (2020) also informed that a study commissioned by UNESCO-UNEVOC in 2018 found that the OER concept is still widely unknown among TVET stakeholders, but at the same time been regarded as highly promising in terms of improving access to high-quality training.

Application of Digital technologies and Inclusive Strategies

Digital technologies for skill development include:

Internet: This is the most important digital facility that makes others workable. Internet is an electronic**c**ommunications network that connects computer networks and organizational computer facilities networks around the world. When the bandwidth is not sufficient other online activities will not take place.

Chat Devices*:* Chat devices are electronic tools that allow multiple users to log in and interact. This device provides opportunity for interaction. It is a great learning tool for asking questions, keeping in touch, and receiving materials, updates, reminders and even assessments. Such include, electronic mail, text messages among others.

Voice (telephone or voice – over IP)*:* Telephone is a system of transmitting voices over a distance using wire or radios by converting acoustic vibrations to electrical signals, a telephone call. This could be used for a conference call with an instructor and/or fellow students.

Video Conferencing Devices: a video conference involves two webcams operating the instructor's and that of another key person. A video conference can involve a live feed from a classroom or elsewhere. Alternatively, the conference might transmit a presentation of slides and graphics, with a question-and-answer session at the end.

Virtual libraries/repositories of documents, presentation, graphics, audio files and video: These are electronic learning devices that consist of articles presentation, slides and illustrative graphics, files, and even full-length movies such as documentaries.They are often in pdf format.

Social Networking Devices: These digital facilities incorporate social networking in order to enhance collaboration and learner interaction. Social networking programs that are often incorporated include blogs, wikis, facebook, Twitter, flicker, YouTube and more

Wikis and collaborative documents Devices: collaborative documents allow students to edit each other's work and to collaborate. This device allows people contribute their ideas and thoughts on issues under discussion.

E-Portfolios Assist learners to demonstrate one's skill and knowledge on a special topic area. E-Portfolios allowcombination of texts, images and presentations, video, audio and web conferencing that permits real time interaction. Sharing of presentations, documents and collaborative discussions are integrated in teaching (Ko & Rosen, 2004; Lorenzo & Littleton, 2005; Mason, & Jweller, 2004).

Other digital technologies and strategies that could be applied include:

Open Educational Resources(OER)

This is a digitized skill-oriented learning that seeks to promote a more collaborative form of learning among learners' by giving them access to software, platforms, and projects to learn from. OER involves the use of teaching, learning and research materials in any digital medium to facilitate deeper learning among students. This technology also helps students to personalize their learning practices. Some of the most popular OER platforms are Khan Academy, Lumen Learning, Learning pod, and OER Commons (Singh,2020).

Flipped Classroom

Flipped classroom is a form of blended learning where students receive content created via digital tools. It focuses on making the classroom learning experience more interactive and collaborative. In a flipped classroom, students get the study material to peruse at home and use it later for discussion and debate. This works in favour of a curriculum built to equip the learners with a set of new skills. It allows the teachers to familiarize the students with the application aspect first rather than the theoretical part.

Simulation-Based Learning

The use of Simulation-Based Learning as a digital learning resource enable students learn a new skill

with multimedia devices. Students avail themselves of a greater opportunity to participate and learn through their mistakes. It is a virtual classroom but works as in a real-life situation, giving the participants the freedom to make mistakes without the fears involved in a real-life situation.

Plug-and-Play Learning

Plug-and-Play learning is adigital learning that stress a plug-and-play curriculum. This enables students to access the training from anywhere in the world simply by logging into a platform. They can also access the study resources at all times. It is applied for any skill-based learning program apart from TVE such as sports, performing arts, coding, cooking etc. (Ko, & Rosen, 2004; Singh, 2020).

Considerations for Inclusion in Digital Resource Applications

Inclusive factors to considered in the use of digital resources in skill development include:

1. **Students' learning needs and differences**

To achieve inclusiveness, students' educational needs, interest, background in terms of previous learning experiences and challenges should be put into consideration. These will determine how the teacher will influence their learning through interactions using digital resources for motivation. These also determines the course materials, assessments, and activities to be made more accessible to all students.

2. **Use of different teaching methods and techniques**

Different techniques of teaching the students should be considered and incorporated for effective learning. Assessment could be made using different methods. Use of different teaching methods and techniques is relevant for active participation and learning, giving the students multiple opportunities and ways in which to learn.

3. **Create multiple means and opportunities of assessment**

Different students demonstrate their knowledge and development in different ways, varieties of assessment methods such as written and verbal, within classroom and take home should be made collaboratively and individually. This takes cognizance of students' different challenges for fair opportunity. Method of grading and evaluation should be made clear to the students

4. **Learning experiences, materials and technologies applied in teaching**

These should be selected in acknowledgement of differences in gender, age, religion, cultural affiliations, socio-economic status, among others (Kurt, 2018).

5. **Accessibility of materials**

Materials for teaching should be accessible to students in the choice of course design and technologies to apply.

Challenges to digital Resource Application for Inclusive TV E

Nigerian universities face lots of challenges in the application of digital resources for inclusive TVE in skill development of undergraduates. Such barriers are categorized into two:

1. Inadequate provision of digital resources

Skill development in TVE programmes in Nigerian universities are hampered by inadequate provision of instructional facilities, digital resources inclusive (Okoli, Ogwa & Okoli,2018; Okoli & Ibeh, 2017). This has been attributed to poor funding of university education, far below 26 percent stipulated by the United Nations Educational Scientific and Cultural Organization (UNESCO).

Nwaiwu, Dikeocha and Nwagu (2015) observed very poor educational budget appropriated in some African countries, with Nigeria recording 0.79 percent. This is grossly inadequate. Funding for provision of the digital materials and technologies, especially adequate internet bandwidth in the universities are grossly inadequate. These digital resources cannot be applied without internet.

Some educators in TVE do not have adequate knowledge and skills in the application of digital resources for skill development. Educators in TVE need to be trained and retrained constantly to move in pace with the technological changes in modern times and skill requirements of the labour market. Many universities cannot embark on these training programmes for their educators due to unavailability of funds.

2. Accessibility and Openness of digital resources

Access to digital resources is costly, especially in many Nigerian universities where internet connectivity is inadequate and not freely provided to educators and students. This becomes a barrier for inclusion in TVE skill development. Equally, some digital materials available are not open for use due to traditional copyright policies. There are other potential accessibility barriers such as conflicting access needs in inclusion. People with different backgrounds and educational needs may require conflicting materials for effective participation, such as in lesson delivery and assessment. The universities may not have adequate fund to provide different version of the materials required**.**

Conclusion

Skill development in a more digital context is much demanding, to cope with the fast-growing technology of a dynamic job market. This is more sensitive in TVE as occupational oriented programme provided to recipients at both formal and non-formal education setting for lifelong learning. This is even more challenged in Nigerian universities where facilities for instruction are inadequate, especially internet connectivity which is the mother of all digital applications. Crucial matters as technologies and teaching strategies to apply in lesson delivery comes into play considering the need for inclusion in Covid- 19 era.

Recommendations

The following recommendations are made:

1. Federal and state governments should provide more funds to TVE programme in Nigerain universities in their budgetary allocations. This is to improve on the provision of digital resources needed for effective skill development of undergraduates in an inclusion classroom environment, for acquisition of skills to match the technological needs of the dynamic labour market IN Covid-19 era.
2. The management of universities and TVE programmes in universities in Nigeria should source for funds beyond government budgetary allocations through internal generated revenues and external grants to ensure adequate provision of digital resources in the universities.
3. There should be collaborations between universities in Nigeria and industries in TVE programme for provision of digital resources for inclusion in skill development of her undergraduates in Covid-19 era.

4. Creation of open educational resources should be encouraged by Nigerian government to enable sharing among educators and students in TVE. This will discourage traditional copyrights that do not allow legal editing and re-editing of digital resources and for accessibility to encourage inclusion in TVE programme in Covid-19 era.
5. Educators in TVE programme should be constantly trained and retraining for acquisition of skill required for effective skill development of their students using digital resources in an inclusion learning environment. This will enable them produce graduates with saleable skills.
6. Educators in TVE programmes should create different versions of teaching lessons, giving assignments and assessment to meet the different educational needs of the students in covid-10 era.

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Chapter Five

Government Expenditure and Economic Growth Nexus Using Zivot Andrews and Granger Causality Approaches

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ABSTRACT

Most scholarly works on the nexus between government expenditure and economic growth have focused on the validity of balanced growth model but feedbacks from these studies show a lacuna in considerations made on infrastructural development for developed economies. Our study focuses on examining the empirical relation between government expenditure and specific sectors of the Nigerian economy and further seeks to establish the existence of structural breaks in government expenditure as a strong factor that influenced Nigeria's economic growth from 1970 to 2020. Data were sourced from CBN Statistical Bulletin and National Bureau of Statistics on government spending on transport, communication, health, education, and utilities sectors. We employed the zivotandrews and granger causality tests for this study and results show that there were structural breaks experienced during the study period for economic growth and aggregate spending in Nigeria. Our findings did not establish any causal link between the growth rate of the government spending for infrastructure and sectoral growth in Nigeria. We therefore recommend that government should not only increase its expenditure in these key sectors but should do so in line with the provisions of the World Bank on infrastructural development so that government spending can positively contribute to sustained economic growth in Nigeria.

Keywords: government spending, structural break, causality, sectoral growth

1. INTRODUCTION

Economic growth is a steady process by which the productive capacity of an economy is increased over time to bring about rising levels of national output and income (Todaro & Smith, 2011). It is therefore the desire of every economy to utilise the resources at its disposal to achieve sustained increase in national income with a view to translate this to improvements in socio-economic welfare of the citizenry. Government expenditure has been identified as a strong driving force of economic growth for countries wishing to move from a less developed economy to developed economy (Deng, 2013). According to Central Bank of Nigeria (2016), government expenditure occurs when there is an outward flow of resources from government coffers to other sectors of the economy either in recurrent or capital forms.

Nigerian government has consistently increased its level of expenditure with the aim of achieving economic growth. These efforts have spanned through from the pre structural adjustment program period to the period of structural adjustment program (SAP) and post period till date. The post structural adjustment program period incorporates salient economic reform programs in the country such as, petroleum special trust fund, national economic empowerment development strategy, various poverty eradication programs (including National Poverty Eradication Programme (NAPEP), Youth Empowerment Scheme (YES), National Enterprise Development Programme (NEDEP), Vision 20:2020, Economic Growth and Recovery Plan (ERGP), and lately the Economic Sustainability Plan. Government had spent ₦883.87 billion in 2010, ₦713.3 billion in 2011, ₦744.42 billion in 2012, and ₦405.37 billion in 2013 (Budget Office of the Federation) on infrastructural development. From Figure 1, it is evident that over the years, there has been increased government spendings for the provision of infrastructure in the country.

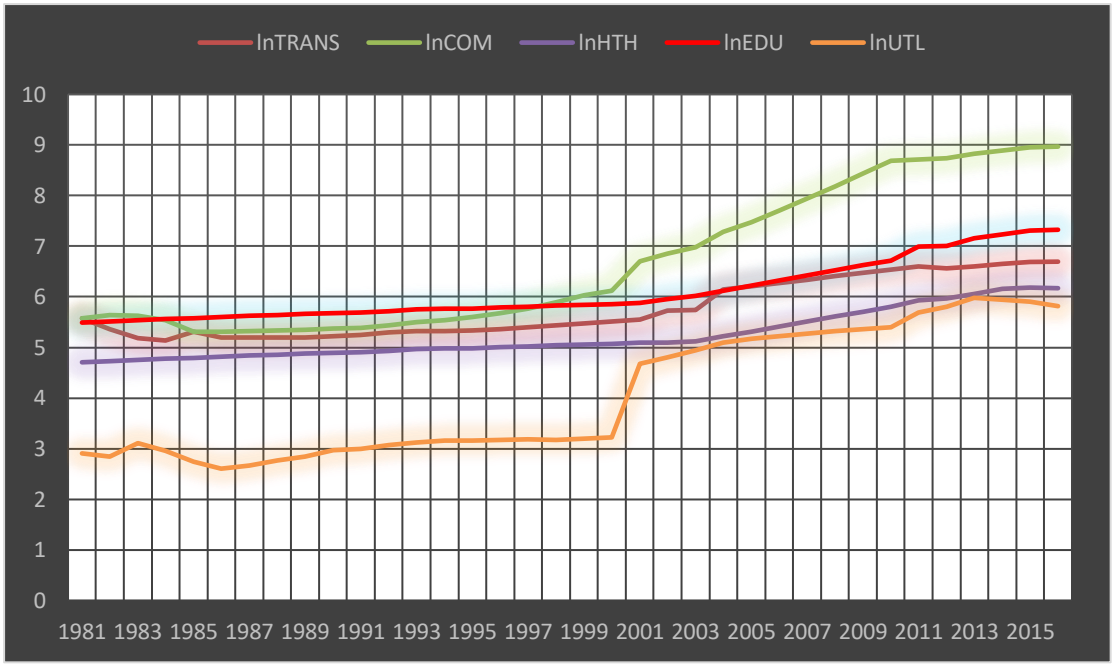

Figure 1: Government spending for infrastructural development (1981 to 2016)
Source: Researchers' Plot, using CBN Statistical Bulletin.

Evidences point to the issue is that increasing government spendings do not reflect the infrastructures available for economic activities. This worrisome situation is further exacerbated by the actuality that in the absence of good road networks, good educational infrastructure, regular public power supply failure, etc., public infrastructural development is unavailable for meaningful economic progress to be achieved. Statistical evidences show unstable economic growth in the country mainly reflected in fluctuations observed in Nigeria's growth rates over the years. Between 1970 and 1979 there was increase in the country's growth rate from 26% to 34% with a decline to an average of -3.4% between 1980 and 1984. Again, economic growth was 11.52% between 2000 and 2004 and further fell from 24.2% to 8.48% for 2000 and 2014 respectively. The Nigerian economy was plunged into a recession by the third quarter of 2016 and recovered partially from it by 2018 but still faces

serious macroeconomic challenges (Africa Economic Outlook, 2020). These fluctuations as shown on Figure 2 are of further interest in this study as they could be attributed to existence of structural breaks within the economy.

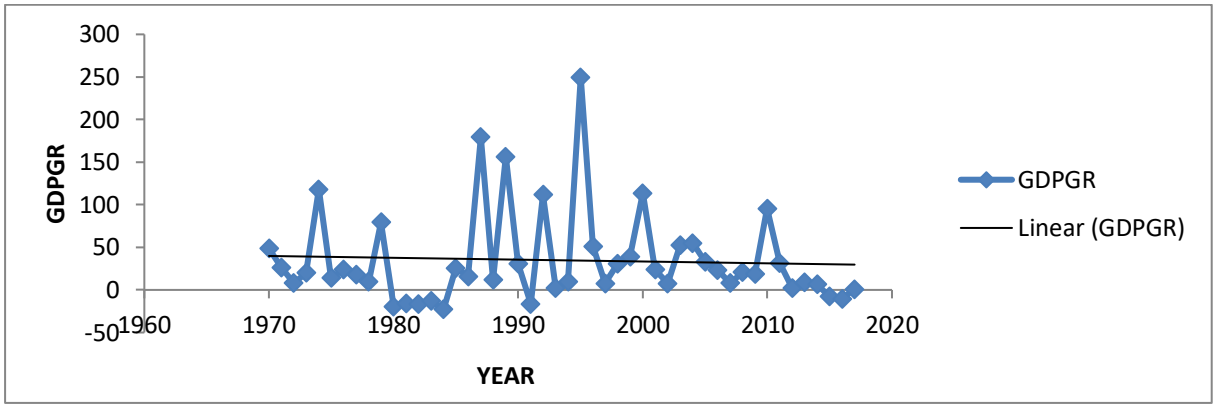

Figure 2: Trends of Nigeria's Economic Growth Rate (1970 - 2017)
Source: Researchers' Plot, using CBN Statistical Bulletin.

Due to the low GDP growth recorded within the period of this study, the Nigerian government took some policy measures to improve infrastructural development within the country to include the national development plans, structural adjustment program, petroleum special trust fund, national economic empowerment development strategy, poverty eradication programs etc. Yet, there exists a lacuna between what was spent for infrastructural development and the available infrastructure. Not minding that revenue inflows from taxation and other income generating activities of the government have been inconsistent yet, there appears to be consistent increase in government spending for infrastructural development in the country. This accounts for continuous borrowing to augment the budget, yet this effort seems not to reflect on the available infrastructures on ground and has not been able to address the question of bourgeoning infrastructural needs in the country. This infrastructural gap witnessed aroused the interest of this research in order to evaluate the probable causes of this negative trend and also to determine the impact government spending on infrastructure through these policies have on economic growth in Nigeria. Table 1 portrays growth in budget allocations on infrastructural development in Nigeria.

Table 1: Growth of Recurrent & Capital Budget Allocations on Infrastructures in Nigeria (%)

Year	1977-1986	1987-1996	1997-2006	2007-2017
Transport & Communication	-1.84	49.2	79.6	7.03
Education	8.78	48.4	33.1	13.3
Health	11.1	38.9	44.1	13.3
Construction	18.8	27.0	57.4	4.96
Water	38.0	33.3	73.2	4.96

Source: CBN Statistical Bulletin 2017.

Despite government's spending on the provision of infrastructures in Nigeria, the contributions of the existing ones are far from raising the quality of growth as shown on Table 2.

Table 2: Contributions of Selected sectors to Growth in Nigeria, 1970-2017 (%)

Year	1970-1979	1980-1989	1990-1999	2000-2009	2010-2017
Education	1.49	0.46	0.23	0.22	0.15
Transport	3.01	4.46	2.64	2.58	1.84
Health	0.52	0.14	0.06	0.06	0.04
Electricity	0.43	0.45	0.13	0.21	0.18
Water	0.07	0.27	0.07	0.01	0.01
Communication	0.20	0.11	0.03	0.52	1.34

Source: CBN Statistical Bulletin, 2017.

Evidences from Table 2 show that education, transport, health, electricity and water did not make significant contributions to economic growth in Nigeria when analysed in line with government expenditure on the sectors. This is reflected in the gross deficit in infrastructural finance facing the Nigerian economy as infrastructures are required to catalyzed economic growth and growth should in turn finance greater commitments towards infrastructural development (Aremu, 2016). Infrastructural deficits facing the Nigerian economy is in turn evident in the growth trend of Nigeria's basic infrastructure as shown in Figure 3.

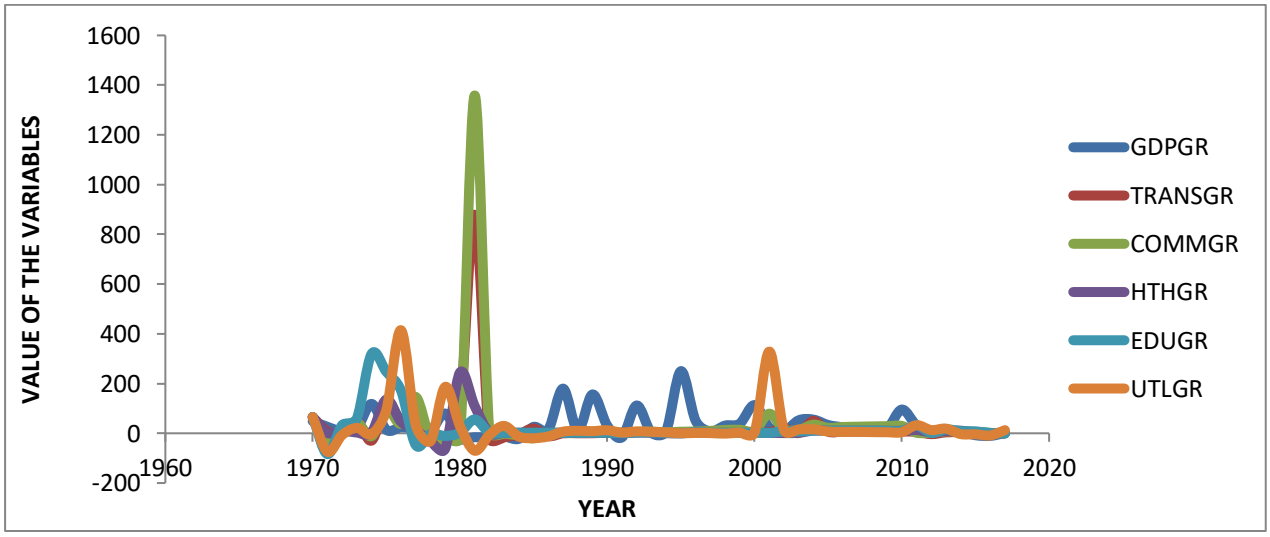

Figure 3: Trends of Nigeria's Economic Growth and Growth rates of Government Spending on Basic infrastructure (1981-2017).

Source: Researchers' Plot using CBN Statistical Bulletin.

Nigeria has the potential to house a large number of the world's investments, but due to poor state of infrastructure development, these potentials could not be showcased to a greater height. The deplorable state of infrastructures and poor state of repairs and maintenance are evident on electricity, roads, railways and water facilities. The reasons for the deplorable conditions of the infrastructures are: reductions in government spending on infrastructure, vandalization of existing ones, corruption, bureaucratic bottlenecks and delay, maintenance and repairs of damaged facilities. As rightly submitted by Ijaiya and Akanbi (2009) and Barro (1990), these could result into: low productivity growth, low-income growth, low savings, low level of industrial development and ultimately end up as vicious cycle of poverty. Infrastructure deficit have decimated Nigeria's growth potentials and made doing business

very difficult and restrictive. For Nigeria to realize its growth potentials, a fully structured and sustainable infrastructure development policy is desirable. Infrastructure development and management constitute the critical area which requires efficient developments that the society heavily relies upon and this would provide a good yardstick of measuring socio-economic development (Ret, Niels, Daniel, &Youdi, 1994).

The growth process of an economy can be ascertained through the quality of infrastructures supporting it. Infrastructures could be financed through domestic savings or foreign direct investment (Lynde & Richmond, 1993; Martin & Rogers, 1995). The bulk of infrastructure financing in Nigeria comes from direct budget investment from fiscal resources, borrowing and market-based financing. A large number of urban infrastructures in Nigeria were financed through direct budget expenditures from the three layers of government (central, state and local governments). However, the dimension of finance differs due to constitutional limitations. Infrastructure development remains grossly inadequate relative to the nation's requirements due to lack of funds. Revenue inflows from taxation and other income generating activities have been quiet epileptic and inadequate to address the question of bourgeoning infrastructural needs in Nigeria. There appears to be a financing gap from direct budgetary spending on infrastructure. This gap can be filled by borrowing and market-based financing. To address this challenge, the Central Bank of Nigeria (CBN) established the infrastructure finance office to come up with a sustainable financing framework to stimulate long-term financing for infrastructure development (CBN, 2011; CBN, 2015).

Previous studies have been made in this area of study for instance Nathaniel and Bekun (2020), Usman, Agbede, and Bako (2016), Akpansungand Gidigbi (2020 Olorunfemi (2008). These existing literatures have not moderated the discussions on the existence of structural breaks in government expenditure and economic growth rates as a clue to the causal relationship between these two variables in Nigeria. While some studies show existence of structural breaks (Akpansung&Gidigbi, 2020; Awe&Gil-Alana, 2019; Ogbonnaya&Otta, 2018), others show that government expenditure and economic growth rates have not experienced joint structural breaks in Nigeria (Jamani&Ukarin, 2020). This knowledge gap has aroused the interest of this research in an attempt at providing further empirical evidences to the debate by examining the causal relationship existing between government expenditure and economic growth in Nigeria. Our study therefore seeks to provide answers to the following objectives:

1. To ascertain the existence or otherwise of simultaneous structural breaks for economic growth and aggregate government spendings in Nigeria during the period under study.
2. To establish the existence of causal links between government spendings and Nigeria’s economic growth.

The outcome of our study will equip policy makers with knowledge with which to make and execute policies on the optimal government spending for the reduction of infrastructural deficit in Nigeria so that the standard of living of the citizens can be improved. Our paper also aims at proving the validity or otherwise of the Hirschman’s approach to infrastructural development. Our findings will also add to existing knowledge and contribute to scholarship as a useful reference material in the course of undertaking further studies. The rest of the

paper is structured into literature review, research methods, result presentation, analysis, and discussion and finally conclusion and recommendations.

2. LITERATURE REVIEW

2.1 Theoretical Review

In this section, the theory of balanced growth and the theory of unbalanced growth are reviewed because they emphasize government investment in infrastructure. The Romer version of the new growth theory is also reviewed since our study is on economic growth.

1. Theory of Balanced Growth

The theory of balanced growth as propounded by Arthur Lewis (1954) postulates that there should be simultaneous and harmonious development of different sectors of the economy by the government so that all sectors grow in unison. For this, balance is required between the demand and supply sides. The supply side lays emphasis on simultaneous development of all inter-related sectors which help in increasing the supply of goods. It includes the simultaneous and harmonious development of intermediate goods, raw materials, power, agriculture, irrigation, transportation, etc., and all industries producing consumer goods. On the other hand, the demand side relates to the provision for large employment opportunity and increasing incomes so that the demand for goods and services may rise on the part of the people. The demand side is related to supplementary industries, consumer goods industries, especially agriculture and manufacturing industries. With simultaneous setting up of all types of industries large number of people are employed, they create demand for each others' goods. In this way, all goods will be sold out.

The theory is stated simply as output at time t is a function of input factors (labour, capital and technology) required in directly productive activities and social overhead capital that will facilitate simultaneous economic growth with both having some degree of homogeneity. The social overhead capital is government investment in all sectors of the economy. The strength of the theory is that if government investment is properly done, it leads to simultaneous economic growth. The weakness is that it leads to rise in costs because simultaneous establishment of a number of industries is likely to raise money and real costs of production thereby making it economically unprofitable to operate in the absence of sufficient capital equipment. When the new industries are established, the demand for the products of the existing firms will decrease and make them unprofitable. At the same time, the demand for factors of production will rise making possible for there to be a raise the prices of factors of production in all industries. The theory pre-supposes the need for balanced investment to provide a growing demand, and the existence of increasing returns.

Hirschman criticism of Lewis' balanced growth theory is on the grounds that it cannot hold for developing countries because developing countries do not have all the capital to provide the required factor input that will lead to balanced economic growth. Hence Hirschman advocated for unbalanced economic growth for developing countries. Secondly, there is no proper explanation concerning degree of homogeneity among direct productive activities and social overhead capitals. Kindleberger observes that instead of starting with new industries, the theory does not consider the possibility of cost reduction in existing industries. In some

countries, labour is in abundance but capital and entrepreneurial skill are scarce. While in others, labour and capital are scarce but other resources are in abundance. This is a great hindrance to the practical application of the concept of balanced growth. According to Kurihara, balanced growth is not to be desired to induce private investment but to be desired for its own sake, as far as an underdeveloped country is concerned. It therefore does not consider planning, but simultaneous investment in all sectors requires planning, direction and coordination by the government. It is therefore wrong to apply a theory applicable to a developed economy on an underdeveloped economy.

Not minding that this theory is on government spending on infrastructure aimed at attaining economic growth, it was not adopted as the theoretical framework for this research work because Nigeria as a developing nation does not have sufficient capital to invest in all sectors of the economy simultaneously and harmoniously so as to attain economic growth. The theory of balanced growth fails as a theory of development because development implies the process of change of one type of economy into another more advanced type. But the doctrine of balanced growth would involve the superimposition of an entirely new self-contained modern industrial sector upon the stagnant and equally self-contained traditional sector. The officials in underdeveloped countries lament that the necessary skills and other resources for development are lacking in the economy but the protagonists of the balanced growth doctrine assume that persons lacking in skills and entrepreneurial ability become omniscient overnight and are in a position to start a chain of new industries, thus appearing to be a contradiction in itself.

2. Theory of Unbalanced Growth

The theory of unbalanced growth was propounded by Albert Hirschman (1958) and contrasts with the doctrine of balanced growth. According to the theory, investment should be made in selected sectors rather than simultaneously in all sectors of the economy. No underdeveloped or developing country Nigeria inclusive possesses capital and other resources in such quantities as to invest simultaneously in all sectors. Therefore, investment should be made in a few selected sectors or industries for their rapid development, and the economies accruing from them can be utilized for the development of other sectors. Thus, the economy gradually moves from the path of unbalanced growth to that of balanced growth. It is his contention that deliberate unbalancing the economy, according to a pre-designed strategy, is the best way to achieve economic growth in an underdeveloped country. According to Hirschman, investments in strategically selected industries or sectors of the economy will lead to new investment opportunities and so pave the way for further economic development. He maintains that development has of course proceeded in this way, with growth being communicated from the leading sectors of the economy to the followers, from one industry to another, from one firm to another.

Hirschman maintained that development can only take place by unbalancing the economy by investing either in social overhead capital or in directly productive activities. In social overhead capital are included investments on education, public health, communications, transportation and conventional public utilities like light, water, power, irrigation and drainage schemes, etc. A large investment in social overhead capital will encourage private investment

later in directly productive activities. Thus, the social overhead capital approach to economic development is to unbalance the economy so that subsequently investments in directly productive activities are stimulated. As Hirschman puts it, "investment in social overhead capital is advocated not because of its direct effect on final output, but because it permits and in fact invites directly productive activities to come into the economy", some social overhead capital investment is required as a prerequisite of directly productive activities investment. Hirschman after establishing his argument modified Lewis' balanced growth into unbalanced growth model. In Hirschman's opinion developing countries do not have all the capital to provide the required factor input that will lead to balanced economic growth. Hence Hirschman advocates unbalanced economic growth for developing countries.

Rosenstein-Rodan (1943) cited in Todaro and Smith (2011) criticized Hirschman's theory of unbalanced growth by pointing out that inadequate attention has been paid to the composition, direction and timing of unbalanced growth. He further points out that the theory concentrates on stimuli to expansion and tends to neglect or minimize resistances caused by unbalanced growth. When development is the outcome of deliberate unbalancing the economy, business attitudes change due to shortages and tensions, and there is lots of opposition and hostility. Hirschman neglects this type of reaction on the part of the existing institutions in underdeveloped countries. Investment creates imbalances thereby creating pressures and tensions in the growth process which are overcome by the inducement mechanism. But pressures and tensions are bound to be serious in underdeveloped countries thereby hampering the process of development. Also, there may be lots of difficulties in procuring technical personnel, raw materials, and basic facilities like power and transport and even in finding out an adequate domestic or foreign market for the products. All these inhibit growth because it is difficult to shift resources from one sector to another. Kindleberger also criticized that the unbalanced growth doctrine leads to the development of inflationary pressure within the economy. When large doses of investments are being injected into the economy at certain strategic points, income will rise which may tend to increase the demand for consumer goods relative to their supply. Shortages arise due to strains, pressures and tension. Such a situation leads to inflationary rise in the price level. It becomes difficult to control prices in underdeveloped countries, as the governments are incapable of wielding monetary and fiscal measures effectively.

The relevance of this theory to a study on the Nigerian economy is that Nigeria lacks sufficient capital to invest in all sectors of the economy simultaneously and harmoniously so as to attain economic growth. There is need to invest in the sectors stipulated by the theory so that the development achieved from them will spill over to other sectors and economic growth will be attained.

3. **The Romer Variant of New Growth Theory**

As postulated by Romer (1991), the endogenous growth theory (which is a variant of the new growth theory of economic growth) holds that economic growth is primarily the result of endogenous and not external forces. Endogenous growth theory holds that investment in human capital, innovation, and knowledge are significant contributors to economic growth.

The theory also focuses on positive externalities and spill over effects of a knowledge-based economy which will lead to economic development. The theory primarily holds that the long run growth rate of an economy depends on policy measures. For example, subsidies for research and development or education increase the growth rate in some endogenous growth models by increasing the incentive for innovation.

The endogenous model gives a constant-savings rate of endogenous growth and assumes a constant, exogenous, saving rate. It models technological progress with a single parameter (usually A). It uses the assumption that the production function does not exhibit diminishing returns to scale to lead to endogenous growth. Various rationales for this assumption have been given, such as positive spillovers from capital investment to the economy as a whole or improvements in technology leading to further improvements (learning by doing). However, the endogenous growth theory is further supported with models in which agents optimally determined the consumption and saving, optimizing the resources allocation to research and development leading to technological progress. An endogenous growth theory implication is that policies that embrace openness, competition, change and innovation will promote growth. Conversely, policies that have the effect of restricting or slowing change by protecting or favouring particular existing industries or firms are likely, over time, to slow growth to the disadvantage of the community.

The theory underlies that the concept of endogenous growth often points to the differences in wealth that still exist between some industrialized and non-industrialized regions, something that exogenous growth proponents would argue evens out over time. On the other hand, one of the main failings of endogenous growth theories is the collective failure to explain conditional convergence reported in empirical literature. Another frequent critique concerns the cornerstone assumption of diminishing returns to capital. Stephen Parente contends that new growth theory has proved to be no more successful than exogenous growth theory in explaining the income divergence between the developing and developed worlds (despite usually being more complex). Paul Krugman criticized endogenous growth theory as nearly impossible to check by empirical evidence because too much of it involved making assumptions about how immeasurable things affected other immeasurable things. The theory is relevant to the present study in that it stipulates factors/determinants needed to be invested in so that we can attain economic growth.

2.3 Empirical Literature Review

We reviewed some selected research works carried out by scholars on the existence of structural breaks in government expenditure and the causal relationship existing between government expenditure and economic growth rates in Nigeria. For instance,

Ogbonnaya and Otta (2018) examined Nigeria's macroeconomic rates from 1970 to 2015 in search of structural breaks. The study focused on interest rates, exchange rates and inflation rates in Nigeria. Unit root tests to detect multiple breaks, LM approach to test for model stability, and the Chow test for identifying break dates were the analytic methods employed. The results show the presence of statistically significant breaks for the macroeconomic

variables employed in the analysis thereby leading to the rejection of the null hypothesis. The paper recommends that the government should adopt the policy of switching regimes in order to reduce the occurrence of breaks in Nigerian time series data.

Awe and Gil-Alana (2019) was able to show that Nigeria's growth rate was unstable with non-linearities and structural breaks caused by erratic political institutions, poor economic management and insecurity from 1960 to 2017. The study recommends that the government should build stronger political structures that will enhance economic growth in the country.

Akpansung and Gidigbi (2020) studied government expenditure on debt management and economic growth nexus in Nigeria while employing the Johansen-Juselius cointegration, granger causality and bai-perron's multiple structural breaks procedures. The results show the existence of both short and long run relationships between government expenditure and economic growth but no causal relationship was established.

Jamaniand Ukarin (2020) examined the existence of structural breaks in public expenditure shocks and human capital development in Nigeria from 1981 to 2018.The study employed the zivot and andrewsnnit root test for structural breaks, variance autoregressive (VAR) technique and the impulse-response functions technique and found that the impulse response functions were robust to structural breaks on the data employed. The study recommended that the government should ensure efficiency in public expenditures.

Nathaniel and Bekun (2020) sought to establish the existence structural breaks in government infrastructural expenditure and economic growth in Nigeria from 1971 to 2014 using vector error correction and granger causality tests. The results show that granger causality test supported the neutrality hypothesis in the short run. The study therefore recommends that the government should embark on more appropriate fiscal policies.

This study therefore becomes imperative because there is no consensus in the literature about the nexus between government expenditure and economic growth.

3. METHOD OF THE STUDY

3.1. Model Specification

Our study stands out to validate the unbalanced growth theory the endogenous growth model as its theoretical framework. According to Romer (1986), an underdeveloped economy can attain economic growth by investing in capital accumulation (K), quality workforce (L) and improved technology (A) which is derived from within the economy. The unbalanced growth theory as stipulated by Hirschman (1958) posits that an underdeveloped economy can attain economic growth by investing in specifically on selected sectors of the economy or in social overhead capital (SOC). SOC is further decomposed into government spending on transport, communication, health, education, and utilities sectors. The model described above can be stated thus:

$$Y = f(K, L, A) \quad (1)$$

$$GDP = f(K, L, SOC) \quad (2)$$

$$GDP = f(GFC, HDI, TRANS, COMM, HTH, EDU, UTL) \quad (3)$$

The mathematical and econometrical form of the model with the variables converted to growth rates is given as follows:

$$GDPGR = \beta_0 + \beta_1 GFCGR + \beta_2 HDIGR + \beta_3 TRANSGR + \beta_4 COMMGR + \beta_5 HTHGR + \beta_6 EDUGR + \beta_7 UTLGR + \mu \quad 4$$

Where GDPGR is gross domestic product growth rate as measure of Nigeria's economic growth; GFCGR is gross fixed capital growth rate as measure of capital; HDIGR is human development index growth rate as measure of human capital which is empowered labour; TRANSGR is growth rate of government spending on Nigeria's transportation sector; COMMGR is growth rate of government spending on Nigeria's communication sector; HTHGR is growth rate of government spending on Nigeria's health sector; EDUGR is growth rate of government spending on Nigeria's education sector; UTLGR is growth rate of government spending on Nigeria's utility sector; β_0 to β_7 are the parameters being estimated and μ other variables not explicitly included in the model.

In order to fully analyse the first objective, Zivot-Andrews (1992) test for presence of structural breaks was employed. It was done in such a manner that economic growth proxied by growth rate of gross domestic product was tested to ascertain if it experienced structural breaks during the study period. The government spending on the key sectors selected for the analysis were aggregated and was tested to ascertain if it experienced structural breaks during period as well. This aimed at ascertaining if structure breaks existed within the periods under study and the most prominent break analysed.

This study also adopted the granger causality technique of analysis in order to ascertain the direction of causality between government spending on infrastructures and Nigeria's economic growth. This was done to analyse the second objective of the study. The empirical causality results of this study were calculated within a simple or pair wise granger-causality test in order to test whether each of the independent variables granger cause economic growth in Nigeria and vice versa (Rexford, 2012; Uwakaeme, 2015). The causality equations herein are specified in two equations as:

$$(GDPGR)_t = \lambda + \sum_{i=1}^{m} \beta i (GDPGR)_{t-I} + \sum_{j=i}^{n} Tj\ (\alpha)_{t-1} + \mu_t \quad 5$$

$$(\alpha)_t = \psi + \sum_{i=1}^{p} \theta i (\alpha)_{t-I} + \sum_{j=i}^{q} \sigma j\ (GDPGR)_{t-1} + \varepsilon_t \quad 6$$

α is representing all the independent variables while βi, Tj, $\theta i$and σj are estimable coefficients of the variables in Equation 3.

3.2 Nature and Sources of Data

Secondary data sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin various issues, National Bureau of Statistics and World Development Indicators for Nigeria (WDI) were utilised in the analysis. The scope covered the period from 1970 to 2020.

3.3 Estimation Technique and Procedure

The time series properties of the variables included in the model was initially tested using the augmented dickey-Fuller (ADF) test. The first objective was analysed using the Zivot-Andrews while the second objective was studied using the granger causality technique. All analyses were conducted with the e-views version 10.

4. RESULT PRESENTATION, ANALYSIS, AND DISCUSSION OF FINDINGS

4.1. Time series properties of the variables

The ADF test result for the stationarity or otherwise of the variables included in the model is presented thus:

Table 3: Unit root test results for the study period

Variable	ADF Statistic values	Test Critical values @ 5%	Order of Integration
GDPGR	-6.945333	-2.925169	I (0)
GFCGR	-6.761319	-2.925169	I (0)
HDIGR	-3.623757	-2.931404	I (1)
TRANSGR	-6.465626	-2.925169	I (0)
COMMGR	-7.060629	-2.925169	I (0)
HTHGR	-9.792461	-3.536601	I (1)
EDUGR	-8.631049	-2.936942	I (1)
UTLGR	-6.229138	-2.925169	I (0)

Following the results on Table 3, we observe that the growth rate of human development index, growth rates of government spending on health sector and education sector passed the ADF test at first difference and were therefore integrated of the order I(1) while the other variables included in the model were stationarity at level. We then conclude that there is stationarity for all the variables used in the study.

4.2 Zivot-Andrews Test Result

We analyzed the entire study period and found that growth rate of Nigeria's GDP fell gradually from 1975 and got to -7 by 1983 after which it rose consistently and remained in between -6.35 and -6.3 from 1985 to 2020. Figure 4 illustrates.

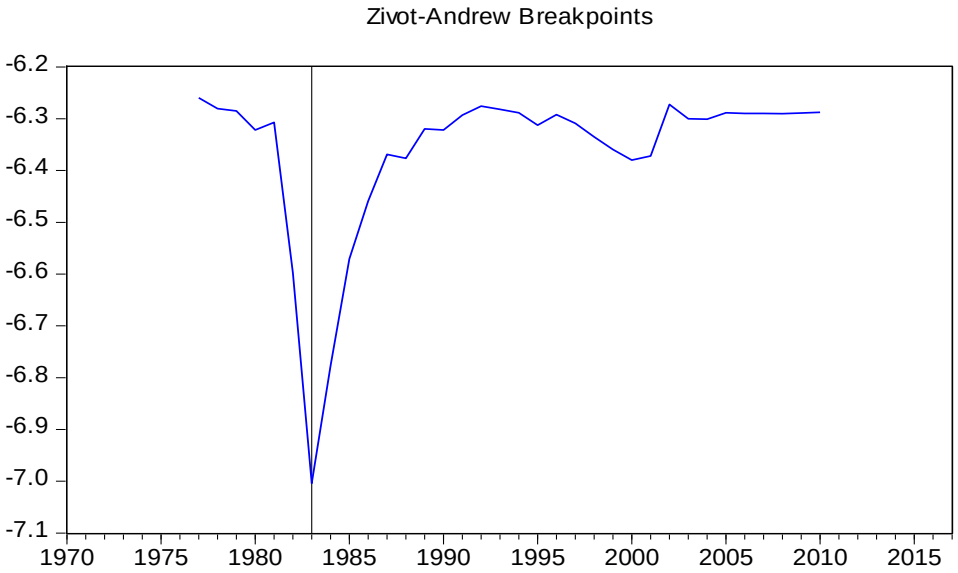

Figure 4: Trends of Nigeria's Economic Growth Rate (1970 - 2020)

Figure 5 also reveals that aggregate government expenditure fell gradually from 1975 till it reached -9.2 by 1987. It rose consistently and remained in between -7.5 and -7 from 1988 to 2020.

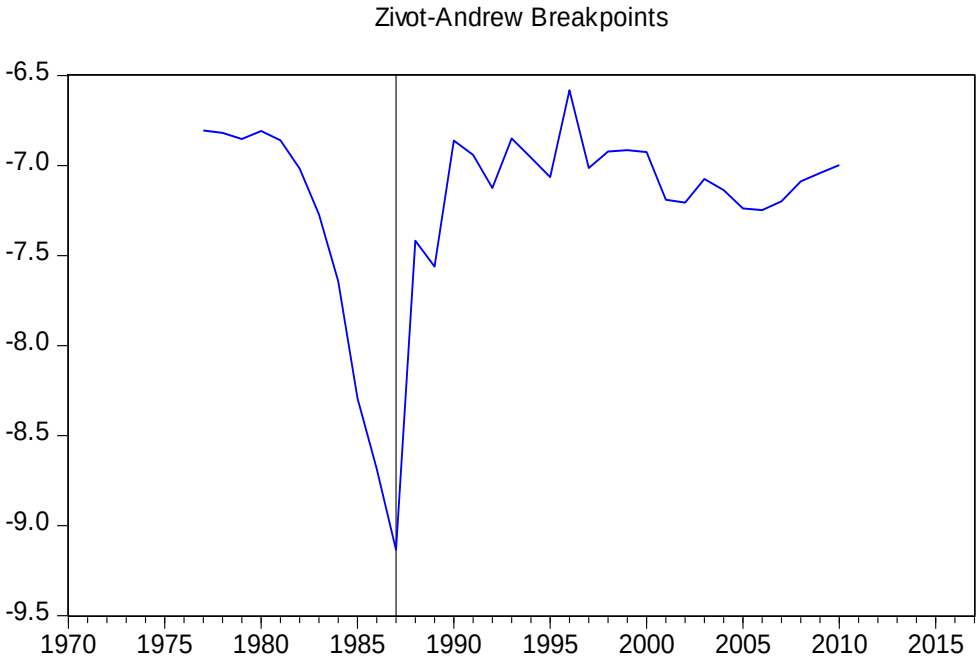

Figure 5: Trends of Nigeria's aggregate spending on infrastructure (1970 - 2020)

A careful look at the trend in the structural breaks between aggregate government expenditure and economic growth for the entire period show that aggregate government expenditure had the lowest break of -7 in 1983 and highest breaks remained consistently between-6.35 and -6.3 from 1985 to 2017 while for economic growth, its lowest break of -9.1 was observed in 1982 and its highest breaks remained consistently between-7.5 and -7 from 1988 to 2020. From this trend analysis, we observe that the gap between the upper breaks and the lower breaks is wide and we maintain that this observation made it impossible for aggregate government expenditure to drive economic growth within this period. We therefore

note that we have been able to achieve our first objective by establishing that public spending is effective in spurring economic growth in Nigeria. The policy implication of this result is that there is a need for government to target these spendings in such a fashion as to achieving growth by ensuring that these expenditures are in line with the size and needs of the populace at every given time.

4.3 Granger Causality Test Result

Causality is a statistical concept which is based on prediction. Its mathematical formulation is based on linear regression modelling of stochastic processes (Engel & Granger, 1987). It determines the direction of causality between variables. Table 4 presents responses to the test of the second objective of this study which is that of establishing the existence of causal links between government expenditures and Nigeria's economic growth.

Table 4: Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
GFCGR does not granger cause GDPGR	48	0.12045	0.8868
GDPGR does not granger cause GFCGR		0.43671	0.6491
HDI does not granger cause GDPGR	48	0.48691	0.6180
GDPGR does not granger cause HDI		0.32722	0.7228
TRANSGR does not granger cause GDPGR	48	0.98742	0.3812
GDPGR does not granger cause TRANSGR		0.50982	0.6044
COMMGR does not granger cause GDPGR	48	0.90319	0.4132
GDPGR does not granger cause COMMGR		0.63233	0.5365
HTHGR does not granger cause GDPGR	48	1.21859	0.3061
GDPGR does not granger cause HTHGR		0.70982	0.4977
EDUGR does not granger cause GDPGR	48	0.22305	0.8010
GDPGR does not granger cause EDUGR		0.00513	0.9949
UTLGR does not granger cause GDPGR	48	0.39733	0.6747
GDPGR does not granger cause UTLGR		0.70442	0.5003

From Table 4, we observe that the null hypothesis that public expenditure on transport infrastructure (TRANSGR) does not granger cause economic growth (GDPGR) in Nigeria was accepted because its probability value was more than 0.05(0.3812). The implication of accepting the null hypothesis is the rejection of the alternative hypothesis meaning that the growth rate of government spending on the transport sector granger causes economic growth rate. Also, we observed that economic growth does not granger cause the growth rate of government spending on the transportation sector as the probability value was more than 0.05 (0.6044) which is the acceptance of the null hypothesis. This simply means that there is no

causality between the growth rate of government spending on the transport sector and economic growth rate in Nigeria.

Again, we observe that the null hypothesis that public expenditure on communication infrastructure (COMMGR) does not granger cause GDPGR was accepted because its probability value was more than 0.05 (0.4132). The implication of accepting the null hypothesis is the rejection of the alternative hypothesis meaning that the growth rate of government spending on the communication sector granger causes economic growth rate. Also, we observe that economic growth rate does not granger cause the growth rate of government spending on the communication sector as the probability value was more than 0.05 (0.5365) which is the acceptance of the null hypothesis. This simply means that there is also no causality between the growth rate of government spending on the communication sector and economic growth rate in Nigeria.

Third, we observe that the null hypothesis that public expenditure on utility infrastructure (UTLGR) does not granger cause GDPGR was accepted because its probability value was more than 0.05 (0.6747). The implication of accepting the null hypothesis is the rejection of the alternative hypothesis meaning that the growth rate of government spending on the utility sector does not granger cause economic growth rate. Also, we observed that economic growth rate does not granger cause the growth rate of government spending on the utility sector as the probability value was more than 0.05 (0.5003) which is the acceptance of the null hypothesis. This simply means that there is also no causality between the growth rate of government spending on the utility sector and economic growth rate in Nigeria. In the rest of the variables examined, there is no causality between the growth rate of capital and labour as well as the growth rate of government spending on the health and education sectors with economic growth rate in Nigeria. Thus, growth rate of government spending on these sectors do not granger cause economic rate in Nigeria.

From the analysis, it could be observed that government expenditure does not cause economic growth in Nigeria. This makes it imperative to recognize the fact that government spending on infrastructural development is an input variable in the growth process and as such it does not cause economic growth directly but will impact on economic activities of production, distribution and consumption which in turn spurs the growth of the Nigerian economy. The policy implication of this, therefore, is that government should always target at achieving providing facilities which drive the growth process such that when this is achieved a positive feedback effect will enable the Nigerian economy to attain optimal growth and development.

5. CONCLUSION AND RECOMMENDATIONS

In analysing the first objective, it was observed that the economy witnessed its worst performance captured by negative growth rate of -12.4 in 1995 during the SAP period while in analysing the second objective, this study finds that there exists no causal link between the growth rate of government spending on all the sectors included in the model (transport, communication, health, education and utility sectors) and economic growth rate in Nigeria.

This is because government expenditure must be considered as an input in the growth process and is indeed an oil in the wheel of progress.

Evidences from the literature show the presence of structural breaks at the introduction of sensitive economics policies. This study therefore recommends that government should not only increase its expenditure in the key sectors of the economy including transport, communication, health, education, utility, petroleum and agricultural sectors but should do so in line with the needs for these infrastructural facilities so that the economy can attain infrastructural development. Also, the policy makers in various sectors of the economy and members of the national assembly, who are the direct beneficiaries of the outcome of this research, should come up with the right policy mix to ensure macroeconomic stability so as to improve the profile of public infrastructure in the economy. This is better achieved by promoting policies that will eschew fraudulent/corrupt practices and abnormal competition in Nigeria sectors and institutions. A more important contribution to existing knowledge is our finding that Nigeria should not adhere to the theory of unbalanced growth because evidences from Nigeria do not support this theory but should rather look inwards to utilise its abundant natural endowments in the petroleum and agricultural sectors so that government spending in these sectors can enable the country achieve infrastructural development which will in turn positively impact on economic growth.

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Chapter Six

Comparative Analysis of Food Expenditure and Consumption Patterns of Rural Non-Farm and Farm Households in South East, Nigeria

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ABSTRACT

This study assessed the comparison food expenditure and consumption patterns of rural non-farm and farm households in South East Nigeria. Descriptive statistics and t-test were used to achieve the objectives. The study found that the percentage per-capita expenditure of consumptions by non-farm households for the three commodities assessed in this study, garri (29.6%) ranks first, followed by rice (24.5%) and yam (21.0%) third. The overall mean food expenditure was ₦58,053.50. On the other hand, rural farm households consume 30.70% (yam), 22.2% (garri) and 22.1% (rice) with mean food expenditure of ₦46,282.60. The statistical test of significance ($t=13.3$ $p<0.05$) indicates the existence of a statistical difference between the mean food expenditure of non-farm and farm households in the study. Legumes such as beans (65.7%), groundnut (18.9%) and melon (11.6%) ranked first, second and third respectively for both non-farm and farm households. The statistical test of comparison ($t=0.212$ $p<0.05$) shows that there is no statistical relationship between the mean food expenditure of non-farm (₦32,348.25) and farm (₦16,807.5) households. The analysis on consumption pattern for non-farm households showed that, their average consumption rate per day has fruits (2.95) as top rank, followed by confectionaries (2.88) and meat/meat product (2.56) is ranked the least. For rural farm households, tubers and cereals (2.98), fruits (2.92) and legumes (2.76) are the three top ranked commodities, consumed. In conclusion, the mean monthly food expenditure of rural farm households was significantly lesser than the mean monthly food expenditure of rural non-farm households. Fruits, legumes and tubers constituted the prominent items in the consumption basket of rural farm and non-farm households. The study recommends that food security interventions need to support households in the rural areas.

Keywords: *Food expenditure, consumption pattern, food insecurity, COVID-19 pandemic.*

INTRODUCTION

Food insecurity is a situation where a person is unable to get a sufficient amount of healthy food on a daily basis. Food insecurity is a condition defined by inadequate access to sufficient, nutritious food for an active, healthy life which excessively affects low-income communities (Wolfson & Leung, 2020). Despite many efforts to improve and increase food production and quality globally, many citizens of Africa and Asia have died due to malnutrition (Matemilola & Elegbede, 2017). Historically, the trend of food insecurity cases keeps increasing in Africa as about 181.7 million people were reported to be food insecure in 1990, 210 million people in 2000, 213 million people became food insecure in 2005, approximately 219 million in 2010 and about 233 million were projected to be food insecure between 2015 and 2016 (FAO, 2019). Therefore, food insecurity remains a global challenge and the number of undernourished people might exceed 840 million by 2030 (Food and Agricultural Organisation FAO, 2020).

Agbola (2014) emphasized that inadequate food supply is one of the most critical problems facing Nigeria, particularly rural communities. As such, Nigerian government has been making attempts to address the problem of food insecurity in the country through special interventions relating to improvement of agricultural value chain programs and projects toward boosting agricultural production (Osuafor et al., 2020). Reliable information on household food security is therefore a prerequisite for effective design, development and monitoring of operational agricultural interventions (Suresh & Ergeneman, 2005). Hence many international development partners such as the World Bank (Economic Economics of West African States (ECOWAS), African Development Bank (AfDB), World Food Programme (WFP) do consider household food security assessment as a guiding principle for designing agricultural interventions.

The rural areas which engage in agricultural production are the most hit in terms of food insecurity and poverty as is reported to be more endemic in rural areas (Haddad *et al*, 2016). Nevertheless, many smallholder farmers hope for sustainable agricultural production since numerous government investment in agriculture are recently being situated on large spans of arable lands in rural communities (Osuafor, 2017).

According to Ojeleye e*t al.* (2014), consumption pattern describes the variation in goods and services consumed. An individual's decision on what range and type of food commodity to consume is influenced greatly by income and other factors such as social norms. Mondal et al. (2015) asserted that the consumption pattern of a community distinctly reveals its financial position as well as its standard of living, poverty level and human development. Hence, the annual family expenditure of a household is an important indicator for determining its economic status and material well-being. Aqccording to Chong et al. (2018), income and expenditure and consumption levels are the most popular parameters that are taken into consideration to determining the food insecurity status of rural households. Farm households refer to two or more persons sharing a single residence of a farm where the primary occupation of the household is the operation of the farm premises and non-farm households refer to two or more persons sharing whose assets and sales are more than 50% non-farm products (Anderson *et al*, 2017). Consequently, the Nigeria's Bureau of Statistics noted that

due to the complexities in the measurement of income and how it varies, consumption and expenditure pattern are being used to give a better indication because consumption pattern depicts the level of welfare and poverty. Determining the food security status of households (both farm and non-farm), income determination and consumption levels are the most popular approaches. National Bureau of Statistics noted that due to the complexities in the measurement of income and how it varies, consumption and expenditure pattern are being used to give a better indication because consumption pattern depicts the level of welfare and poverty (Ogboru *et al.* 2018).

The contemporary coronavirus (i.e. COVID-19) is a nascent factor compounding the hunger-related problems in rural communities. Hence, Nigerian populace are endangered with a new type of food insecurity relater problem; thus, reemphasizing commitments to be more proactive in agricultural investments. For example, the novel COVID-19 pandemic poses a new threat to the food system by reducing the food supply chain due to lockdown imposed by Federal Government (Ogbodo *et al*, 2021). Betwwn March and October, 2020, many Nigerian households were affected by the interruption of the food supply chains caused by lockdowns amid COVID-19 pandemic in the country. Food shortage created during lack of food availability during COVID-19 lockdowns further contributed to lowering immunity of many households that could not maintain their daily ration. Hence, resulting to high rate of the coronavirus infection across the geopolitical zones of Nigeria (Egwue *et al*, 2020). It is very rare to find study that assessed the present food insecurity situation of the country due to COVID-19 pandemic most especially among rural non-farm and farm households from the angle of food expenditure and consumption pattern. The current period of COVID-19 pandemic requires that research should be conducted to investigate effects of COVID-19 on food expenditure in comparison with consumption pattern of rural farm and non-farm households in Nigeria.

The aim of this study was to compare the food expenditure and consumption patterns between rural farm and non-farm households in South-East, Nigeria. Specifically, the study compares amount of food expenditure in naira with the consumption pattern of both non-farm and farm households in rural areas. Consequently, food insecurity in the study area was determined using the total amount of food expenditure in comparison with the consumption pattern,

Methodology

i. Description of study area

This study was conducted with the five states of Abia, Anambra, Ebonyi, Enugu and Imo States, making up the Southeast Geographical Zone of Nigeria. The Zone is located between latitudes 4 and 7 degrees North of the Equator and between longitudes 7 and 9 degrees East. Its population stood at 22,000,000 in the 2006 census (Clement, 2018).

Figure 1: Map of study area depicting the five states making up the Southeast Zone of Nigeria.

ii. Description of sampling approach adopted in this study

The target population of this study were generally rural farmers registered in the agricultural development programme (ADPs) of South-eastern states of Nigeria and non-rural farmers whose primary occupation was not farming. All rural farmers and non-farmers in south-east, Nigeria in view make made up the population of the study. The sampled farmers were drawn using a multi-stage sampling process. The first stage involved the random selection of three of the five states in South-east region of Nigeria which are Anambra, Enugu and Abia State (Figure 1).

In the second stage, eight LGAs were purposively selected from the three states. The criteria for selecting the LGAs was the predominance of their rural setting. A rural setting is a geographical setting that is located outside cities and densely populated by Agriculture.In the third stage, 15 communities were randomly selected from the eight LGAs sampled as seen in Table 1.

iii. Development and validation of the questionnaire

A semi-structured questionnaire designed by the researchers was used for data collection. Instrument was validated by two lecturers in the Department of Agricultural Economics. Descriptive statistics was used to achieve the objectives.

Table 1: Sample Size Determination

States	Purposively selected LGAs	Selected Communities	Number of registered farmers (ADPs)	Confidence Level (%)	Margin error (%)	Actual Sample size	Rural Farm households	Non-Rural Farm households
Anambra	Anambra west	Ogidi	281	90	15	28	14	14
		Anam	392	90	15	29	15	14
	Anambra East	Obosi	493	90	15	29	15	14
	Ayamelum	Omasi	192	90	15	27	14	13
		Umueje	167	90	15	26	13	13
	Ogbaru	Afuleri	102	90	15	24	12	12
		Umuleri	321	90	15	28	14	14
Enugu	Uzo-Uwani	Adani	212	90	15	27	14	13
	Isi-Uzo	Eha-amufu	121	90	15	25	13	12
Abia	Ohafia	Nkporo,	129	90	15	25	13	12
		Ohafia	45	90	15	19	10	9
		Abiriba	76	90	15	22	11	11
	Ikwuano	Omuegwu,	54	90	15	20	10	10
		Ibeku	67	90	15	22	11	11
		Isingwu	91	90	15	23	12	11
Total	8	15	2,281	-	-	**374**	**201**	**183**
								GRAND=384

RESULTS

Food Expenditure among Rural Non-Farm and Farm Households in the Study Area

Table 2 shows the comparison of annual food expenditure among rural non-farm and farm households in the study area.

Table 2 Comparison of Annual Food Expenditure among Rural Non-Farm and Farm Households in the study area

Households	Annual Expenditure Rural Non-Farm households			Annual Expenditure Rural Farm households				
Indicators	**Mean Annual Expenditure**	**% Expenditure**	**Food Class Rank/Mean**	**Mean Annual expenditure**	**% Expenditure**	**Food Class Rank/Mean**	**T value**	**Significant level**
TUBERS AND CEREALS	₦			₦				
Yam	121,517	21.0	**3rd**	142,203	30.7	1st		
Cocoyam	34,504	5.9		29,102	6.3			
Ona	23,304	4.0		19,203	4.1			
Potatoes	19,705	3.4		10,203	2.2			
Wheat	39,302	6.7		37,021	7.9			
Maize	13,022	2.2		9,403	2.0			
Rice	142,039	24.5	2nd	102,602	22.1	3rd		
Garri	172,029	29.6	1st	102,902	22.2	2nd		
Fufu	13,389	2.3		9,203	1.9			
Abacha	1,220	0.2		984	0.2			
Total	₦580,535	100.0	₦58,053.5	₦462,826	100.0	₦46,282.6	13.3***	0.003
LEGUMES								
Beans	85,021	65.7	1st	43,203	64.3	1st		
Groundnut	24,560	18.9	2nd	10,902	16.2	2nd		
Melon	15,029	11.6	3rd	9,302	13.8	3rd		
Oil bean seed	4,783	3.7		3,823	5.7			
Total	₦129,393	100.0	₦32,348.25	₦67,230	100.0	₦16,807.5	0.212**	0.039

MEAT /MEAT RELATED PRODUCT								
Meat	55,694	33.7	1st	15,605	12.6	3rd		
Egg	15,603	9.5		15,021	12.2			
Fish	46,930	28.4	2nd	12,302	9.9			
Snails	7,604	4.6		4,030	3.2			
Stock fish	39,201	23.8	3rd	37,293	30.2	2nd		
Dry fish	15,043	9.1		39,102	31.7	1st		
Total	₦165,032	100.0	₦27,505.3	₦123,353	100.0	₦20,558.5	14.93***	0.001
MILK/ MILK PRODUCT								
Powdered milk	14,503	61.7	1st	15,289	68.7	1st		
Yoghurt	3,405	14.5	3rd	2,029	9.1	3rd		
Soy milk	5,600	23.8	2nd	4,930	22.2	2nd		
Total	₦23,508	100.0	₦7,836	₦22,248	100.0	₦7,416	139.2	0.201
FATS AND OIL								
Palm oil	19,293	32.6	2nd	18,203	32.0	2nd		
Vegetable oil	24,503	41.4	1st	23,402	41.2	1st		
Margarine	9,302	15.7	3rd	8,392	14.8	3rd		
Butter	6,040	10.2		6,849	12.0			
Total	₦59,138	100.0	₦14,784.5	₦56,846	100.0	₦14,211	11.202	0.733
FRUITS								
Orange	9,043	17.5	1st	9,201	18.1	1st		
Mango	7,392	14.3		7,293	14.3	3rd		
Paw-paw	5,302	10.3		5,029	9.9			
Water melon	4,032	7.8		4,938	9.6			

Guava	1,022	1.9		2,102	4.1			
Avocado	3,402	6.6		4,201	8.0			
Apple	5,063	9.8		6,302	12.4			
Banana	8,920	17.3	2nd	7,950	15.6	2nd		
Pineapple	7,403	14.4	3rd	3,948	7.7			
Total	₦51,579	100.0	₦5,731	₦50,964	100.0	₦5,662.7	20.21	0.302
VEGETABLES								
Okro	17,829	12.6	3rd	12,201	12.3	3rd		
Garden egg	7,859	5.6		6,950	6.9			
Carrot	15,003	10.6		16,402	14.4			
Telfaira	46,493	32.9	1st	14,302	16.5	2nd		
Bitter leaf	34,202	24.2	2nd	29,302	29.5	1st		
Scent leaf	6,943	4.9		5,940	6.0			
Cucumber	8,910	6.3		2,920	2.9			
Pepper	4,032	2.9		4,201	4.2			
Total	₦141,271	100.0	₦17,658.9	₦99,218	100.0	₦12,402.3	0.93**	0.041
CONFECTIONARIES								
Bread	17,203	41.2	1st	16,840	42.0	1st		
Cakes	8,912	21.4	3rd	10,928	22.7	3rd		
Biscuit	12,203	29.2	2nd	9,102	27.3	2nd		
Buns	3,402	8.2		3,192	7.9			
Total	₦41,720	100.0	₦10,430	₦40,062	100.0	₦10,015.5	13.20	0.290
Total Monthly			₦174,345.6			₦133,355.6		
Expenditure			₦14,528.8			₦11,112.9		

Source: Field Survey: 2020. * Significant at 99% confidence level; ** Significant at 95% confidence level; * Significant at 90% confidence level.**

Non-Food Expenditure of Rural Non-Farm and Farm Households Per Month

Table 3 shows the monthly non-food expenditure of rural non-farm and farm household.

Table 3: Non-Food Expenditure of Rural Non-Farm and Farm Households per Month

Rural Non-farm households	N	Min.	Max.	Mean (N)	Std Deviation	Rank
Social	183	200.00	1000.00	476.18	1661.78	
Education	183	700.00	3300.00	2826.32	1984.98	1st
Health	183	500.00	2000.00	1340.91	11.65	
Transport	183	890.00	2300.00	2090.54	67.28	3rd
Farm	183	450.00	1000.00	714.41	12.37	
House	183	1450.00	4250.00	2735.18	71.336	2nd
Miscellaneous	183	1500.00	5000.00	1609.59	34.25	
Total				9793.13		
Rural Farm households	**N**	**Min.**	**Max.**	**Mean (N)**	**Std Deviation**	**Rank**
Social	201	200.00	900.00	560.93	29.02	
Education	201	500.00	1100.00	748.30	64.21	
Health	201	450.00	1800.00	1295.93	1231.94	
Transport	201	1700.00	5000.00	3409.02	28.22	3rd
Farm	201	820.00	5200.00	4943.21	21.20	1st
House	201	350.00	5250.00	3430.00	190.19	2nd
Miscellaneous	201	980.00	2500.00	1489.20	87.90	
Total	201			12,876.59		P=0.002

Source: computation from field survey, 2020

Consumption Pattern of rural Non-Farm and Farm Households in the Study Area

Table 4 shows the consumption pattern of rural non-farm and farm households in the study area.

Table 4: Consumption Pattern of Rural Non-Farm and Farm Households in the Study Area

Food groups	Consumption pattern Rural Non-Farm households				Consumption pattern of Rural Farm households				Test of Significance
	Daily/ 24 hour recall	Weekly	Monthly	Mean	Daily/ 24 hour Recall	Weekly	Monthly	Mean	P value (Sig.)
Tubers and cereals	18 (10.0)	106 (58.9)	56 (31.1)	**2.21**	89 (49.4)	59 (32.8)	32 (17.8)	**2.98**	29.02***
Legumes	31 (17.2)	127 (70.5)	22 (12.2)	**2.32**	24 13.3)	88 (48.9)	68 (37.8)	**2.76**	11.20**
Meat and meat product	72 (40.0)	61 (33.9)	47 (26.1)	**2.56**	43 (23.9)	54 (30.0)	83 (46.1)	1.82	23.20***
Milk and milk product	13 (7.2)	42 (23.3)	125 (69.4)	1.20	15 (8.3)	38 (21.1)	127 (70.6)	0.92	12.90
Fats and oil	45 (25.0)	68 (37.8)	67 (37.2)	1.97	43 (23.9)	57 (31.7)	80 (44.4)	1.72	39.21
Fruits	20 (53.9)	52 (28.9)	31 (17.2)	**1.45**	102 (56.7)	58 (32.2)	20 (11.1)	**2.92**	71.21
Legumes	28 (15.6)	102 (56.7)	50 (27.8)	**2.19**	66 (36.7)	102 (56.7)	12 (6.7)	**2.17**	20.91
Confectionaries	52 (28.9)	102 (56.7)	26 (14.4)	**2.88**	47 (26.1)	110 (61.1)	23 (12.8)	**2.12**	34.53**

Note: Figures in parenthesis are percentages. Decision rule: Mean >2.0=Accept; Mean <2.0=Reject. The accepted mean scores are bolded.Source: Field Survey: 2020. * Significant at 99% confidence level; ** Significant at 95% confidence level; * Significant at 90% confidence level.**

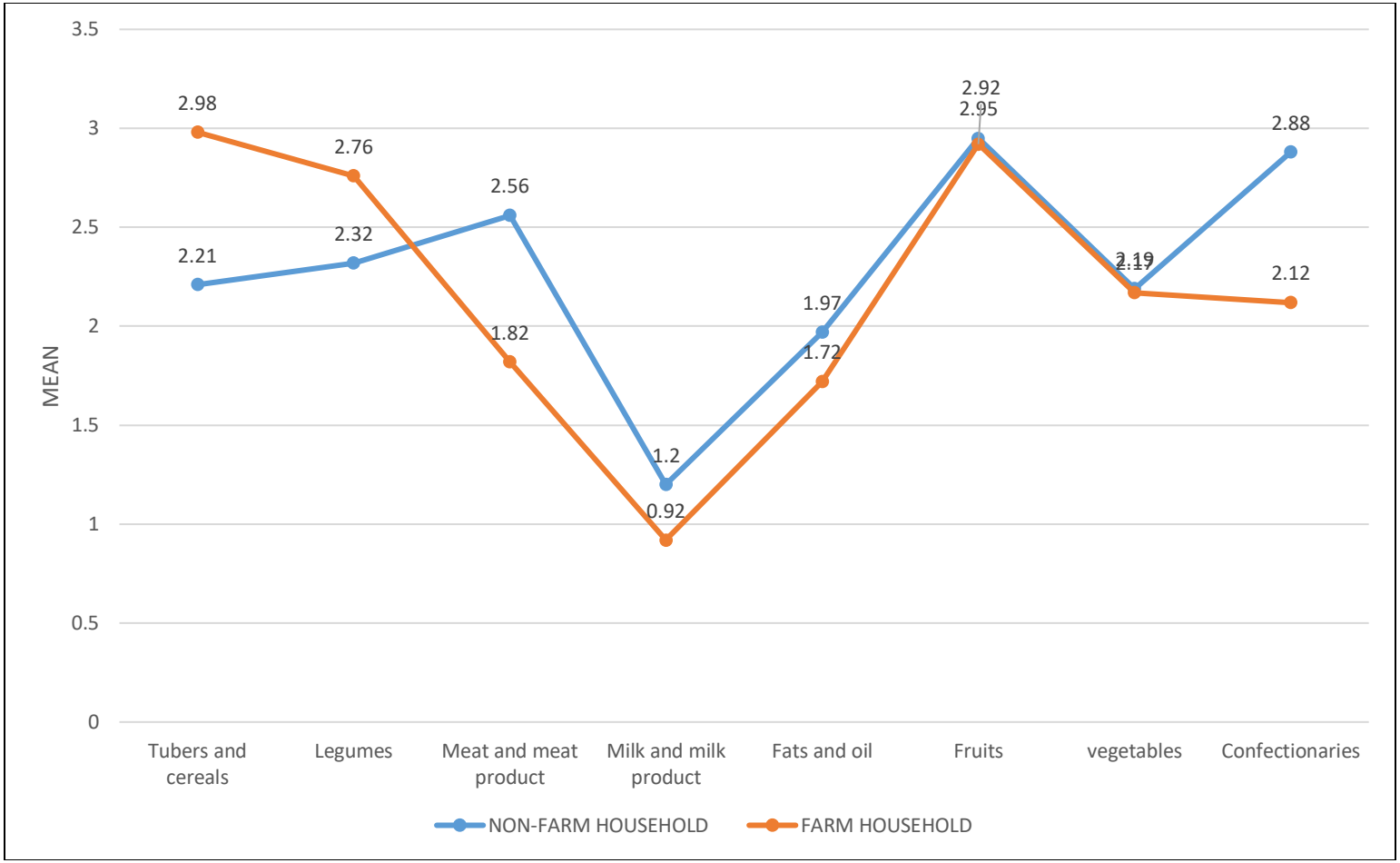

Figure 2: Consumption pattern of rural non-farm and farm households

Discussion

Expenditure Pattern of Rural Non-Farm and Farm Households

Food expenditure of rural non-fam and farm households is presented in Table 2. The results showed that the total food expenditure for rural non-farm households is ₦174,345.6 while for rural farm households is ₦133,355.6. Per capita food expenditure per month for rural non-farm and farm households are ₦14,528.8 and ₦11,112.9, respectively. This implies that rural non-farm households expended more on food than rural farm households per month. The per capita expenditure on energy giving food is very high. A relatively small amount was expended on fruit and vegetables per month. Within the class of tubers, garri (29.6%) ranked first for non-farm households while yam (30.7%) ranked first for farm households. The statistical test of significance ($t=13.3$ $p<0.05$) suggest a statistical difference between the mean food expenditure of rural non-farm and farm households. For meat and meat products, meat (33.7%) ranked first for non-farm households while dry fish (31.7%) ranked first for farm households. It may be possible that farm households spend more of fish because it is gotten from their farms or their fellow farmer, on demand. In the case of confectioneries, for both non-farm and farm households, bread (41.2% and 42.0%), biscuit (29.2% and 27.3%) and cakes (21.4% and 22.7%) are the most consumed confectionaries. Total expenditure of farm households was ₦133,355.6 while that of non-farm households was ₦174,345.6. This result was expected because rural farmers should produce most of their needed farm produce which will make them spend less, compared with their non-farm counterparts. This result agrees with the findings of Akarue and Bakporhe (2013) who reported that 66.2% of the households grew most of their food on their farmlands in North Central Nigeria. Similarly, Manza and Banta (2014) in their study of Southern Borno State, found that the major foods for the rural farm households was from own production.

Non-Food Expenditure of Rural Non-Farm and Farm Households per Month

Table 3 showed the non-food expenditure of rural non-farm and farm households. The result showed that rural non-farm households spend most on education (₦2,826.32), followed by house (₦2,735.18) and transport (₦2,090.54) while rural farm households spend most on farm (₦4,943.21), followed by house (₦3,430.00) and transport (₦3,409.00). Both categories of households had little expenditure for social and health categories. This minimal expenditure could be due to the COVID-19 pandemic which restricted the movement of people. Their level of participation on social activities were obviously reduced. Also, they may have been registered under the national Health Insurance Scheme (NHIS). The findings further showed that the mean monthly food expenditure (₦14,528.8) of non-farm households was higher than their mean monthly non-food expenditure (₦9,793.13). Whereas, the mean monthly food expenditure (₦11,112.9) of farm households was less than their mean monthly non-food expenditure (₦12,876.59). This result is not surprising that food expenditure was mild among the farm households. This is likely because it is expected that they depend on own farm production more

than their non-farm counterparts. Also, the farm households will likely produce food items required by the household on their farm.

Consumption Pattern of Rural Non-farm and Farm Households in the Study Area

Based on consumption pattern on 24 hour, weekly and monthly recall depicted in Figure 2, the mean consumption per day for rural non-farm households of fruits (2.95) ranked first with confectionaries (2.88) and meat/meat product (2.56) ranking second and third respectively. For rural farm households, tubers and cereals (2.98) ranked first while fruits (2.92) and legumes (2.76) ranked second and third respectively. This result implies that legumes do not form major consumption item for both rural non-farm and farm households. Also, it is likely that both categories (non-farm and farm) were not particular about spending on milk (1.20 and 0.95), though they allocate good amount to the consumption of meat (2.56 and 1.82). This indicates their preference to non-vegetarian food. Both households reported expenditure on vegetable oil. All households had spent on Sugar consumption. Also, confectionaries like buns, meat pie were not consumed at a higher level. This could be due to health reasons. This result agrees with the findings of Bester *et al*. (2019) and Bickel *et al.* (2020) who noted that even the middle-income families had not consumed much of confectionaries, unlike what they consume of non-confectionaries. Bzugu et al. (2005) noted that most of them used confectionaries to satisfy hunger temporarily.

For farm households, the high food consumption was on tubers and legumes. This could mean that they have a reasonable balanced consumption of carbohydrates and protein foods. This result is not expected because given the low education status of the farmers, one would expect that they are not particular about eating balanced meals. This result contradicts with the findings of Ojeleye *et al.* (2015) who observed a pattern of skewdness towards starchy food consumption to the detriment of adequate of adequate balanced diets by farm households in Kaduna state. In the case of the non-farm households, food consumption was more on high starchy foods such as garri, rice and cassava. This was to the detriment of balanced diet necessary for an active and healthy lifestyle. It could also mean that the non-farm households do not pay attention to balanced diets. This finding is in line with Kaloi et al. (2005) who noted that garri is the main staple food of households in Kenya and averages over 80% of total cereals they consume.

Conclusionand Recommendations

The study aimed at comparing the food expenditure and consumption patterns between rural farm and non-farm households in Southeast Nigeria. The per capita expenditure on energy giving food was very high. A relatively small amount was expended on fruit and vegetables per month. Food consumption was generally geared towards tubers, legumes and meat products. The study concludes that the mean monthly food expenditure of rural farm households was significantly lesser than the mean monthly food expenditure of rural non-farm households. The study recommended that food security interventions should target at supporting rural households to

reduce their income expenditures on foods and increase own food production in order to be more food secure.

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Chapter Seven

Application of Geospatial Technologies for Attainment of Sustainable Peri–Urban Agriculture in Nigeria: Roles, Challenges and Prospects

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ABSTRACT

Peri–urban agriculture plays an essential role in achieving sustainable development, especially in developing nations. The purpose of this chapter is to present the potentials of peri–urban farming in Nigeria, with a particular interest in geospatial tools for its establishment and assessment. Various aspects of peri–urban farming are covered, including the concept of peri–urban interface, peri–urban agriculture, significant functions of peri–urban agriculture, challenges of peri–urban agriculture, and geospatial tools for establishment and monitoring of peri–urban farming scheme. This chapter's content demonstrates that peri–urban agricultural practice can sustain the livelihood and ecological balance in Nigeria. Of course, it contributes to food security, employment opportunity, climate change adaptation and mitigation, etc. However, peri–urban agriculture and the environments its production systems rely upon are under threats by rapid urbanization. Thus, a modern method is required for the assessment of the peri–urban landscape and the activities therein. In this regards, geospatial technology allows a cost–effective manner for farmlands to be quickly established and monitored.

Keywords: Farmland, food security, sustainable, urbanization, urban fringe

1. Introduction

The global population and the migration of people from rural to urban areas are increasing (Araya and Cabral, 2010; Omali, 2020). Consequently, more than half the global inhabitants reside in cities, and there is the likelihood of an increase in this percentage to 70% by 2050 (FAO, 2016). Of course, the Global South will absorb 90% of future urban population growth, notably in Asia and Africa (Pauleit et al., 2019).

Although Africa is less urbanized than other continents, it has the highest rate of annual average urbanization. The population of Africa's urban centres, which was 395 million in 2010 will likely increase to 1.339 billion in 2050 corresponding to a 21 per cent global urban population projection (UN, 2014). Similarly, Nigeria is the fastest urbanizing country in the Sub–Saharan region. Since independence in 1960, Nigeria's urban population has increased by approximately 62.5 million, with an additional 226 million projection in 2050 (UN, 2014). Most of this population upsurge is in the Federal Capital City (FCC), Abuja and the state capitals– the country's main administrative, economic and commercial centres.

Urbanization has become a significant issue in Nigeria, holding five of the thirty most urbanized centres in Africa. As Nigeria's population continues to concentrate in and around cities, the urban areas have also continued to expand significantly. Consequently, it becomes difficult for several cities within Nigeria to survive the associated pressures. The reasons for this are inadequate urban institutional abilities, ineffective governance apparatus, and absence of economic development commensurate with urban expansion, etc. Most farming areas around Nigerian cities suffer urban encroachment (Brinkmann et al., 2012). The growing urban sprawl into peri–urban areas without intentionally planning for peri–urban food production is a problem for the city food and nutrition security in Nigeria. It is specifically true in the absence of operational control over land–use alteration from agriculture to non–agricultural uses (Satterthwaite et al., 2010).

Generally, the increasing degree of urbanization in Nigeria has truncated both the deprived and middle class within towns to purchase all the food they need. Of course, most households in Nigeria use 50 – 80 per cent of their remuneration on food (NBS, 2005). Accordingly, there is the likelihood of an increased food's demand and the function of peri–urban farming (Mawois et al., 2011) in the country. This function is significant in all the rising cities in Asia and Africa, where the city population and future land development will probably arise (Seto, Fragkias, Güneralp, & Reilly, 2011).

About 25% of urban food consumption worldwide comes from within and around urban areas (El Bilali et al., 2013). Regrettably, most research on urban food security has focused on large cities (e.g. Crush and Caeser, 2014; Seto and Ramankutty, 2016; Craveiro et al., 2016). But, prejudice towards the main towns ignores the significant challenges faced in the peri–urban regions, where poverty rates are characteristically higher relative to larger cities. Remarkably, peri–urban areas afford imperative prospects for early intervention by policymakers (Joos–Vandewalle et al., 2018). It is suitable for practical food policies or strategies that enhance urban food security. Therefore, this chapter presents a discussion on the prospects of peri–urban agricultural practice in Nigeria, with a particular emphasis on the application of geospatial tools for its establishment and assessment.

2. Peri–Urban Interface

In the early 19th century, Johann Heinrich von Thünen (1783–1850) advanced a model on the processes of local land–use patterns, which describes five concentric zones with distinct features and roles (Figure 1). The central ring represents the city, while subsequent rings are mainly agrarian societies and zones surrounding cities (peri–urban areas, fringes and rural settings). Though, Thünen's model is seemingly the first of its kind, the transformations that occur on cities' boundaries greatly attracted researchers' interest in the 1940s. Specifically, the US and Western Europe urban geographers became more interested in the emergence of the peri–urban fringe as an area where urban and rural groups coalesced.

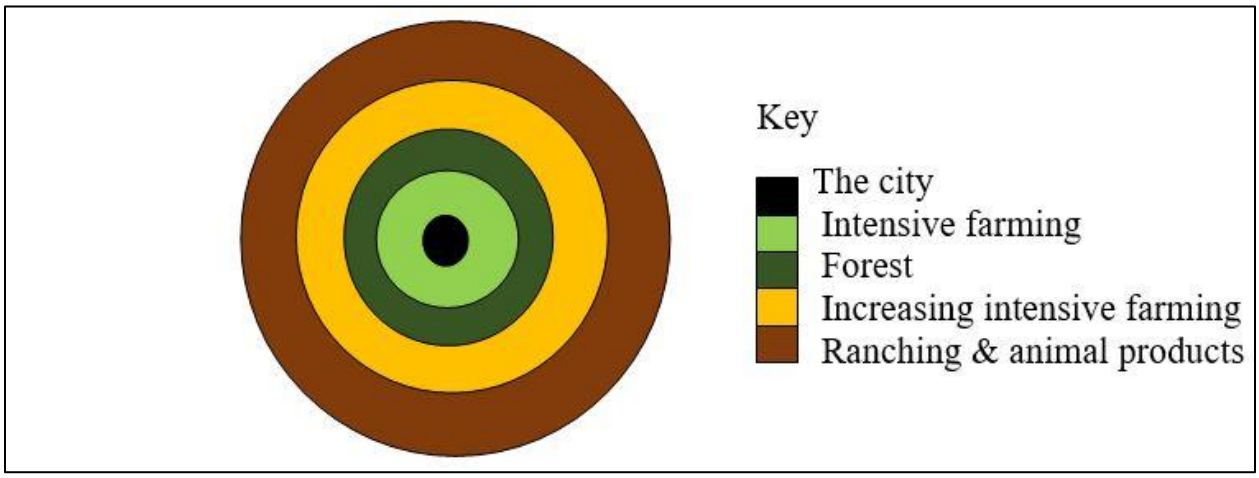

Figure 1: Zones with distinct features and roles representing the processes of local land–use patterns

The term 'peri–urban' describes a place, concept or process (Narain and Nischal 2007). 'Peri–urban' is the urban periphery and cities' geographic edge (i.e. as a place). It refers to an interface between rural and urban activities, institutions and perspectives (i.e. as a concept). It is the movement among physical spaces and the rural–urban transition (i.e. as a process). Generally, peri–urban zones are compound spaces from an ecological, economic and social perspective, especially concerning their spatial closeness and common dependence with both cities and rural areas (Tacoli, 1998). The peri–urban settlement is naturally heterogeneous. It consists of original inhabitant farmers, migrant inhabitants, leisure land users, industrial users, natural resource users, investors, developers, and builders (Thuo, 2010). These people share similar demographics and socio–economic characteristics with those in the cities, and their lifestyles change from rural to urban. Yet, the accessibility to urban amenities varies between them and the urban dwellers, and more importantly, they have only a limited voice in the development of urban settlement (FAO, 1996).

3. Peri–Urban Agriculture

Peri–urban agriculture is an activity on the borderline of a city concerned with agricultural production using human, land, and water as primary resources. It is a multi–actor, multi–function, multi–scale farming that provides food and fibre, ecological and communal services, aiming to satisfy societal demands locally (Lardon et al. 2010). Peri–urban agriculture encompasses various activities, including small–scale farmers who sell their products to urban markets, community–based projects that focus on food justice, and individual households who grow plants, raise animals around the house, etc.

Peri–urban farming zones and rural settings share more commonalities. But the peri–urban practice conspicuously deviates from its rural equivalents because of its location and its function relative to the urban land regarding structural, social, cultural, economic and ecologic aspects (Veijre et al., 2016). Thus, they are areas where urban and rural areas are changed through trade and reciprocated interactions between the physical and practical dimensions of living. Specialized and high–quality food and vegetable cultivation, diversification of agricultural and non–agricultural activities, and direct marketing of leisure and social services are far more frequent within the peri–urban agricultural landscape than in rural settings (Zasada et al., 2013; Pölling et al., 2017). By and large, most peri–urban farmers are not subsistence farmers because over 70 per cent of them sell above half of their agricultural produce, 16 per cent sell below half of what they grow, and only four per cent consume all that they produce (Abumere and Oluwasola, 2001).

4. SignificantRoles of Peri–Urban Agriculture for Sustainable Development in Nigeria

As urbanization increases in Nigeria (Figure 2) and the entire globe, peri–urban cultivation is acknowledged as an approach for enhancing food security. In other words, peri–urban agriculture is an effective alternative food supply system (Balazs, Pataki &Lazanyi, 2016). Thus, it is essential for achieving some of the Sustainable Development Goals (SDGs) because it has the prospects of reducing hunger, increasing incomes, and supporting environmental enhancement. This section deals with the social, ecological, and economic roles of peri–urban farming.

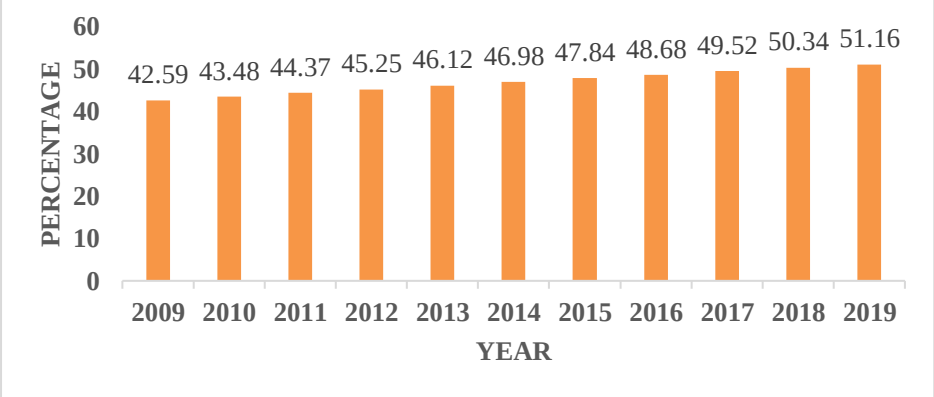

Figure 2: Urbanization in Nigeria from 2009 to 2019. Source: Arthurs'lab work based on World Bank data for 2020.

4.1 Social Function

Peri–urban farming activities provide leisure, recreation, social interaction, education, and other categories of innovative urban–rural associations (Zasada, 2011; Paradis et al., 2016). Also, it is a space where the city and rural dimensions face each other in a relationship of complete reciprocity. Farming close to cities can re–join consumers and producers, helping them form a relationship based on solidarity (Van Der Schans and Wiskerke, 2012). Here, people residing close to the countryside usually buy food from farmers, and spend their free time in agrarian spaces.

The documentation of women's contribution to agriculture is scanty in Nigeria. However, peri–urban farming encompasses social inclusion (Simon–Rojo et al., 2016), especially sidelined groups, including the underprivileged and women in the urban areas. Of course, apart from mothering roles, women can play a significant role in any country's nutritional development and food security.

4.2 Ecological Function

Peri–urban agriculture has a prominent, strategic role in keeping the urban and rural environment's balance and quality. Peri–urban farming practice directly relies on the constant functioning of the settings and the environmental services, including clean water, pollination and soil nutrient recycling, etc. Besides, it contributes to multiple ecosystem services with benefits for peri–urban societies and the wider urban population. However, peri–urban farming processes equally impact the degree to which it can add to other ecological services, such as air and water purification, decreased urban heat island impacts, and flood control (TeLintelo et al., 2002; Moustier and Renting, 2015). Ecosystem services are central to the rural–urban linkages transformation. Services by peri–urban ecosystems and peri–urban farming are essential in several facets of urban sustainability and flexibility, including food security, disaster hazard management, poverty and vulnerability reduction, support of local economies, protection against shocks and stresses, and safeguarding health and wellbeing of the people. Ecosystem services can support livelihoods through farming, an integral part of peri–urban economies and a vital source of jobs and income for many, including poor, vulnerable and disadvantaged people (Gaston et al., 2011).

Nigeria has suffered the effects of climate change in recent time, including flooding, sea–level rise and ocean surge in the South, and drought in the Nigerian Sahelian region. Projections for the future show a substantial temperature increase across all the ecological zones in Nigeria (see table 1).

Table 1: Current and projected maximum daily temperature of some locations in Nigeria

Location	Current mean annual max. (deg. C)	Projected increase by 2046–2065 (deg. C)
Abuja	33.1	1.4 – 2.7
Ibadan	32.0	1.4 – 2.5
Ikeja	31.6	1.4 – 2.3
Ilorin	32.6	1.4 – 2.6
Kano	33.7	1.5 – 3.2
Maiduguri	35.5	1.5 – 3.2
Makurdi	33.6	1.5 – 2.6
Owerri	32.5	1.5 – 2.3
Sokoto	35.5	1.5 – 3.2
Warri	32.0	1.4 – 2.3
Zaria	32.0	1.4 – 3.0

Source: Building Nigeria's Response to Climate Change (2011), p.10

The above data have implications for city systems, urban infrastructure, public health, economic development, local environmental resources, food security, and water supplies. They will affect excessively the vulnerable urban poor, women, the elderly, and the young. However, there is rising evidence that peri–urban agriculture can play a significant role in potentially reducing the vulnerability to climate variation (Lee–Smith, 2010). Also, peri–urban agriculture is a component of green infrastructure, and thus, it conserves the heterogeneous nature of landscapes that perform essential ecological functions. The extra large–scale peri–urban farming can afford green buffers around cities, which usually filters and cools the air.

4.3 Economic Function

Peri–urban agriculture is a commercial farming activity for cultivating vegetables, cereal and root crops, raising chickens and other livestock, producing milk and eggs" (FAO, 2001). It also encompasses the creation and circulation of agricultural inputs, processing and marketing of products within and around cities. Thus, it has become vital, especially in the developing economies (Rezai et al., 2016), as it is a tool for reducing poverty and improving diets (Lwasa et al., 2013).

Providing adequate food, proper nutrition, and dietary quality (May & Rogerson, 1995) enables urban homes in major cities of evolving nations to manage poverty. It can offer revenue diversification and employment, particularly for the urban underprivileged and susceptible

clusters, thus enhancing the comfort of billions of persons worldwide (El Bilali et al., 2013). For example, more than two–thirds of peri–urban farmers in Ibadan, Nigeria, sell over half of their agricultural produce in Ibadan and nearby towns (Adelekan et al., 2014). Also, peri–urban farming is supposed to produce an "opportunity cost", whereby local producers can either save income by consuming home–produced foodstuffs cheaper to have than buying, and increase income selling or selling their products.

5. Challenges to Peri–Urban Agriculture in Nigeria

Though numerous benefits characterize peri–urban farming, several factors constrain its growth in Nigeria. Many of the challenges surrounding peri–urban agriculture stem from concerns about inadequacies in physical planning, government limitations, the market, support agencies, and the farming community itself. Some of the significant challenges to peri–urban agriculture in Nigeria are as follows:

5.1 Inadequate Institutional/Legal Frameworks

The Nigerian farming sector's poor performance is due to the absence of effective agricultural policies and implementation setback. Peri–urban agricultural practice is frequently discouraged in Nigeria through policies and laws. Moreover, the lack of guidelines and rules, specifically for peri–urban farming, presents a more limitation to its approach. Policies to sufficiently assimilate important issues involving environment, health and poverty or take account of the several gains of peri–urban agriculture are not strong in Nigeria.

Another institutional constraint is the absence of information upon which to base appropriate policies and other actions. Critical information gaps about peri–urban agriculture in Nigeria encompass the extent of output, land areas used, the magnitude of employment and income produced, the related ecological effects, and food safety. Of course, decision–makers, extension workers, and farmers need information about peri–urban agricultural activities and potentials to enhance peri–urban farming activities.

5.2 Urban sprawl

Rapid urban expansion and population upsurge in peri–urban regions negatively affect farming land availability (Adelekan et al., 2014). For example, urban transition in peri–urban interface within Lagos–Nigeria can be traced to numerous factors including socio–demography, linkages to the cities, availability of basic services, availability and affordability of housing for the low–income migrants and the state government policy on land use. Generally, unprecedented urban intrusion into agrarian lands and other natural ecosystems leads to loss of biodiversity (Cumming et al., 2014). As populations increase and cities expand, they continuously absorb nearby peripheral areas, generating a new periphery, away from the town, which triggers the peri–urban area to shift outward constantly.

Population increases and the consequent urban sprawl result in a decrease in agricultural activities at the fringe, particularly for several core food groups, including fruits, bread and

grain–based foods (Ramsey et al., 2011; Kavitha et al. 2015). In Nigeria, the sprawl into rural areas is more prevalent in the southern parts, which has led to a decline in extensive agricultural lands. For example, the amount of farm land available to each farming household in port Harcourt (due to the Greater Port Harcourt City Urbanization Project) is reduced, while some households were completely displaced by reason of the fact that the amount of farm lands which are now converted to building roads and other urban expansion activities (Nlerum and Wechie, 2018). The major implication is that many of the farmers were displaced from farming which is their natural occupation. Also, 58 per cent of the land in peri–urban Ibadan is anticipated for change into settlement and other infrastructure by 2020 compared to 2000 (Oladele and Oladimeji, 2011). Generally, the rise in urbanization is giving rise to the growing relocation of farms, which increases the distance between farmers' home and their farmlands and a substantial increase in production costs.

5.3 Limited Access to Agricultural Inputs

One of the most critical constraints to peri–urban agriculture in Nigeria is the limited availability and poor access to the primary inputs to agricultural production, as discussed in the following subsections.

5.3.1 Land

Access to land is a vital determinant of the extent and kind of peri–urban agriculture that is possible. Relevant factors are the amount and quality of available land; these include the availability of services, accessibility, and tenure security. In Nigeria, however, peri–urban agriculture's primary constraint is the inaccessibility of land rather than its availability. For instance, socio economic inaccessibility and land ownership pattern in Ilorin, (Kwara state, Nigeria) has affected farming activities negatively (Yusuf and Abbas, 2012). Complex rental systems have often been in place through the succession of occupants or administrations' informal involvement. Leasing is also typical between landowners and producers.

Furthermore, zoning laws in some cases may prevent the land owned by a farmer from peri–urban agriculture. In other instances, tenancy and lease laws may cause landowners to refuse to lease their land for agriculture out of fear of losing their property. Thus, the precarious nature of the activity is not conducive for efficient long–term farming. With low tenure security and questionable legality, farmers are not motivated to perform efficient farming practices or care about the long–term land conditions, soil regeneration, or the impacts of farming on the ecosystem. The low tenure security also makes the peri–urban farmer a high–risk borrower for credit agencies. Lastly, misconceptions about the accessibility of land for agriculture and the economic competitiveness of this activity pose further constraints to peri–urban agriculture.

5.3.2 Water

The deficiency of water in the peri–urban areas is a significant constraint to the growth of agriculture. In most places, the water supply system does not recognize the farmers living in peri–urban communities. Therefore, it does not provide them with a sufficient supply of water

for adequate irrigation. Urban expansion into villages has led to increasing competition over scarce water. Thus, water is subject to severe pressure from farming and local non–farm demands due to massive land–use changes.

5.3.4 Seeds, Pesticides, Equipment, and others

The essential farming inputs such as seeds, pesticides, equipment, animal feed and medicine are not readily available to many Nigerians in the peri–urban settlements. The intensification of farming in and around the cities requires more inputs. Fertilizers and pesticides are the most expensive inputs based on direct costs and possible environmental impacts. The markets for these inputs are undeveloped, and organized, but for rural farmers. Moreover, their supply is usually limited. The information accessible to the smaller farmer are of uncertain quality and often in an insecure collection. For example, available seeds may not produce high yields. Also, equipment and tools are usually designed for rural agriculture and are seldom well suited to per–urban needs, which involve smaller fields and extra intensive production.

5.3.5 Inadequate finance

The reason for low productivity and "wretchedness" associated with the farming activity is the lack of financial incentives or assistance in bearing or subsidizing the high costs of needed inputs like insecticides, farm implements and water. Farming activity in the urban fringe is not often recognized as a valid economic activity, as such, it does not receive credit quickly. The absence of recognition, tenure insecurity, and lack of organized markets make peri–urban farming a high–risk activity for loan agencies to consider in Nigeria.

Although most countries have special facilities for rural farmers, there are usually no government programs preserving peri–urban farmers' credit in Nigeria. The absence of credit for this project reduces the farmers' ability to absorb business shocks under challenging periods, resulting in high failure rates. It can also result in low yields from the farming activity because the farmer does not have the working capital to plan and purchase necessary inputs. Lack of fund also prevents farmers from upgrading in technology or investing in higher–yield farming systems.

6 Geospatial Tools for Planning and Monitoring Peri–urban Agriculture

Land–use modifications in the peri–urban zones are complex and dynamic processes that involve both natural and human systems. For example, crowding farming land and a decrease of agrarian production capacity can directly result from rapid urbanization (Kim et al., 2003). The farmers could become susceptible as they lose cultivable land. However, proper land use planning at various spatial levels could reduce impending unsustainable land use conversions, which significantly causes global environmental change (Grimm et al. 2008). Of course, planning and monitoring land use are best by using sophisticated methods for change detection.

In recent decades, examination of land use alterations over time has been made easier through the utilization of geospatial technology, which integrates Remote Sensing (RS), Geographic Information System (GIS), and Global Navigation Satellite Systems (GNSS) (Okeke and Omali,

2016). This approach has proved useful in mapping, analyzing, and modelling land use/land cover change (Herold et al., 2003; Grey et al., 2003). They help identify suitable areas to preserve agriculture as determined by the ecosystem services' suitability, increase understanding of the connections between environmental modification and poverty, and highlight hot spots for intervention. Various approaches, including satellite remote sensing, census data, and community–based participatory mapping, can produce agricultural–based ecosystem service maps and observe health and poverty associations. These approaches can also support discussion on the socio–political obstacles and prospects for handling peri–urban ecosystems sustainability. The following subsections discuss the components of geospatial technology with respect to peri–urban agriculture.

6.1 Geographic Information System

GIS provides a platform for spatial analysis and modelling (using geographic principles), and integrates analytical capabilities to broaden the real–world system's knowledge (Jansen et al., 2005; Omali and Umoru, 2019). GIS can efficiently monitor and estimate the land–use conversion (Batty et al., 1997) in the urban periphery. It is a powerful means for obtaining valuable information spread over space (spatial data analysis). One of the essential components of spatial data analysis is the land suitability analysis, which helps determine suitability factors for some specific land use or its part. Land suitability deals with diverse conditions like physical, socio–economic and environmental criteria. The evaluation result of those multiple criteria can be used to make robust decisions about suitable areas for specific use such as agriculture and/or more specific agriculture such as suitable crop type for particular soil.

6.2 Remote Sensing

Reliable data on the spatiotemporal distribution of peri–urban zones used for farming is lacking in most developing nations. Land use/land cover change detection is of great importance for decision making. Using a ground–based survey method for data capturing to detect and measure change is relatively expensive and time–consuming. Consequently, the spatial area for agricultural activities in most emerging nations is unknown. Remote sensing is a potent tool for monitoring land–cover changes (Omali, 2018). It allows the spatiotemporal measurement of peri–urban farmlands rapidly at a relatively low cost. Multispectral images in digital form coupled with the modern innovative digital processing and analysis have made change detection easier (Kachawalla, 1985). Therefore, GIS and satellite imagery have brought to the fore the most operative and cost–effective tools for evaluating spatiotemporal land use/ cover (Geist and Lepers, 2003). Changes in peri–urban farms can now be measured by integrating remotely sensed data with accessible historical evidence from archival photography and other sources in a GIS environment. Apart from the spatial assessment of agro–based activities, remote sensing has proven to be important in other areas of agriculture including crop phenology assessment, and spotting of crop disease, etc.

6.3 Global Navigation Satellite Systems

Global Navigation Satellite Systems (GNSS) refers to the group of satellite–based systems for a user receiver's location in a worldwide (Earth–centered) coordinate system. Examples include the Navigation by Satellite Timing and Ranging Global Position System (NAVSTAR GPS or simply GPS) owned by North America, the Global Navigation Satellite System (GLONASS) owned by Russia, Galileo of the European Union and Compass of China. Detailed information on GNSS technology is plentiful, and many books provide a complete description of these navigation systems (e.g., Dierendonck, and Hegarty, 2000; Feng, 2003; Leick, 2003). However, this chapter is focused explicitly on GPS utilization in agriculture.

NAVSTAR GPS is a satellite–based radio–navigation tool that affords exact global, 24 hours, 3–dimensional position data (latitude, longitude, and elevation). GPS has transformed positioning perception, though it started mainly as a navigation tool. It is easy to use, and it can operate in all weather. The acceptance of GPS application is a function of its high precision in determining position, time and direction. Thus, it is applied in various areas of endeavours such as precision agriculture.

Precision agriculture intensifies agricultural productivity at a low cost while circumventing the ecosystem's undesirable impacts. It is possible by using existing field equipment with added controllers and GPS for spatially–variable applications. At present, fertilizers' site–specific application is the leading precision agriculture application (Naiqian et al., 2002).

Precise position information at any time is of great importance for measuring and mapping crop, soil and water. Of course, GPS utilization in precision agriculture is pretty essential for farm planning and mapping of field boundary, roads, irrigation scheme, and farm or crop yield. Previously, farmers cannot easily relate production methods and crop yields with land variability. Consequently, developing the most efficient soil/plant treatment approaches for enhancing production was restricted. More accurate application of insecticides, herbicides, fertilizers, and improved control of those chemicals' distribution can be achieved using precision farming, which reduces costs, produces a higher yield, and creates more ecologically friendly farming.

7 Conclusion

Rising urbanization in Nigeria necessitates alternative sources of food and nutrition for the urban dwellers. Generally, agricultural systems have the prospects to enhance food security, reduce poverty and improve livelihoods, especially among the ever–enlarging urban and peri–urban societies. The content of this chapter explicitly justifies that the integration of peri–urban agriculture into the core economic policies and agendas of urban and peri–urban zones in Nigeria is imperative for numerous social, environmental, and economic purposes. Such policies and plans would improve the city's livelihoods and peri–urban residents through job creation, technological development, environmental growth and accessibility to fresh and low–cost food items.

Using the geospatial tool to establish and monitor urban peripheries and their agricultural activities can be highly beneficial. GIS helps derive intricate interpretation about fields and to take effective agro–based decisions. Also, Remote sensing is a pretty cost–effective method for rapid assessment of farmlands and crop phenology. Moreover, farmers can take account of spatial variability with GPS. The derivation of helpful information on various land use/land cover categories of peri–urban landscape could help in planning and execution of multiple planning activities for sustainable development. For instance, it is essential for utility planning, assess environmental impacts from the changes that occurred through urban sprawl and preserve socio–environmentally crucial areas.

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Chapter Eight

Implication of Climate Change on Food Security and Peace in Nigeria: A Review

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ABSTRACT

Climate change is a global emergency and has featured as a major issue in most international conferences and debates in recent years. Rather than achieving a significant decline in the impacts of climate change, there is an increasing trend in climate change issues, including flooding, drought, vegetation depletion, food security issues, negative impact on agriculture and escalating threat to regional peace and security across the Sub-Saharan African region. These emerging trends create uncertainty about the possibility of achieving the sustainable development goal on climate change or arriving at a solution to climate change problems. This review explores the nexus among climate change, peace and food security in Sub-Saharan Africa with a focus on Nigeria, aimed at discussing and suggesting policy strategies towards promoting sustainable climate change actions and measures for mitigating climate change impacts. The study also emphasizes the concept of adaptation and committed public engagement as important strategies for addressing climate change challenges, and a focus on sustainable agriculture for improved food security and ecological recovery. It is also suggested that at the individual level, the public should consciously conserve or use energy wisely, step down the level of fossil fuel burning, and switching to use of clean energy; promote knowledge about climate change, and advocate for the right government policies in this regard.

KEYWORDS: Climate change, climate action, food security, peace, Sub-Saharan Africa

INTRODUCTION

The ecosystem provides a natural environment and habitat within which life exist. Plants and animals, as well as human beings depend almost exclusively on the natural environment for their survival. Like other living things, human beings depend largely on the natural environment for food, water, air and other indices of wellbeing. On the other hand, the ecosystem is characterized by a network of ecological features including the climate; which refers to the general weather condition usually found in a particular place; or an average pattern of weather for a particular region. This takes into consideration weather conditions such as temperature, rainfall, air pressure, precipitation, humidity, cloudiness, sunshine, and winds, throughout the year, averaged over a series of years. These climatic features largely influence the wellbeing of living things including human beings. The ecosystem and its potential to provide normal physical and biological services are greatly influenced by changes in climate; which thus, influence the environmental condition of the area or region.Thus, changes in climate or disturbances in the general environment directly influence the condition, habitats, and wellbeing of all living things (Udom *et al.,* 2019). These changes can be natural or caused by exploitation of natural resources by human beings.

In other words, climate change is considered a natural phenomenon in its form as a series of significant changes in the measures of climate; but involves an interplay of natural and anthropogenic activities producing a rather devastating scenario that in turn affects both nature (the environment) and man (Whitmarsh, 2011; Connolly-Boutin, 2016). Hence, climate change discourse would not be conclusively undertaken without addressing direct and indirect human impact on nature, as a major agent of climate change. Thus, everyone is a major stakeholder in the climate change action. Individual or public actions cannot be underestimated; human beings have greatly influenced the course of nature, contributing to climate change by unsustainable activities resulting in environmental issues including pollution and carbon emission (Whitmarsh *et al.,* 2011). Emphasizing pollution, industrialization is among the most feared sources of environmental pollution (Huang & Ukpong, 2019). Household and industrial wastes also form a large gradient of environmental pollution that has culminated into heightening the course of climate change (Aguma, 2007; Adinna, 2001).

Most natural conditions cannot be regulated but through a sustainable action plan, certain natural courses can be prevented, influenced or managed to mitigate negative impacts. As a critical agent of climate change, human beings would need to take actions to prevent or avoid activities capable of exacerbating climate change, as well as helping to ameliorate its impact. More so, the government in different countries and continents has a key role to play towards helping to implement climate change policies to regulate human activities in terms of domestic, agricultural and industrial influence on the ecosystem.

The Sub-Saharan Africa, for instance, has witnessed emerging footprints of climate change, ranging from impacts on the environment to food security issues and regional insecurity. Nevertheless, the region would avert the rising threats of climate change including environmental degradation, drought, famine and desert encroachment, if appropriate sustainable strategies are made to combat climate change challenges. On the contrary, despite the growing challenges, the response to climate change in Sub-Saharan Africa is quite weak and slow, worsened by poorly specialized technological system, poor political will, public reluctance and economic limitations. The region faces a multidimensional effect of climate change, ranging from the impact on food security to regional peace and security. The region has been threatened by food security challenges; hunger, child malnutrition and poverty which make climate change impacts very obvious and exceptionally worrisome. On the other hand, the region remains vulnerable to actions and processes capable of promoting climate change, including unsustainable activities of multinational organizations, weak policies and natural epidemic. Climate change is influenced by several dimensions including a political dimension (Connelly *et al.,* 2003), and the skepticism in public attitude towards climate change issues seems to be a significant barrier to public engagement in climate change prevention and mitigation process (Corner *et al.,* 2012; Whitmarsh, 2011). It is thus obvious that the impact of climate change in the Sub-Saharan Africa (SSA) is worsened following the complex economic situation and cultural diversity, as well as lack of political will by governments in the region to regulate policies towards mitigating climate change issues. Nigeria, for example, with its fast-growing population, faces emerging risks of climate change impacts, following daily pressure on the natural environment, increasing industrial development, expanding urbanization and persistent threats from the oil and gas industry. Therefore, the government reserves the obligation to regulate policies to promote climate change actions. More so, as a global pandemic, everyone is a stakeholder; thus, needless to overemphasis the need for increased public engagement in climate change action.

CLIMATE CHANGE ISSUES IN SUB-SAHARAN AFRICA

Africa is facing emerging threats from the recurrent issues of climate change. The Sub-Saharan Africa (SSA), in particular, seems to have a peculiar case; with an ecosystem seriously threatened. According to Connolly-Boutin *et al.* (2016), Sub-Saharan Africa is particularly vulnerable to climate change, with the interaction of biophysical, political and socioeconomic factors increasing the region's susceptibility and constraining its adaptive capacity. The region consists of numerous areas and countries where the bulk of Africa's natural minerals and other valuable resources are extracted. These include crude oil, gold, diamond and other precious stones, as well as timber and wildlife. The oil and gas industry, for instance, induces inestimable amount of environmental pollution globally, and involves unsustainable operations that potentially aggravate climate change issues (Ukpong *et al.,* 2019), which consequently affect sources of human livelihood such as agriculture and the marine ecosystem (Ekpebu & Ukpong, 2013).

On the other hand, certain agricultural practices continually expose the ecosystem to undesirable changes, making it vulnerable to climate change possibilities. For instance, most indigenous and traditional farming practices, mostly common to Sub-Saharan African farming system, also directly affect the environment; creating climate change issues. Such practices include the routine practice of vegetation clearing (or bush clearing) and bush burning during farming operations (See Plate 1 below).

Plate 1: Photograph showing a large area of vegetation (or bush) cleared and burnt in preparation for planting of crops

Source: Author's Research Album, 2019. Location: Southern Nigeria.

The photograph shown in Plate 1 above shows a typical example of bush clearing and bush burning which is a routine farming practice and culture in most African countries including Nigeria. Year after year, inestimable portion of green vegetation are cleared and burnt as a part of the farming practice to enable planting of crops. While the bush clearing destroys the vegetation and natural habitat of valuable flora (plants) and fauna (animals), bush burning produces excessive heat and high temperature, as well as a tremendous amount of carbon resulting in environmental pollution. These practices are unsustainable and make the environment vulnerable to climate change, by causing environmental pollution and depriving the environment of its green vegetative component relevant for its resilience. The agricultural sector, particularly crop production, also promotes application of ecologically unfriendly agro-chemicals, such as inorganic fertilizers, pesticides, herbicides, etc. Also, with an expanding livestock industry, across the Sub-Saharan Africa where nomadic animal production system is mostly practiced, overgrazing has become one of the emerging ecological issues of concern in

recent time. Nevertheless, agriculture is one of the economic or livelihood engagements mostly affected by environmental changes or climate change (Ukpong & Obok, 2018).

The region also experiences persistent cases of deforestation as a result of crude oil exploration/extraction and urbanization, as well as agro-forestry, and a buoyant trade in wildlife and lumbering. Across the Sub-Saharan Africa, there are high rate of illegal forest activities and deforestation propelled by a booming internal and cross-border trade (most of which are illegal) involving a large volume of timber and fuel woods, and endangered animal/plant species; which are facilitated by weak conservation policies and laws, government negligence or lack of political will to implement strict compliance (Saka-rasaq, 2019). On the other hand, where there are conservation laws, they are known to be either poorly regulated or not implemented. Thus, the lucrative nature of the business coupled with loose laws, has motivated a widespread engagement in deforestation and fuel wood cutting across the SSA region, including Nigeria (Plate 2).

Plate 2: Heaps of Commercial Fuel Wood obtained from deforestation of indigenous Mangrove in Southern Nigeria. Source: Field Photograph (Udom *et al*., 2019).

The massive depletion of forests as a result of deforestation has raised a global concern about natural resource conservation and sustainability (Udom *et al.,* 2019). Deforestation is a threat to forest conservation, and one of the dark sides of deforestation is the certainty of climate change issues, and there is no doubt that Nigeria, and other Sub-Saharan African countries are already

experiencing the effects of climate change (Ogundele, 2016). According to Saka-rasaq (2019), deforestation negatively impacts on 'people and environment', which usually result in biodiversity loss, coastal erosion, desertification and ecological complexity. Like other parts of the world, the Sub-Saharan Africa loses a large proportion of its forest yearly, which may have intensified climate change challenges in the region in recent time (Connolly-Boutin & Smit, 2016). According to Ogundele (2016), a large proportion of forests are being lost yearly in Nigeria. Furthermore, the prevailing environmental conditions in the two regional extremes (north and south) of Nigeria indicate a scenario that defines how existing ecological situations can enhance the impacts of climate change. The semi-desert condition of the Sahel region of Northern Nigeria is associated with the problems of desert encroachment and drought; while the coastal ecology of the Niger Delta region in the south is associated with ocean encroachment/sea level rise and coastal erosion (Ekpebu & Ukpong, 2013; Ukpong, 2012). Evidently, the footprints of climate change are also obvious in the deteriorating state of coastal areas across Nigeria, which pose constraints to coastal farming, fishing and general wellbeing of coastal population. Human activities such as unsustainable agricultural practices and exploitative oil industry operations seem to have catalyzed the peculiar climate change problems in these regions respectively (Ukpong, 2012).

Indeed, climate change is a threat to global peace and food security, and Nigeria as well as other Sub-Saharan African countries has witnessed accumulating evidence of these impacts over the past decades. Thus, it is important that every individual, groups, governments and multinational organizations should be committed to the sustainable development goal as underlined by the United Nations, with a view to addressing climate change challenges in the country and region.

CLIMATE CHANGE AND FOOD SECURITY

Climate change is a direct threat to food security, with evident impact on the environment and livelihood in the Sub-Saharan Africa (Ringler *et al.,* 2010). According to Kotir (2011), '*Sub-Saharan Africa has been portrayed as the most vulnerable region to the impact of global climate change because of its reliance on agriculture which is highly sensitive to weather and climatic variables*'. Numerous factors may be attributed to the upsurge of climate change issues across the region, for instance the increased activities of nomadic herders which have resulted in significant loss of vegetation, destruction/loss of crops, as herds of cattle and other livestock are usually made to invade farmlands across the region. According to Ibrahim *et al*. (2017), farm invasion by livestock is among the major causes of farmers-herders crisis in Nigeria and other countries in the Sub-Saharan Africa, and farmers usually complained of loss of crops and compaction of soil/farm area by livestock. Besides farmland destruction, there is obvious evidence of vegetation loss as a result of persistent animal grazing across Africa. It is a fact that nomadic system has been a part of the history of animal production in Sub-Saharan Africa, spanning over the past century, but the recent increase in cross-border and inter-regional grazing cannot be disconnected from climate change challenges.

Climate change also affects water resources which are very critical variables for food production. With various water sources, Sub-Saharan Africa should comparatively be better-off in fish and seafood production to complement its food supply. Huang & Ukpong (2019) noted that climate change is a major factor in the water scarcity problem experienced in most regions in China and other parts of the world, which affects food security. Water is critical to agriculture and food production. In fact, agriculture cannot be successfully practiced without a sustainable source of water supply, whether by rainfall or irrigation. According to Ngigi (2009), *stress on water availability induced by climate change negatively affects crop productivity*. On the other hand, livestock production is largely affected by water problem across Sub-Saharan Africa, which is one of the major driving forces that encourage nomadic livestock production. In Nigeria, a large proportion of livestock especially cattle is produced through nomadic production system; with numerous herds of cattle being moved from the northern region down towards the south in search for pasture and water (Ekpebu & Ukpong, 2013).

Changes in rainfall patterns and duration influence agriculture (or food production). For instance, the prolonged period of no rain or drought and the accompanying impacts on green vegetation in most parts of Northern Nigeria have encouraged nomadic farming; forcing herders to move with their animals in large numbers down south in search of water and pasture. In a bid to jostle for pasture, herders are forced to move their animals across farms and arable lands where the animals undoubtedly trample on crops and vegetation. As unavoidable as such practice might seem, it could be avoided to preserve crop production and prevent frequent crisis. One could imagine that besides natural distribution of natural resources including vegetation, water resources, rainfall patterns, etc, a fair climate would support at least a substantial pasture and water resources for animal production in the north without much pressure on the south and other areas with a barely supportive agro-ecological climate.

Besides crops, livestock is a major contributor to food security (Inyeinyang & Ukpong, 2019), but changes in climate resulting in drought and harsh environmental conditions including harsh temperatures have affected livestock production across the Sub-Saharan African region, leading to increased nomadic methods of animal production; while crop production in affected regions is yet diminished. In a narrower perspective, it has been reported that most farmers are scared to go to farm due to herders' threats. This spells crisis amongst crop and livestock farmers and by extension their communities; and threatens food security in the nations of sub-Saharan Africa.

CLIMATE CHANGE AND PEACE

Mankind in the 21st Century would wish to rewrite the traditional basic needs listed as food, shelter and clothing, to include peace. They would want to tumble Abraham Maslow's hierarchy of needs which only subsumed peace in the second level of needs called Safety. This is because peace is perhaps the Alpha need and denominator of the need's equation of mankind.

Going by the Encarta Dictionary, peace means "*harmony; freedom from conflict or disagreement among people or groups of people; Mutual calm: a state of mental calm and serenity, with no anxiety; Freedom from war, or the time when a war or conflict ends*." Thus, one would begin to imagine the relationship between peace and climate change.

Evidently, climate change has affected peace and security indirectly, and has become a 'weapon of war' and cause of conflicts/crisis in the Sub-Saharan Africa in recent years. Climate-related disasters have become the prevailing emergencies facing us in the now; claiming property, lives and livelihoods with speed. The outcomes of Climate change are recorded as hostilities of nature to man; e.g., excessive temperatures, flood, wildfires, drought and other climate-related disasters. Globally, the impacts are seen in desertification in Africa, forced migration of vulnerable people in Central America, resource conflict e.g., water scarcity, rising sea levels and tropical storms in small islands around the continents. These aspects individually and collectively pose inverse impact on peace. The attendant disasters due to climate change cause population displacement and eventual encroachment or scramble for land, resulting in disputes and sometimes full-blown crises between communities.

The relationship between climate change, food security and peace, cannot be overemphasized, as the farmers-herders crisis is a threat to national peace and security, and has direct impact on food production in the affected areas (Ibrahim *et al.*, 2017). Loss of arable land for agriculture and grazing have caused conflicts of varying dimensions across Sub-Saharan Africa. In Nigeria, the herders/farmers crises that have claimed lives in their hundreds in every zone of the country over the last few years, is a stark example. This resource conflict has caused almost 4,000 deaths in the last two years and over 10,000 in the last decade (Udo *et al*., 2019). So is flood a menacing phenomenon in Nigeria today; causing significant loss of life and property, with very high disease risk. Between July and September, 2018, 80% of the country was caught in serious flood disasters that affected 34 states, and killed 141 persons, injured 265 and displaced 300,000 (IFRC, 2018). In the last 3 decades, flood disasters have affected 2.8 billion people and claimed 200,000 lives globally (Olarenwaju *et al*., 2019). Obviously, the totality of the changing fate of the climate is a worrisome trend, as nations embrace industrialization, urban development and agricultural revolution to meet the increasing demand from the fast-growing world population. Hence, to protect the planet, and its ecosystem, and explore a sustainable status in food security, world peace and economic development, there is a need for a global action on climate change.

CLIMATE CHANGE AND CLIMATE ACTION

Climate change as an ecological phenomenon thus refers to a significant change in the measures of climate, such as temperature, rainfall, or wind, lasting for an extended period like decades or more; caused by natural factors or human activities. The contribution of human activities to the changing climate of our planet is in the emissions of greenhouse gases, causing global warming

presenting as significantly increased air and ocean temperatures, drought, melting ice and snow, rising sea levels, increased rainfall, flooding and other influences (EPA, 2019), with concomitant impacts that are threatening the very existence of man. This is enough reason to arouse global attention and call for action. Tackling climate issues should begin from tackling the human causes of climate change. According to Bhau & Ukpong (2019), unsustainable exploitation of natural resources is a major factor exacerbating climate change issues, as in the case of the associated issues arising from the operations of the oil and gas industry. Evidently, the oil and gas industry generate wastes and pollution which directly affects the ecosystem, promoting climate change possibilities.

Nature does not negotiate. Can mankind be at peace with nature when its elements get at their extremes? Climate action is a call to action to enable mankind be at peace with nature. This call has been spearheaded by the United Nations (UN). To the United Nations, peace is more than just the absence of war; it means "dignity and well-being for all peoples (UN, 2014). Since its establishment in 1945, The UN has been at the fore of maintaining international peace and security using a range of activities including conflict prevention and mediation, peace keeping, peacemaking, peace enforcement and peace building (UN, 2019a). The International Day of Peace, established in 1981 is the UN's initiative declared by its General Assembly as a day devoted to strengthening the ideals of peace, both within and among all nations and peoples. In 2019, 37 years after it was first celebrated the focus was on a concept of peace under the extremes of nature: The theme of the 2019 celebration was 'Climate Action for Peace'. This theme was necessitated by the realities of a climate emergency facing mankind in the now; which the UN describes as a danger to peace, as it threatens security, livelihoods and lives of peoples of the world.

Climate Action is the 13th of 17 Sustainable Development Goals being the key element of the 2030 Agenda for Sustainable development adopted by the UN General Assembly in September 2015, which emphasizes a holistic approach towards achieving sustainable development for all. According to the United Nations, *Climate action means stepped-up efforts to reduce greenhouse gas emissions and strengthen resilience and adaptive capacity to climate-induced impacts, including: climate-related hazards in all countries; integrating climate change measures into national policies, strategies and planning; and improving education, awareness-raising and human and institutional capacity with respect to climate change mitigation, adaptation, impact reduction and early warning*. Goal 13 seeks to mobilize US$100 billion annually by 2020 to address the needs of developing countries to move towards a low-carbon economy (UN, 2019b). Truly, there is a climate emergency facing mankind today; indeed, a danger to peace, hence the call for action.

WHAT ACTION AND BY WHOM?

In the words of UN Secretary-General António Guterres, "It is possible to achieve our goals, but we need decisions, political will and transformational policies to allow us to still live in peace with our own climate." The UN therefore calls for action to tackle climate change as an option towards attaining peace. Every human on earth is a part of the solution.

Actions are required at the individual and governmental levels as adaptive strategies in response to climate change. Adaptation is a response to global warming, which is the most significant manifestation of climate change impact. The Intergovernmental Panel on Climate Change defines adaptation as,"*the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities."*

Adaptation means anticipating the adverse effects of climate change and taking appropriate action to prevent or minimize the damage they can cause, or taking advantage of opportunities that may arise. It has been shown that well planned, early adaptation action saves money and lives later. At the individual level, the public should consciously conserve or use energy wisely, step down the level of fossil fuel burning, e.g. by reducing driving and sharing automobile transport means, and switching to use of clean energy; promote knowledge about climate change, and advocate for the right government policies in this regard.

CONCLUSION

Climate change is one of the emerging global issues in recent years. Climate change is exacerbated by both natural factors and anthropogenic activities (emanating from human activities). Exploitative use of natural resources and other unsustainable human activities have exerted overwhelming pressure on the ecosystem resulting in undesirable changes in climate. Most of these changes do not favour the natural nomenclature and resilience of the ecosystem resulting in ecological imbalances and impacts on human beings. These changes often trigger undesirable natural actions such as flooding, drought, coastal erosion, environmental degradation which in turn pose a threat to human survival. With regards to food security issues, most climate change dimensions such as flooding, drought, etc, directly affects agriculture in terms of yield volume, water availability, and ecological compatibility. More so, the need for a quick action on climate change cannot be overemphasized, considering the rising global population growth, and in particular the seemingly uncontrollable population trend in the Sub-Saharan Africa.

Thus, governments of the world's nations must pursue with intent to achieve the climate change-related sustainable development goal and domesticate relevant international treaties, and enhance adaptive capacities to help reduce vulnerability to climate change. The government must engage policies and programmes that would improve infrastructure and institutional capacities, public awareness; and promote sustainable local indigenous practices, as well as reduce poverty and enhance general wellbeing of the people. In particular, there should be a committed policy aimed

at improving agricultural development with a view to promoting food security, increased income, increased employment opportunities and security. Also, farmers should be encouraged to fully adopt sustainable agricultural practices to improved food security and ecological recovery. To address the raging herders/farmers crisis threatening regional security and peace in Sub-Saharan Africa, it is important that appropriate technology is encouraged to promote intensive livestock production with a view to discourage nomadic animal production system, and unregulated open grazing which currently limit sustainable resilience and productivity of ecological resource.

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Chapter Nine

Covid-19 Impact on Mode of Teaching and Learning Science Education in Nigeria

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ABSTRACT

The recent outbreak of coronavirus (COVID-19) pandemic in 2019 has led to serious disorganizations in every facet of human activity, education, especially higher education not spared. In order to curtail the spread of the ugly pandemic, World Health Organization (WHO) imposed restrictions on movement together with other COVID-19 protocols. This led to closure of educational institutions as well. The result is that both students and staff of educational institutions were forced to stay at home pending on the time the pandemic would phase out. In order not to allow total decay of education during this period of the lockdown, it was necessary to device an alternative means of sustaining teaching and learning for students. This led to introduction and re-affirming of digital teaching and learning mode using online means. The present study therefore aims at investigating this COVID-19 triggered mode of instruction: a panacea for sustainable science education in Nigerian higher institution to explore its impact.

Keywords: COVID-19 pandemic, digital learning, Nigerian higher institutions, sustainable science education.

Introduction

Toward the end of the year 2019, there was a sudden outbreak of a deadly and highly contagious viral disease - the coronavirus (COVID-19) in Wuhan, China. Coronavirus is an epidemic which in a very short time interval overwhelmed the entire world such that the on March 11, 2020, it was a public health emergency of international concern by the world health organization (WHO) after it covered 114 countries in three months and infects 118,000 people in the world (Anake et al., 2020). COVID-19, according to Danso (2020), is a transferable disease caused by a recently discovered virus which causes a serious respiratory condition and is contacted through different respiratory tracts like the mouth and the nostrils. As at May 2020, over 4,900,000 cases of COVID-19 has been found in more than 200 nations and territories, with about 325,125 deaths and more than 1,900,000 recoveries (Worldometer, 2020). Due to the exponential manner with which the disease was spreading, many countries were locked down in their education system.

Being the bedrock of national development, education, especially science education is highly valued by all the countries of the world. No country could boast of any meaningful progress in technology without a significant investment in education, especially in the area of science education, of her citizens. Science education, according to Nwosu (2015) is the study of the interrelationship between science and as a discipline and the application of educational principles to its understanding, teaching and learning. It involves, Nwosu continues, an in-depth study of both science disciplines and educational disciplines (psychology, philosophy, sociology and curriculum). Science education is therefore an applied field which drives derives its authenticity from the fact that science as a field of human endeavor is fundamental to human survival and must be seen as one of the rights of every child to learn properly and appropriately and effectively.

Effective teaching and learning of science education will involve the creation of critical and learner-friendly environment to nourish inquiry and help students to be critical and creative in nature which will involve the development of the three educational domains, namely, cognitive, affective and psychomotor. The question now is how contain these within the digital learning in the pandemic era. In this era, distant teaching and learning is the solution. However, the lack of infrastructure, computers and internet assess pose a serious challenge to science education by digital means in the era. To meet up with this new trend in learning and to sustain education in Nigeria, there is need for a rapid science education curriculum development and reform to contain the need of education during this era and beyond. This will involve training and retraining of teachers to be ICT competent. It is, therefore, noteworthy that for all sustainable missions, the most pressing is to improve lives. And there is no better way to do so than through proper and sound education for all.

Unfortunately, in the past, education system has been under crisis ranging from reforms in education, curriculum issues, incessant strike action by educators, poverty and most recently the closing down of education system due to widespread of the recent pandemic disease (Owusu-Fordjour, et al., 2015). The listed crisis at various stages have impacted on education negatively at various level, spanning from the basic to the tertiary level as offered in higher institutions and this does not encourage sustainability of education, especially science education in Nigerian higher institutions.

Higher education (HE) as is offered in higher institutions is defined as the post-secondary section of the national education system which is given of universities, polytechnics and colleges of technology including courses as are given by the college of education; advanced teacher training colleges, correspondence colleges and such institutions that may be allied to them (FRN, 2004). Adeyemi, 2001 earlier defined higher education as a system which embraces much of the countries research capacity and reproduces majority of the skilled professionals that are required in the labour market. In the same vein, Obanya (1993) viewed HE to embody all organized learning and training activities at the tertiary level. This, he said, includes conventional universities i.e. those with conventional arts, humanities and science faculties as well as

specialized universities like institutions specializing in agriculture, engineering, science and technology. HE is therefore, include all forms of professional institutions drawing from the available pool of persons who have completed a various forms of secondary school education: institutions of military, the police, nurses, agriculture, forestry, veterinary workers, catering services, tourism, secretarial services and other possible combination of programmes.

Objectives of Higher Education in Nigeria

The under listed are the objectives of Higher Education in Nigeria:

1. The acquisition of, development and inculcation of the proper value orientation for the survival of the individual and society
2. The development of the intellectual capacities of the individual to understand and appreciate environment
3. The acquisition of both physical and intellectual skills which will enable individuals to develop into the useful members of the community
4. The acquisition of an overview of the local and external environment (FRN, 2004).

Nigerian higher institutions have been battling with how to catch-up with these laudable objectives when suddenly the advent of COVID-19 pandemic set in and this compounded the problem.

COVID-19 Problem

The outbreak of COVID-19 pandemic brought about unprecedented changes in the way people live and function within the society. It created confusion and people seem not to be sure again which direction to follow. The greatest worry for people was how to continue to exist and the direction to follow in order to sustain life and human activities. A lot of adjustments were made in every aspect of life in order to contain, curtail and survive the deadly virus. Most sectors, education inclusive, of many nations at every level were adversely affected and were under threat due to long periods of restrictions to movement which led to school shutdown.

In Nigeria, there were additional problems of the “END SARS” campaign and protracted ASUU strike which made resumption of activities, including academic activities, in schools impossible even after resumption from COVID 19 imposed lockdown till after about nine months; in effect nearly one academic session. However, in the midst of all these confusions, some schools, especially privately-owned schools and universities reverted to learning through digital means in distant education. This was how virtual learning come into use by those who could afford it while others, the less privileged, were cut off for a long time. This was indeed a very trying period in the history of humans in the 21st century, especially in Nigeria, as regards the education sector in higher institutions.

Prevalence of COVID 19 has impacted negatively on university students in Nigeria in the areas of disruption of university education, academic calendar, halting of examinations and disruption of learning, halting of physical education and extra-curricular activities, actual learning losses, inequality, big gap between the rich and the poor students, delayed graduation, future unemployment, about 8-9% loss in lifetime earnings which will affect negatively many children's wellbeing. The learning loss could translate into less access to higher education, lower labour market participation and lower future earnings.

To buttress this fact, researchers have further been working on the impact of COVID 19 on education in general, higher edition inclusive. Deborah (2020) for instance did a study to find out the perception of undergraduate students on the impact of COVID-19 pandemic on higher education development in Federal Capital Territory (FCT), Abuja, Nigeria. This study adopted the descriptive researchdesign of the survey type. All higher institutions in FCT, Abuja, Nigeria, formed the population of the study. Out of this population, a sample of two higher institutions was taken and selected through the stratified random sampling technique. In the selected higher institutions, there were about 205,878 final year undergraduate students out of which 200 undergraduate students were sampled. The method of selection was also through the stratified random sampling technique. The instrument used to collect data for the study was a questionnaire titled "Perception of Undergraduate Students on theImpact of COVID-19 Pandemic on Higher Institutions students Questionnaire. The questionnaire has two parts, A and B. Part A was demographic. The reliability of instrument was determined using the test-retest reliability techniques. The instrument was administered through the use of online medium. Data collected were analyzed using simple percentage while Chi-square test was used to test the hypotheses. Result of the analysis showed among others that 100% of the respondents agreed that Covid-19 pandemic affects the academic calendar of higher institutions while 89% of the respondents agreed that online mode of instruction is the alternative measures to face-to-face teaching and learning as was previously used before the advent of COVID 19.

Online Digital Mode of Teaching and Learning as Triggered by COVID 19

According to Iseolorunkunmi et al. (2021), COVID 19 pandemic lockdown necessitated alternative teaching method, the online, digital or virtual learning, other than the face-to-face interaction to avoid total collapse of educational sector.

Since the announcement of the directive of the federal government to close down schools in the country, precisely on march, 19, 2020, things have never been the same for parents and students alike (Amorighoye, 2020).

Advantages of Virtual Interaction:

Digital interaction has many advantaged among which include:

1. Reaching many people at the same time

2. Does not require people to come together in a place or under a common roof
3. Uses three broad categories of tools namely; real time social media Channels-WhatsApp, YouTube, face book; asynchronous learning processes which involves the use of discussion board and digital library; and video conferencing tools such as MS Teams, Zoom, Google hangout, WebEx, Skype, Google meet

Disadvantages of Digital Interaction Mode of Learning

Digital mode of interaction, though with numerous advantages is fraught with a host of challenges. The response rate to virtual teaching and learning process as an alternative to face-to-face mode in this pandemic time would depend on the level of the nation's preparedness for such emergencies. For instance, the united nation asserted in 2019 that more than half of the schools in sub-Saharan Africa (SSA) including Nigeria have no assess to the internet and computer facilities. Furthermore, Nigeria was ranked 62nd position among nations in terms of institutional readiness (Kyari, 2018). These points to the inadequacy of infrastructure and shortage of ICT facilities as compared to the teaming number of students in the universities. Olobio et al, (2014), Obiakor & Adeniran (2020) observed that the new virtual learning is disproportionately easier for staff and students of private institutions as compared to those of public schools.

Science Education in the Post Pandemic Era

In this era, distant learning as is made possible by digital interaction is inevitable. However, the lack of infrastructure, computers and internet assess pose a serious challenge to science education by digital means. To meet up with this new trend, there is need for a rapid science education curriculum development and reform to contain the need of education during this era of online learning. This will involve training and retraining of science education teachers to be ICT competent. According to UNESCO report, in developing countries, there is dart of trained ICT teacher at all levels of education

Other Impacts of COVID-19

Social Gap

Impact of COVID 19 increases social inequality in schools because students from more advantaged parents attend schools with better digital infrastructures and better qualified and more experienced teachers who might have higher levels of digital technology and educational resources. Disadvantaged students are attending schools with lower ICT infrastructures and educational resources (Di Pietro et al., 2020). Schools in the disadvantaged rural areas lack the appropriate digital infrastructure required to deliver teaching at the remote areas. Also, there is a significant difference between private and public schools in technology and educational materials.

Psychological Unrest

It was also discovered from a survey done by Woday et al. (2020) that during the school closure, there was high level of anxiety, depression disorder and stress among students. Uncertainty about what their future would be like caught many students while their teachers and parents were equally disturbed.

Access to computer and internet is basic to a successful distant teaching. This is not guaranteed for all students in developing countries (Zhang, 2020). Also, staff and teachers should be familiar with online teaching platforms. Teachers struggle with difficulty in the area of technology and lack of infrastructure availability. The physical school closure and the implementation of distance education led the students to spend less time learning, hence, stress and lack of learning motivation abounds. (Di Pietro et al., 2020).

Unequal Access to Education Resources

Even in urban areas where distant learning is provided due to a lack of monitoring strategies, some students may not use them properly. Where properly done, schools especially in urban areas teach their students through google classroom, e-mail, social media and other applications. Public school teachers have limited or no access to the internet (Tzifopoulos, 2020). Students from parents with lower educational level and students with poor learning motivation suffer most as a result of coronavirus lockdown. Poor and digitally illiterate families' children are further suffering. School closure further increased the inequality between students due to lack of access to internet, technology and educational resources. Assessment and education

Shifting from face-to-face class to online learning is challenging for teachers, students, parents and the countries' government due to lack of finance, skill, ICT infrastructure, internet access and educational resources (Sahu, 2020). Computer and other equipment at home are difficult for most parents, children and students in developing countries. Furthermore, some courses are difficult or impossible to teach and learn through online learning methods such as sports, nursing, laboratories, music and art courses.

Shift from face to online classroom has serious impact on assessment and evaluation. Depending on the assessment type and course nature, applying assessment and evaluation online is a challenging task. Teachers therefore have to change their assessment mode to fit the online mode of instruction. It is also difficult to monitor children when they take online courses and difficult to ensure that they do cheat during examinations online (Basilaia & Kvavadze, 2020). Also, laboratory test tests, practical tests and performance tests are impossible to conduct online. Hence, students who have no internet access will suffer during examinations (Sahu, 2020). Osman (2020) posited that assessment and evaluation of students' performance in online learning is difficult for both instructors and students particularly in teaching practicum, technical competencies and practical skills. as stated by UNESCO (2020b) report, even for students, teachers and parents in countries with reliable ICT infrastructure and internet access, the rapid

transition to online learning has been challenging. All education stakeholders require training to deliver online learning effectively, but such support is particularly limited in developing countries (O'Hagan, 2020).

Mental and Physical Health

School closure during the period of pandemic adversely affected the mental and physical health of both students, parents and teachers all over the world, especially I developing countries because during this time, students are forced to assist parents in whatever work they do. Girls are exposed to a higher risk of sexual harassment and forced labour and early marriages especially in villages. In high spread created a lot of anxiety and uncertainty in people's hearts, also stress, fear like fear of dying or their relatives and guardians dying. This may affect the physical and mental health of the student. Not all students can have equal access to ICT facilities due to learning and familiarization speed difference in people.

Continuity Education System during COVI-19

The shutdown is an opportunity to get schools and government to install natural infrastructure and scale internet access across urban and rural areas. Before now, even in developed countries, online learning has been the first option. Examples are digital online manager such as Alison, courser, EdX, and Udemy, self-directed learning content such as Khan Academy and Onecourse (UNESCO, 2020a). Since it is not certain when the virus will end, it is important that countries will design strategies for continuity of education system through distant learning by scaling education technology during pandemic, establish zero-rating education resources, practice mobile learning, practice radio and television.

Digital Learning as the Solution

Abbey and Hoxley (2020) stated that with the closure of schools, there are very few schools that can afford, set-up and maintain virtual learning science laboratories and the teachers or lecturers can work together to simulate experiments.

Distant learning solutions are continuing platforms, educational applications and resources that aimed at helping parents, students and teachers to benefit from learning online even when it is not possible to have face to face interaction between the teachers and the students. These include digital management systems, massive open online platforms and self-directed learning content. Presently, Nigeria is already moving towards digital learning through open university, a distant learning institution whose course delivery is digitally facilitated through a combination of web-based modules, textual materials, audio and video tapes as well as CD-ROM. With the onset of COVD-19 pandemic and its social distancing status, a wider need for digital learning which has before now been neglected and abandoned owing to the deplorable state of our infrastructure and educational sectors was opened up. To fully embrace this mode of learning, the students have to

be digitally ready for it. At the moment of lock down like what happened this period, education in emergency was the best option.

By Education in emergency (EiE) is generally meant providing safe, relevant and quality education to people affected by conflict, health-related crisis or natural disasters. EiE is also caused by armed conflict, natural disasters and sometimes epidemic. According to Winthrop (2020), EiE focuses on the cycle of prevention of, preparedness for, response to and recovery from emergencies. COVID-19 is considered an emergency situation, so there is an urgent need for EiE in the form of distance or rather digital learning.

Benefits of EiE

Though an emergency situation, EiE has its own benefits as enumerated:

1. It helps to meet the psychological needs of the children and youth s affected by the trauma
2. It provides physical and social protection for children and youths who face higher risk of such as unwanted pregnancies, violence, sexual assault, substance abuse and all the likes.
3. It helps young people keep familiar routines by maintaining study skills to mitigate schooling
4. EiE is important in conveying survival and peace building messages and skills (UNHCR, nd)
5. It gives students some elements of control over time, place and pace (Florida virtual school, 2020).

Digital readiness indicates a nations' ability to implement digital learning and harness advantages of ICT. Presently, Nigeria as a nation is not yet digitally ready for distance learning online. This is because, in 2018 as reported by Zubairu et al. (2020), Nigeria ranked 79 out of 80 countries in economist's intelligence unit's technological readiness rating. Nigeria is therefore graded as ICT emerging country.

COVID-19 Pandemic and the Need for Digital Learning in Nigeria

Forceful closure of educational institutions (schools, colleges and universities) as a result of COVID-19 pandemic has a lot of negative effects on the students such as a detrimental and poor academic performance. To revamp the ugly situation, there arose an urgent need to continue education through digital modalities. According to Dhawan (2020), there was an overnight shift from conventional classrooms into digital learning in order to tackle the conditions and adapt to the changing situations. Embracing digital learning prior to the COVID-19 pandemic was more of a choice which was due to the fact that the digital world was increasingly penetrating the educational domain, with technology gradually being used to teach and learn (Osuagwu & Umeh, 2020). However, today, it has become a necessity. China for example swiftly and successfully adopted this courtesy of the fact that digital learning in Chinese universities has

increased exponentially after the Covid-19 outbreak (Dhawan, 2020). Nonetheless, the digital infrastructural backwardness and the unpreparedness of some educational sectors mostly in developing nations such as Nigeria to totally embrace such change have almost made continuing education through digital modalities unfeasible. With this, there is an exposition and recognition of the increasing importance of online learning not only in this dynamic world but also in emergency. This corroborates the view of John F. Kennedy that in as much as an emergency situation comes with challenges, that an inward look will present the opportunity therein (Oyedele, 2020). The urgent demand has revealed the weaknesses of the Nigerian educational sector and the need to rethink and review existing education infrastructure as learning has become an activity that that can be carried out irrespective of time and places amidst the pandemic with the support of digital tools. Now is an opportunity to improve standards, contribute to knowledge-based economies, enrich learning potentials, facilitate personalized learning and in all, transform pedagogy to make it more student-centered in line with the global standard (Fullan, 2013; Hammond, 2013). Therefore, the adoption of digital learning is very crucial to ensuring the continuity of education in Nigeria which demands working on our digital infrastructure, up-skilling staff and expanding their capabilities.

Challenges of Digital Learning as Necessitated by Covid-19 Lockdown

1. Difficulty in Accessing digital devices and internet access as a result of poor coordination of all the digital learning activities over the years.
2. The multi-dimensional aspects of access example: slow internet connections, having to share devices with parents and other siblings, lack of proper skills on how to use internet efficiently, lack of solid support like technical assistance from family members
3. Financial implications. Internet facilities are poorly funded by the government and some parents and guardians also find it difficult to provide regular airtime for their children or wards.
4. Students' concentration and the need for physical connections
5. Assessing the effectiveness of remote learning platform
6. Teachers and parents inexperienced with teaching and supporting the students remotely
7. Students with learning disabilities and issues around keeping children safe online
8. Problems with slow learners
9. Inadequate power supply. According to Ajadi (2008), epileptic power supply is a perennial issue that has been argued to be the major setback to the adoption of digital learning by Nigerian educational sector and the technological achievement generally
10. Difficulty in assessing the students
11. Poor coordination of all the digital learning activation over the years: due to poor funding
12. Lack of inadequate personnel to manage available systems
13. Poor technical infrastructure; not highly developed; that is, phone lines and internet connections are unreliable or slow due to narrow bandwidth (Olobio et al., 2014)

14. COVID-19 has also threatened education of children and youth with special needs and disabilities. Without a crisis, this group of students already experience some form of marginalization. Hence, the likelihood of losing learning opportunities during and post-COVID-19; due to combination of the factors including socio-economic income of their families, the non-availability of special needs teachers and the inexperience of parents and guardians in facilitating their learning needs (UNICEF, 2020).

Opportunities Created by COVID-19

1. Blended learning: blend of traditional classroom and distant learning opportunities for students even after the pandemic
2. Innovative partnership: government to partner with educational technology companies and internet service providers to cater to the learning needs of students. Also, partnership between the and provider organizations.
3. Business opportunities: the situation also provided entrepreneurial opportunities for the private sectors by internet providers, original equipment manufacturers (OEMs) focused on education-related equipment etc.
4. Accelerated digital skill acquisition: by parents, teachers and private organizations.

Recommendations

Sequel to the discussions of the study, it is recommended among others that:

1. All concerned stake holders in education should consider it as a matter of urgency to prioritize teacher development and wellbeing that is COVID 19 compliant.
2. Government at all levels should endeavor to provide support for parents so as to enable them provide for their children and wards what it takes to engage in meaningful digital online learning.
3. Government and school management should try to make available necessary infrastructure for remote teaching and learning of requisite courses for familiarization with digital learning
4. Parents or government should try to provide for students, portable solar radios to help bridge the digital divide between students based on socio-economic backgrounds.

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Chapter Ten

Utilization of White Board Utilization in Digital Teaching and Learning of Vocational Technology Education in Tertiary Institutions in Imo State

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ABSTRACT

Vocational Technology Education as a type of education that equip the learners with the necessary knowledge and specific skills to enter occupation and progress in it, need the utilization of Interactive White Board (IWB) to transform the teaching learning situation for effective learning. This study ascertained the extent vocational and technical teachers in tertiary institutions in Imo State utilize IWB in teaching. The population comprised 68 technical and vocational teachers in the four tertiary Institutions that offer the programme in Imo State. The study adopted descriptive survey research design and was guided by one research question. One null hypothesis was tested at 0.05 level of significance. The entire population was used as sample because of the manageable size. A structured validated questionnaire on a five- point scale was used for data collection and its internal consistence determined with Cronbanch Alpha coefficient formula which yielded a reliability coefficient index value of 0.73. Data collected were analyzed using mean, standard deviation and t- test statistic. The findings of the study revealed that technical and vocational teachers were making use of IWB at moderate extent. It was also discovered that gender has significant influence on the extent technical and vocational teachers utilize IWB in teaching and learning. Based on the findings, it was recommended among others that Association of Business Educators Nigeria (ABEN) should organize seminars, workshops to train and retrain technical and vocational teachers on how to effectively utilize ICT facilities such as IWB in teaching and learning.

Keywords: Utilization, Interactive White Board (IWB), e- learning, instructional delivery, technical and vocational teachers.

Introduction

Making sure that Nigeria achieves a mass of skilled manpower in the various sectors of the economy is vital for attainment of her full economic potential. This is equally critical for the harnessing of the country's natural resources which is determined by the type and quality of

educational programmes put in place. Educational programmes today are challenged by the demands of the 21st century that is technology and information driven, Vocational and Technology Education(VTE) inclusive. Therefore, the ability of VTE to incorporate Information and Communication Technology (ICT) in its training procedures and presentations for skill acquisition among recipients without doubt will accelerate the economic development of Nigeria.

VTE is occupational oriented form of education whose primary purpose is to prepare persons for employment through systematic learning experience designed for provision of skills, knowledge and attitude which is necessary for effective employment in specific occupation (Okoli, Uzoagulu & Okoli, 2018). Federal Republic of Nigeria (2013) defined vocational technology education as that aspect of education that leads to the acquisition of practical and applied skills as well as basic scientific knowledge. This was ensured into the National Policy on Education with the following aims:

1. To provide trained manpower in applied science, technology, and commerce, particularly at sub professional grades.
2. To provide the technical knowledge and vocational skills necessary for agricultural, industrial, commercial and economic development
3. To provide an individual who can apply scientific knowledge in the improvement of environmental problems for the use and convenience of man.
4. To give training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant and
5. To enable our young men and women to have an intelligent understanding of the increasing complexity of technology (FRN, 2013).

The above aims were noted as the general goals of vocational technical education wherever it is taught; whether as basic technology, vocational / technical education at senior secondary level or core technology education at tertiary institutions.

In Nigeria, five types of VTE institutions exist outside the universities. Such include prevocational, vocational schools, technical colleges, and colleges of education. At lower levels, the nomenclature ‘technical education’ was noted as more appropriate and ‘technology education’ at higher levels (Ogwo, 2006). At tertiary education level, VTE programmes include technology education, business education, home economics education and Agricultural education. Technology education has three option areas as; wood/building technology, mechanical/auto mechanics, electrical and electronics technology. Business education habours programmes as Secretarial education/Office Technology Management, accounting education, cooperative economics and management education. Other programmes of VTE include home economics and agriculture that offer special options areas necessary in producing individuals that are self-reliant.

Science education programmes are not left out as technology oriented andforms the foundation for sustainable national development (FRN, 2013). Nations all over the world strive to apply technologies in acquisition of scientific knowledge in order to provide solutions to their problems. Owolabi and Oguni (2014) asserted that science education exposes the learners to scientific nature, processes and attitudes which equip them with relevant scientific skills. In science education, there is also a growing concern for the use of electronic learning facilities because they enable students to navigate through the ocean of knowledge making discoveries that are capable of improving their understanding of the world around and dealing with specific issues being taught by the teachers for achievement of programme objectives (Okoli & Osuafor, 2019).Vocational and Technology Education (VTE) equips the learners with the necessary knowledge and specific skills with which to start work and progress in it.

Vocational technology teachers according to Okoli (2012) are professional teachers found in colleges of education and universities that prepare students for careers that require a specific knowledge and set of skills. Vocational teachers have a challenge to stay current in the use of technology and its devices. Federal Republic Nigeria (2009) remarked that VTE teachers are required to be professionally competent by adapting their teachings to the use of ICT facilities in classroom as e-teacher. VTE programmes in the 21st century to achieve objectives therefore should be incorporate and constituently use ICT facilities such as computers, internet, interactive white board, overhead projectors, among others, so as to equip the recipients with the necessary soft skills with which to adapt to work environment.

The Interactive White Board (IWB) is an ICT device with large white surface for display that connects to a computer and a multi - media projector which projects onto the board's surface. The board is typically mounted to a wall floor stand and controlled using the computer with a pen, finger, stylus, or other devices. This has been found very useful in enhancing teacher's professional knowledge, skills, with the capability of facilitating quick and easy access to a wide range of information among learners. IWB would help the VTE teachers to create learning environments that are flexible, dynamic and capable of responding to a wide variety of individual needs and learning styles. Nwokocha and Onwuchekwe (2014) reported that when teachers are giving constant technical and pedagogical IWB training, they are likely to be better equipped to transform the teaching learning situation. Adapting to these challenges would no doubt enhance the quality of VTE programmes so as to attract students' interest and improve the productive capacity of labour force required for sustainability of Nigerian economy.

In this study, utilization of IWB facilities refers to the application and integration of the IWB in e - learning instructional delivery by vocational technical teachers. E-learningAccording to Ajadi (2008) is innovative approach for delivering electronically mediated, well designed, learner centered and interactive learning environments to anyone, any place, anytime by utilizing the internet and digital technologies in the instructional design principles. This has become an

acceptable phenomenon in our educational world, where learning materials are presented through the aid of a computer via internet or offline through CD-ROM etc. IWB as a teaching aid in educational technology or instructional technology offers tremendous opportunities for learning by electronic means. Similarly, e- learning instructional delivery means the adoption of a teaching method that is participative and student oriented. The teacher applies teaching strategies that require great students' involvement using the multi-media technologies as IWB. The introduction of this new multimedia technology in teaching-learning relationship has been seen as a means to improve accessibility, efficiency and quality of learning by facilitating access to information resources and services. It has been found that students in higher educational institutions that are engaged in e-learning, using IWB generally performed better than those in face-to-face courses using the traditional chalk board. Holley (2002) also found that students who participate in e-learning achieve better grades than students who studied using traditional approach. As result of these developments the usage of e – learning facilities such as IWB is growing very fast and becoming popular. Today many tertiary institutions world over are adopting to virtual learning system and Imo State inclusive.

However, in Nigeria there is no doubt that the utilization of these multimedia technologies as IWB in learning is been challenged by poor supply of electricity and constant power failures. In some institutions many of the e – learning facilities provided for instruction remain unused and such does not add any value to their teaching and learning activities. Ukor, Agwazie and Ayemhenre (2014) reported that business educators in colleges of education in Delta State almost never utilized ICT tools in teaching. They were constrained by lack of requisite skills, funds, infrastructure, power and management support. This report supports the earlier findings of Ekeh and Oladayo (2011) which indicated that the extent of teachers' application of ICT facilities in both public and private secondary schools in Port Harcourt was found to be low. Guaranteed. Moursund (2009) also observed that relatively little has been achieved in the VTE programme in spite of government efforts in integration of ICT in teaching and the significant impact of ICT tools like IWB on students' academic achievement when compared with the traditional methods of instruction. For vocational technical graduates to be relevant in the teaching profession, they must possess relevant skills and competences required especially in the use of ICT facilities in teaching. This implies that vocational technical teachers who train the undergraduates must be versatile in the use of ICT facilities in classroom instruction to make their students learn and be conversant with them.

There is also a feeling that there will be a difference in the usage of IWB among vocational technology teachers based on gender. The issue of gender has remained an area of interest in educational practices especially in the use of electronic facilitates in teaching and learning, as it appears that male educators are more interested in the use of electronic facilities for teaching and learning than their female counterparts. Rupere (2006) report that women are less interested in e-learning activities than male counterparts in rural Zimbabwe. Observably, in Nigerian society

and African continent in general, it seems that women are less involved in the use of electronic gadgets than their male counterparts in different spheres of human endeavours. These are the issues that this study was set to ascertain empirically, as it relates to the extent of utilization of IWB by vocational technical teachers in e- learning instructional delivery in tertiary institutions in Imo State.

Review of Related Literature

Benefits of utilization of InteractiveWhite Board

Interactive white board (IWB) sometimes referred to as electronic white board or smart board were originally developed for office settings and are relatively a new addition to education. The IWB devices are connected to a computer, which in turn are connected to a multi-media projector. As Robert (2009) noted, IWB is a large display that connects a computer and a projector that projects onto the board's surface. The board is typically mounted to a wall floor stand as users control the computer with a pen, finger, stylus, or other device. Appropriate use of IWB by vocational technical teachers in the classroom can help equip future technical teachers with the necessary knowledge and skills to use it effectively in the classroom (Schuck & Kearney, 2007). IWB's are used to reinforce current didactic teaching practices as teachers can use them as a black board replacement. Teaching with IWB allows vocational technical teachers to accommodate different learning styles. It is a pedagogical tool that promote creative teaching and motivate students into absorbing information.

Bell in Nwokocha and Onwuchekwe (2013) noted that IWB is an effective medium for teacher input to the whole class and for reviewing the lesson. With IWB, the teacher is able to present from the front and is better positioned to observe students, thereby making the students to focus on the lecture. In some classroom, IWBs have replaced traditional flipcharts. Even were traditional boards are used, the IWBs often supplement them by connecting to a school network digital video distribution system. Roberts (2009) also found that Interactive White Board (IWB) supports interaction and conversation in the classroom and helps in the presentation of new learning. Some benefits of IWBs to include:

1. Visual learners benefit from a clear view of what is happening on the board
2. IWBs allow lecturers to accommodate different learning styles.
3. The software supplied with the IWB will usually allow the teacher to keep notes and annotations as an electronic file for later distribution either on paper or through electronic formats.
4. Some IWBs allow teachers to record their instruction as digital video files and post the materials for review by students at later times.
5. This can be a very effective instructional strategy for students who benefit from repetition, who need to see the material presented again, for students who are absent from school, for struggling learners, and for review for examinations. The students will see the

exact presentation that occurred in the classroom with the teachers audio input (Onwuachu, 2013).

Nwokocha and Onwuchekwe (2014) reported that when lectures are giving constant technical and pedagogical IWB utilization training, they are likely to be better equipped to transform the teaching learning situation. Vocational technical teachers today are challenged to utilize IWB in their instructional delivery in a manner that would enhance students learning and achievement.

Statement of the Problem

Despite government efforts and benefits of ICT utilization for educational purposes, it appears that the teaching and learning with ICT facilities as IWB in VTE programmes in tertiary institutions in Nigerias are very poor as many teachers and students are still not fully ICT compliant. It is also observed that most vocational technical teachers, especially at the tertiary level are still using the traditional chalkboard methods of lesson delivery. This is a threatening condition which would in no small way hamper the achievement of vocational technical education objectives in the institutions. In the same vein the researchers observed that most vocational technical students in tertiary institutions in Nigeria, after graduations are found roaming the streets without self or paid employment. Even when they secure paid employment, many find it difficult to satisfy their employers using modern ICT facilities. This unsatisfactory state of affair create worry in the mind of the researchers as whether the graduates were not adequately prepared and exposed by the VT teachers in the use of ICT facilities which dominate the modern world of work. This equally, raises the question as to what extent vocational technology teachers in tertiary institutions who teach students that are expected to work in the various modern businesses as office technologists, in industries and in the classroom as vocational, technology and science teachers utilize IWB as an ICT facility in teaching and learning? This is the problem that this study was set to solve.

It is against this backdrop that this study was conceived to ascertain the extent of utilization of IWB in instructional delivery by vocational technology teachers in tertiary institutions in Imo State.

Research Question

One research question guided the study

- To what extent do vocational technology teachers utilize Interactive white board (IWB) in instructional delivery in tertiary instructions in Imo State

Hypothesis

One null hypothesis was tested at 0.05 level of significance

- There is no significant difference in the mean ratings of male and female vocational technologyl teachers on the extent of utilization of interactive white board in instructional delivery in tertiary institutions in Imo State.

Method

The study adopted descriptive survey research design. The population comprised 68 vocational technical teachers from three tertiary institutions in Imo state offering the VTE programme namely, Alvan Ikoku federal college of education Owerri and Imo state University, Owerri. The instrument for data collection was a validated structured questionnaire on a five-point rating scale with response categories of Very Great Extent (VGE), Great Extent (GE), Moderate Extent (ME), Low Extent (LE) and Very Low Extent (VLE). The instrument was pilot tested to determine its reliability which was conducted using ten vocational technical teachers from Federal College of education, (Technical), Umunze Anambra State, who were not part of the study. Cronbanch Alpha coefficient formula was used to determine the inter-item consistency of the instrument which yielded a reliability coefficient of 0.73. Data were collected with the help of a research assistant who was briefed on the purpose of the study. Copies of the questionnaire were distributed face to face to the respondents on the first visit with little briefs on how to complete them. Out of 68 copies of the questionnaire administered, 65 copies representing 96 percent were adequately completed and returned and were finally used for the analysis. Data collected were analyzed using mean to answer the research question, the standard deviation of each item determined the spread of the scores about the mean. Decision on the research question was based on the cluster mean in relation to real limits of numbers as follows;

KEYS	**RATING**	**BOUNDARY LIMITS**
Very Great Extent (VGE)	5	4.50 - 5.00
High Extent (HE)	4	3.50 - 4.49
Moderate Extent (ME)	3	2.50 - 3.49
Low Extent (LE)	2	1.50 - 2.49
Very Low Extent (VLE)	1	0.50 - 1.49

t-test was used to test the null hypothesis at 0.05 level of significance. A null hypothesis was not rejected where the calculated t-value was less than the critical t-value but rejected where the calculated t- value was equal or greater than the critical t-value at 0.05 levels of significance.

Results

Table 1

Mean and standard deviation on the extent vocational technical teachers utilize interactive white board in instructional delivery, N=65

S/N	Interactive White Board Utilization	Ẍ	SD	Remarks
1.	I use interactive white board to download picture and video clips from the internet and teach a set of lessons.	3.14	1.01	Moderate Extent
2.	I use interactive white board to highlight text and then save them to be printed out.	3.03	1.03	Moderate Extent
3.	I use interactive white board to show educational video and pictures to the whole lecture theater	3.16	0.88	Moderate Extent
4.	I use interactive white board to demonstrate the content available on a website in a teacher directed activity.	3.06	1.03	Moderate Extent
5.	I use interactive white board to add annotations	3.84	0.93	Moderate Extent
6.	I use interactive white board to show case students projects and presentation virtual field trips.	3.01	1.08	Moderate Extent
7.	I use interactive white board to record lessons that can be used to substitute teachers	3.31	1.04	Great Extent
	Cluster man	3.08		Moderate Extent

Table 1 shows that out of the seven items rated, interactive white board was utilized in teaching in six areas at moderate extents. Only item 7 was rated at a great extent. This was confirmed with the cluster mean of 3.08 that indicates moderated extent. The standard deviation score is within the same range showing closeness in the respondents' opinion.

Table 2

t-test analysis of the mean ratings between male and female vocational technical teachers on the extent of utilization of interactive white board in instructional delivery.

Gender	No. of subjects	X	SD	DF	Level of Significant	t-Cal.	t-Cri	Decision
Male	40	23.67	6.67	63	0.05	2.72	1.96	Significant
Female	25	19.24	6.97					

Discussion of Findings

The findings of the study revealed that vocational technology teachers utilize interactive white board at moderate extent in instructional delivery. This finding is in line with Ukor, Agwazie and Ayemhenre (2014) report that business educators in colleges of education in Delta State almost never utilized ICT tools in teaching and that of Ekeh and Oladayo (2011) which indicated low

application of ICT facilities by teachers in both public and private secondary schools in Port Harcourt. This also supports the observation of Moursund (2009) that relatively little has been achieved in the VTE programme in spite of government efforts and the significant impact of ICT tools like IWB on students' academic achievement when compared with the traditional methods of instruction. Although interactive white board are utilized by vocational technical teachers in tertiary institutions in Imo state but the extent of utilization is not adequate to achieve effective learning amongst students. These students are equally to be affected in performance after graduation as teachers and technologists. No wonder the high rate of unemployment among graduates of VTE in Nigeria. Vocational technology teachers should utilize IWB appropriately in the classroom to equip students with the necessary knowledge and skills that will enable them to use it effectively in the classroom as future teachers and other places of work, as noted by Schuck and Kearney (2007). The findings also show a significant difference in the mean ratings of male and female vocational technology teachers on their extent of utilization of interactive white board in teaching. This is also in line with Rupere (2006) report that women are less interested in e-learning activities than male counterparts in rural Zimbabwe. This also confirms the researchers' observation that women are less involved in the use of electronic gadgets than their male counterparts in different spheres of human endeavours in Nigerian society and African continent in general. The findings have implications for management of institutions and departments to organize trainings for vocational technology teachers to develop interest for constant use of IWB in teaching their students and acquisition of skills in its utilization in classrooms instructional delivery. This is to ensure the production of students who on graduation will possess adequate knowledge and skills in the utilization of IWB facilities for both office work and classroom presentations as teachers and technologists.

Conclusion

Based on the findings of the study, it was concluded that vocational technology teachers do not utilize interactive white board adequately in instructional delivery and this hampers the achievement of objectives in VTE programmes. This invariably results to increased unemployment among its graduates in the country where technology has great influence on human performance. Constant utilization of ICT facilities in teaching vocational technology education is a prerequisite for producing highly efficient vocational technology graduates with knowledge and skills relevant for effective performance in modern world of work and sciencee, where these facilities have replaced the traditional methods of jobs performances.

Recommendation

Based on the findings and conclusion of this study, the following recommendations were made;

1. Professional bodies such as Association of Business Educators of Nigeria (ABEN) and Science Teachers of Nigeria (STAN) should organize seminars, workshops to acquaint vocational and technology teachers on how to effectively utilize ICT facilities for teaching and learning.

2. State and federal governments should also assist by providing funds and equipment for the training of vocational, technology and science teachers for effective utilization of ICT facilities in tertiary institutions in Imo State.
3. Vocational and technnology teachers should endeavour to avail themselves the opportunity of making use of ICT facilities in teaching and learning.
4. Government should increase funding in its budgetary allocation to tertiary institutions to fully take care of supply and maintenance of ICT facilities for teaching and learning.

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Chapter Eleven

Voluntary Risk Management Disclosures and Organizational Sustainability: Nigerian Experience

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ABSTRACT

This study examined the relation between Voluntary Risk Management Disclosures and Organizational Sustainability in Nigeria. The study is vital as it portrays the extent to which voluntary risk management disclosures influence organizational sustainability. Risk Management is seen as a top-down strategy to define, assess and respond to strategic, operational and financial threats to achieve certain goals, high-level objectives that fit with the purpose of the organization, effective and efficient use of resources, ensure reporting reliability and comply with relevant laws and regulations. In order to depict a clear view on the relation between voluntary risk management disclosures (VRMDs) and organizational sustainability (OS), VRMDs key proxy variables were extensively discussed in the study, namely; Strategic Risk Management Disclosure (SRMD), Technological Risk Management Disclosure (TRMD), Empowerment Risk Management Disclosure (ERMD) and Operational Risk Management Disclosure (ORMD) while organizational sustainability on the other hand was also elaborately discussed. Hence, the study concludes that voluntary risk management disclosures ensured organizational sustainability in Nigeria.The implication of the findings of the study is thatrisk

management policy not well implemented would have an adverse effect on the organizational sustainability which could also lead to its liquidation.

Keywords: Strategic Risk Management Disclosures, Technological Risk Management Disclosures, Empowerment Risk Management Disclosures, Operational Risk Management Disclosures, Organizational Sustainability

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1.1 Introduction

The forces that give rise in demand of information disclosure in the modern capital market stems from the information asymmetry and agency conflicts existing between the management and the stockholders. Therefore, the solution to agency conflicts lies in the ownership structure and the function of board of directors (Oluwagbemiga, 2014). Nowadays, every organization whether public or private, big or small, profitable or non profitable is looking forward to ensure sustainability by satisfying customers, investors, creditors, suppliers, regulators and the public at large. They are trying to operate in a way that makes all those users or stakeholders appreciate them by being sustainable.

Risk disclosure is an important tool for improving the efficiency of capital markets, as it provides for monitoring the behavior of managers and reducing uncertainty among investors regarding future cash flows (Barakat & Hussainy, 2013). The voluntary risk disclosure promotes stability of the corporate organizations, market discipline effectiveness, sustains the social support of stakeholders and enhances the legitimacy and reputation of those organizations.

Risk is an uncertainty that cannot be avoided but could be controlled. Financial services regularly face different aspects of risks in their operations. The financial performance of a company also depends on the risk taken but managed to a minimal level, and this is where the control of risk comes in to look at the steps taken to monitor the risk to an optimal level which would not affect the financial stability of the firm but rather increase it (Adegbola, Damilola, Tony, Sainey, Kerry and Jemima, 2021). Implementation of risk management strategy must be carried out by employees or hired personnel with a proper understanding of the effect of risk management and its results if adherently followed. Business environment is increasingly volatile and uncertain due to many factors. Studies found that non-financial risks are the leading factors contributing to the volatility and uncertainties in today's business environment (Ernst and Young, 2014).

Information on voluntary risk management is given less emphasis and therefore less disclosure compared to the disclosure of financial risk management information (Abdullah, Shukor, Mohamed & Ahmad, 2015). The lack of voluntary risk information may mislead investors in their investment decision-making process which hampers organizational sustainability. As noted

in the study of Cabedo and Tirado (2004), investors make their investment or disinvestment decisions by evaluating both the returns associated to a determined investment project and its risk level. If investors fail to identify actual key risk factors of firms, investors could not assess actual risk level of those firms. This would subsequently lead investors to make wrong investment decision which could end up in a huge loss or disaster to the investors and also organization on the long run.

To date, only the financial risk management information is required to be disclosed through among others, the enforcement of IFRS 7 Financial Instruments Disclosure. This accounting standard provides specific guidance on what and how to disclose financial risk management information in firms' financial statements. However, there is still no generally accepted guideline that proposes what and how to disclose non-financial risk management information (i.e voluntary risk management disclosures) in firms' annual reports and accounts and therefore remains discretional.

Several stakeholders have also expressed concerns over the need for firms' risk management information (RMI) to meet their expectations and not much have been done in academic literature based on available literature in Nigeria as regard to the usefulness and relevance of voluntary risk management disclosures for investors decision making which questions if risk management practices ensure organizational sustainability. Thus, the study aimed at discussing the relationship between the voluntary risk management disclosures and organizational sustainability.

2.1 Conceptual Review

2.1.1 Voluntary Risk ManagementDisclosure (VRMD)

In recent years, the importance of voluntary risk management has been evidenced in the corporate sector. Risk management is important because effective risk management improves the company's performance by contributing to reduce fraud, managing potential threats, and more efficient use of resources. Taking and managing risk is the very essence of business survival and growth (Axelos Global Best Practise, 2014).

In addition, voluntary risk management is a useful measure that enables good corporate governance. A good corporate governance is concerned with the balance of power between the various stakeholders involved in the business and with the way in which the organization is governed (Acharya & Clement, 2011). Voluntary risk management disclosure however helps to mitigate information asymmetry and reduce stakeholder conflicts between shareholders and management. Furthermore, risk reporting is seen as a useful instrument of change management as well as an important instrument of accountability for management (Omaliko, Nwadialor & Nweze, 2020). The study notes that reporting via annual accounts and reports by corporate entities is a means of disclosing their business activities including risk management practices.

For this reason, annual reports of companies are a dependable medium for shareholders and other stakeholders to assess information on risk management regarding a company.

Wong (2012) opines that risk management practices of companies particularly financial institutions are disclosed in their annual published accounts and reports, which (the reports) are subject to scrutiny by professional auditors and prepared in accordance with rules and regulations governing financial reports. In addition, Holland (1998) opines that risk management disclosure is an information made available to shareholders and other stakeholders in the annual reports and accounts of companies in order to assess information on risk management regarding such company.

According to Nigerian Code of Corporate Governance [NCCG] (2018), a sound framework for managing risk and ensuring an effective internal control system is essential for achieving organizational sustainability. The following are recommended by NCCG 2018 as regard to RMD;

The Board should ensure the establishment of a risk management framework that:

- Defines the Company's risk policy, risk appetite and risk limits; and
- Identifies, assesses, monitors and manages key business risks to safeguard shareholders' investments and the Company's assets;
- Formally approve the risk management framework and ensure that it is communicated in simple and clear language to all employees;
- Ensure that the risk management framework is integrated into the day-to-day operations of the business and provide guidelines and standards for management of key risks;
- Articulate, implement and review the Company's internal control systems to strengthen the risk management framework;
- Conduct at least annually, or more often in companies with complex operations, a thorough risk assessment covering all aspects of the Company's business and ensure that mitigating strategies have been put in place to manage identified risks;
- Obtain and review relevant reports periodically to ensure the ongoing effectiveness of the Company's risk management framework;
- Ensure that the Company's risk management framework is disclosed in the annual report; and

- Ensure that the risk management function is headed by a member of senior management who is a professional with relevant qualifications, competence, objectivity and experience.

The position of Global Reporting Initiative (G4-2a-e) on risk management information for organizational sustainability is as follows:

- Description of the most important risks and opportunities for the organization arising from sustainability trends.

- Prioritization of key sustainability risks and opportunities according to their relevance for long-term organizational strategy, competitive position, qualitative, and (if possible) quantitative financial value drivers.

- Description of governance mechanisms in place specifically to manage these risks and opportunities, and identification of other related risks and opportunities.

- Targets for the next reporting period and medium-term objectives and goals (that is, 3–5 years) related to key risks and opportunities.

- Description of sustainability trends, risks, and information system opportunities on the long-term prospects.

2.1.2 Determinants of Voluntary Risk Management Disclosures

2.1.2.1 Strategic Risk Management Disclosure (SRMD)

Strategic risk disclosure is information that describes firms' major risks and their expected economic impact on their current and future performance (Miihkinen 2013). Strategic risk management is the process of identifying, quantifying, and mitigating any risk that affects or is inherent in a company's business strategy, strategic objectives, and strategy execution. Strategic risk management is a crucial but often overlooked aspect of enterprise risk management (ERM). While ERM has traditionally focused on financial and, more recently, operational risk, the fact is that strategic risk is far more consequential (Bokpin, 2013).

Yazid, Razali and Hussin (2012) stated that the organizational of strategic risk is a means to achieve a desired end. It suits the risk management process by influencing the estimates of investors regarding the future value of the company. Strategic risk is voluntary in nature and firms report it in their financial reports voluntarily and discretionally. However, operational risk reporting remains an unexplored topic in academic research.

According to Mohamad, Salleh, Ismail and Chek, I. (2014), strategic risk is the risk that failed business decisions, or lack thereof, may pose to a company. Strategic risk is often a major factor

in determining a company's worth, particularly observable if the company experiences a sharp decline in a short period of time. Due to this and its influence on compliance risk, it is a leading factor in modern risk management.

Strategic risk management disclosures include competitors' risk disclosure, business portfolio risk disclosure, pricing risk disclosure, life cycle risk disclosure and planning risk disclosure.

2.1.2.1.1 Strategic Risk Management Framework

According to Nigerian Code of Corporate Governance (2018), strategic risk management process of an organization should address the following:

- **Strategic Risk Profile Analysis**

In this step, risks are identified by examining factors that could affect the business. These could be internal factors, such as the organization's structure and culture, or external factors such as industry trends, consumer preferences, or the regulatory environment the company is operating in. A SWOT analysis can be performed to evaluate and prioritize certain risks.

- **Formulation of Strategic Plan**

Using insight gained from the analysis, the company outlines proposed strategies and defines the objectives and goals needed to carry out its strategic mission/vision. The strategic plan should detail key risk metrics and performance indicators to measure, how they will be measured, and who is responsible for managing them. It should also establish thresholds, or trigger points for these metrics, which will be used to determine when management should take action to mitigate or accept more risk.

- **Implementation**

During this step, the company puts the strategy into practice through their operations. This includes setting budgets and the organizational structure. This is also where strategic risk is controlled and managed by monitoring the risk metrics identified during the analysis.

2.1.2.2 Technological Risk Management Disclosure (TRMD)

According to Al-Hadi, Al-Yahyaee, Hussain and Taylor (2017) providing little or no information about an insurance company's technological risk management might lead outsiders to overestimate the expected loss and/or the probability of the realization of technological risk event, which would result in investors demanding a higher return. The dissemination of information on technological risk is of paramount importance for companies seeking to establish themselves in the financial market. In particular, the utility depends on the quality and quantity of information revealed, which goes beyond annual reports. The objective is to provide an overview of the organization's use of financial instruments and its exposure to risk. Not only do

they maintain the monitoring and internal reporting, but they also seek to defend the investors and the insured.

Technological Risk Management according to Hoyt and Liebenberg (2011) is the application of risk management methods to information technology in order to manage IT risk, i.e. *The business risk associated with the use, ownership, operation, involvement, influence and adoption of IT within an enterprise or organization*

Technological risk management is also a voluntary in nature and therefore considered as a component of a wider enterprise risk management system. The establishment, maintenance and continuous update of an Information Security Management System (ISMS) provide a strong indication that a company is using a systematic approach for the identification, assessment and management of information security risks (Lang & Lundholm 1993). According to Amir (2020), technological risk framework encompasses not only the negative impact of operations and service delivery which can bring destruction or reduction of the value of the organization, but also the benefit enabling risk associated to missing opportunities to use technology to enable or enhance business or the IT project management for aspects like overspending or late delivery with adverse business impact.

Technological risk management disclosures include integrity risk disclosure, access risk disclosure, availability risk disclosure, infrastructural risk disclosure and database risk disclosure.

2.1.2.3 Empowerment Risk Management Disclosure (ERMD)

Empowerment is a management strategy that aims to give employees the tools and resources necessary to make confident decisions in the workplace without supervision. Empowerment is a long-term, resource-intensive strategy that involves significant time and financial investment from the organization's leaders (Wong, 2012). Al-Akra and Ali (2012) suggested that the three tools' managers should be using to empower their staff are information sharing with everyone, creating autonomy through boundaries and replacing old hierarchies with self-managed teams.

Azhar (2017) suggested that empowerment risk as regard to front-line workers is crucial if organizations want to understand core business processes, because front-line workers are closest to these processes and are the only ones who really understand how they work. Some of the perceived benefits of employee empowerment include greater job satisfaction and motivation, reduced supervisory requirements and increases in innovation and creativity. Disadvantages include increase risk as staff become more entrepreneurial and more likely to take chances. Security can also be a problem because all important information must be shared for employees to take decisions on their own.

According to Chan and Wong (2015), empowerment is the concept in management that if employees are given information, resources, and opportunity at the same time as being held

responsible for their job outcomes, then they will be more productive and have higher job satisfaction. Where the outcome of it falls standard, it gives rise to empowerment risk. It is important to understand that a company cannot implement empowerment itself - instead, management creates the right environment so that empowerment can take place.

Empowerment risk management disclosures range from leadership and management risk disclosure, outsourcing risk disclosure, performance incentive risk disclosure, change readiness risk disclosure to communication risk disclosure.

2.1.2.4 Operational Risk Management Disclosure (ORMD)

The annual financial reports of the listed firms should show the key indicators of operational risk, because one of the essential responsibilities of listed firms' is to accomplish, evaluate and administer the risks that emerge from their business activities.

The operational risk information disclosed in financial reporting are based on the type of supported risk event, the exposed business line, the risk indicators, the frequency and severity of operational losses, the measurement approach and the management techniques used. Operational risk is the greatest risk threatening the survival of a company. Studies find evidence of a significant impact of operational risk disclosure on capital markets. But the particular impact depends on the reporting format chosen (Yazid, Razali & Hussin, 2012).

According to Amir (2020), the term operational risk management (ORM) is defined as a continual cyclic process which includes risk assessment, risk decision making, and implementation of risk controls, which results in acceptance, mitigation, or avoidance of risk. ORM is the oversight of operational risk, including the risk of loss resulting from inadequate or failed internal processes and systems; human factors; or external events. Unlike other types of risks (market risk, credit risk, etc.) operational risk had rarely been considered strategically significant by senior management. The voluntary disclosure of information relating to operational risk depends on regulations, pressure from financial markets and cultural factors.

Operational Risk Management is a methodology for organizations looking to put into place real oversight and strategy when it comes to managing risks. Every business faces circumstances or fundamental changes in their situation that can be seen as presenting varying levels of risk to that business, from minor inconveniences to potentially putting its very existence in jeopardy.

Operation risk management disclosures range from environmental risk disclosure, health and safety risk disclosure, customer satisfaction risk disclosure, product development risk disclosure to efficiency and performance risk disclosure

2.1.2.4.1 The Benefits of Operational Risk Management Disclosures

The benefits associated with operational risk management disclosure according to NCCG 2018 include;

- Improving the reliability of business operations
- Improving the effectiveness of the risk management operations
- Strengthening the decision-making process where risks are involved
- Reduction in losses caused by poorly-identified risks
- Early identification of unlawful activities
- Lower compliance costs
- Reduction in potential damage from future risks

2.1.3 Organizational Sustainability (OS)

Omaliko, Okeke and Obiora (2021) assert that OS is having the leadership, global insights, talent and change in strategies necessary to rise to the unique challenges facing the organizations.

From the perspective of an organization, sustainability is the capability of an organization to transparently manage its responsibilities for environmental stewardship, social well-being, and economic shared value over the long-term while being held accountable by its stakeholders (Pojasek, 2017). This definition is actionable with any organization at the community level. The definition can form the bottom-up feedback loop for any definition of corporate sustainability or corporate social responsibility. No euphemisms, no slogans, no colors, and no initiatives. Each of the responsibilities can be defined by best practices associated with corporate sustainability.

Some organizations define these responsibilities in general terms as thus:

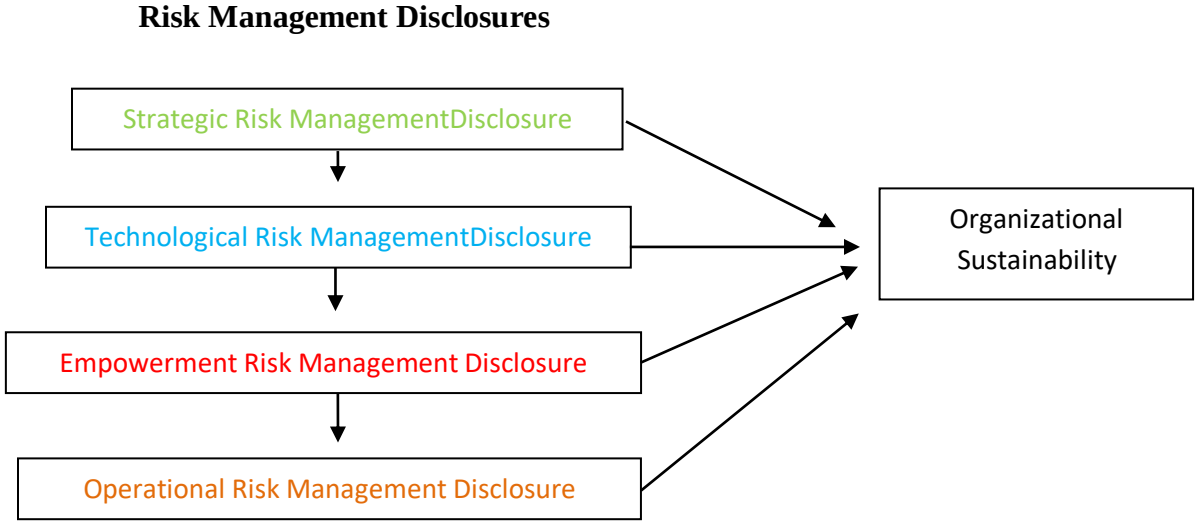
- Doing what you have committed to do
- Always giving your best effort
- Being held accountable for your choices
- Helping others when they need help
- Being fair
- Helping to make a better world

To reinforce these responsibilities and make them more specific to daily activities, an organization may create a “code of conduct” that outlines expectations for how responsibility will be embedded into what employees do every day. Organizations may also specify responsibility as part of their core values to ensure that “acting responsibly” is part of the organization’s culture. These codes of conduct according to ISO (2013) typically state that for organizations to be sustainable, the following shall be conceded:

- Be accountable for its impacts on the environment, society, and the economy
- Be transparent in its decisions and activities that impact its responsibilities
- Behave ethically
- Respect, consider, and respond to the interests of its stakeholders
- Accept that respect for the rule of law is mandatory

Each organization will have its own list of significant sustainability responsibilities which is often disintegrated into categories. The sustainability responsibilities are interconnected with the one another.

Figure 1: The Diagram of Conceptual Framework



Source: Researcher's Concept (2021)

2.2 Theoretical Exposition

2.2.1 The Legitimacy Theory

This study employs legitimacy theory as a theoretical framework. This theory was propounded by Donavan in the year 1984. The legitimacy theory presents two basic ideas whereby corporate organizations need to legitimize their activities and this legitimacy process provides benefits to the organization. Disclosing quality Voluntary Risk Management Information is a way for companies to legitimize their activities. The benefit from the legitimacy process is represented by firm's Sustainability. Legitimacy theory presumed that a corporation will act to ensure that its activities and actions were congruent with whom it believed has the necessary attributes to affect the corporation's image and ultimately, existence (Donavan, 1984).

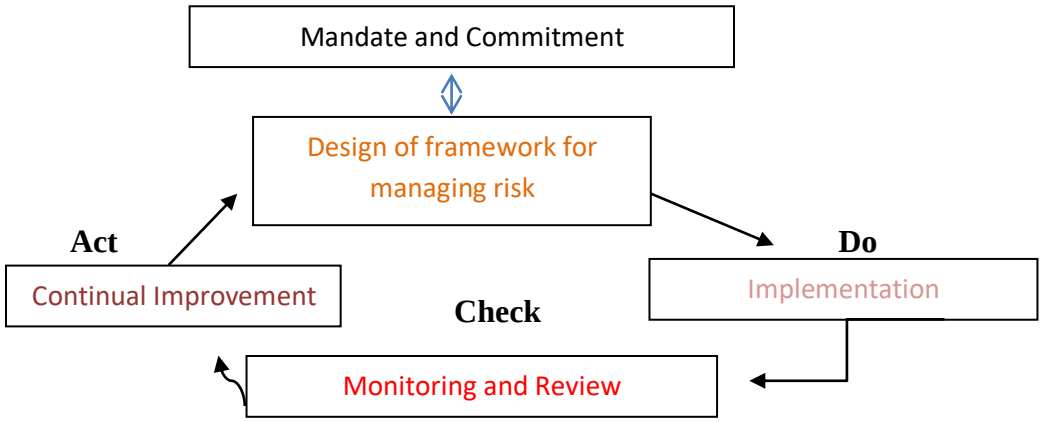
Suchman (1995) described legitimacy theory as a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs and definitions. Using the legitimacy perspective, firms voluntarily disclose risk management information to show that they are conforming to the expectations and values of the society within which they operate. According to Guthrie and Parker (2009), if the legitimacy explanation holds true, the corporate disclosure policies will react to risk management practices, major social and environmental events.

On the other hand, the theory suggests that social expectations no longer rests upon mere generation of profit but has broadened to include health and safety of employees and local communities as well as concern for voluntary risk management disclosures. Therefore, firms need to provide voluntary information to meet the broad expectations of the stakeholders especially as regard to risk management information. Hence the study is based on Legitimacy theory.

2.3 Risk Management Framework for Achieving Organizational Sustainability

A risk management framework is a means of managing uncertainty since the risk is focused on meeting the organization's strategic objectives (See Figure 2 below).

Figure 2: Design of Risk Management Framework for Achieving Sustainability



Source: Adapted from Pojasek (2017)

The design as shown above does not describe a stand-alone set of activities, but rather what is happening within the routine work of the people in the organization. Everything in the framework (design) is fully embedded into the way the organization operates every day. It is not a single document, nor is it a procedure, even though these elements can be important in the risk management framework. The design of the risk and uncertainty management framework must take into account the internal and external context of the organization. This is how it will identify the opportunities and threats (i.e., the effects of uncertainty).

A number of general characteristics of the organization need to be considered in the design:

- Organizational structure
- Governance practices
- Policies, internal standards, and operating model
- Contractual requirements
- Strategic and operational systems
- Capability and resources

- Knowledge, skills, and intellectual property
- Information systems and flows

These characteristics should be recorded so they can be referred to from time to time to detect any change that might require the framework to be adjusted (Posajek, 2017). Members or employees of the organization must have the appropriate competence for managing risk and uncertainty in order to be held accountable for their role in this risk management framework. The framework must be embedded in all the organization's practices and processes while keeping the contents associated with the framework relevant, effective, and efficient as thus ensures organizational sustainability.

Risk management needs a strong and sustained commitment from the organization's leader to ensure it ongoing effectiveness. Leaders should do the following to ensure organizational sustainability according to Pojasek (2017):

- Create a risk and uncertainty management policy
- Ensure that the organization's culture is aligned with the policy
- Monitor and measure the risk management performance in a way that is similar to measuring other performance categories
- Embed risk and uncertainty management in the strategic objectives at all levels in the organization
- Align the goals of all members or employees with the risk and uncertainty management objectives
- Ensure legal and regulatory compliance
- Ensure there are proper resources available for risk and uncertainty management
- Communicate the benefits of risk management to all stakeholders
- Ensure that the framework for managing risk and uncertainty remains appropriate

2.4 Voluntary Risk Management Disclosures (VRMDs) and Organizational Sustainability (OS) in Nigeria

Orabueze, Agbaji and Iyodo (2020) noted a positive relationship between ERM and bank sustainability and survival indicators. To this effect, the study asserts that for a better opportunity to remain relevant and financially successful, it is imperative for deposit money banks to readjust their strategic financial plans; increase their income diversification base to combat adverse impacts of risks and uncertainty in business transactions; more so, to keep up with global trends, banks should not underestimate the role sound administration and financial management play in reducing attendant cost and forestalling future financial crisis.

Owolabi (2017) reported that operational risk management practices have a positive impact on the profitability of insurance companies. The study also found an important link between

strategic risk management practices and the profitability of insurance companies. The study recommended that insurance managers easily identify risks and develop smart procedures to mitigate risks and ensure that financial performance is not adversely affected.

Fadun (2017) in his study on corporate risk management and firms' performance noted that if a firm wants to reduce its cost of capital by raising market confidence, it must disclose its risk management policies. The basic premise being that such a step will reduce the information asymmetry between investors and company directors and will thereby improve investor relations and corporate governance.

Okoroafor (2014) noted that firms with effective risk management practices make higher profit. This presupposes that a firm which has good value as a result of effective risk management will try to signal this fact by disclosing more information in the annual reports to its stakeholders. Taiwo, Ucheaga, Achugamonu, adetiloye, Okoye and Agwu (2017) reported that risk management has an insignificant impact on the growth of total loans and advances by Nigerian deposit money banks. The study hence recommended that deposit money banks should strictly adhere to their credit appraisal policies which ensure that only creditworthy borrowers have access to loanable funds.

Okike (2007) investigated the corporate reporting practice in Nigeria and discovered that it was weak and that accounting reports were found deficient because they lack vital information on risk disclosures. Also, Adeyemi (2006) reported that there is a positive relationship between corporate financial risk disclosure and some companies' characteristics outside profitability. Thus, firms are urged to report more of risk management disclosure for stakeholders' perusal in investment decision making.

Dabari and Saidin (2015) found that enterprise risk management (ERM) is implemented by some banks in Nigeria, but yet to be implement by others. Thus, banks are suggested to adhere strictly to the code of corporate governance on risk management disclosures as it ensures corporate sustainability.

2.5 Achieving Organizational Sustainability (OS) through Voluntary Risk Management Practices in Nigeria

For organizations to be sustainable, the organizational code of conduct should consider the following voluntary risk management disclosures:

- Description of the most important risks and opportunities for the organization arising from sustainability trends.
- Prioritization of key sustainability risks and opportunities according to their relevance for long-term organizational strategy, competitive position, qualitative and (if possible) quantitative financial value drivers.

- Description of sustainability trends, risks, and information system opportunities on the long-term prospects.
- Targets for the next reporting period and medium-term objectives and goals (that is, 3–5 years) related to key risks and opportunities.
- Description of sustainability trends, risks, and information system opportunities on the long-term prospects.
- Maintaining evidence of compliance with relevant local, regional, and federal laws
- Understanding the consequences of noncompliance with the laws and regulations
- Effectively managing the elements of the code of conduct
- Maintaining the integrity and reputation of the organization
- Adhering to aspirational values in line with sustainability
- Dealing with conflicts of interest and confidentiality
- Being responsible for engaging with external stakeholders
- Maintaining nondiscriminatory practices
- Paying attention to how members or employees are treated
- Conditions of membership or employment
- Using and accounting for organizational resources
- Conditions within the organization are safe and hygienic
- Paying attention to occupational health and safety
- Acting as a steward of the environment and a good citizen of the community

An organization should consider these codes as shown above to be an integral component of the framework developed to manage risk in order to achieve sustainability within the organization.

2.5 Conclusion

A priori expectations on the relation between voluntary risk management disclosures and organizational sustainability is puzzled and remain unsettled due to Ontological (differences in economic, social, and legal systems where organizations operate); methodological (differences in measuring performance i.e market or accounting; and behavioural (differences in culture of various boardrooms) complexities (Aram & Cowen, 1983; Rabeiz, 2015). Nevertheless, effective risk management practices ensure organizational sustainability.

The study having discussed extensively based on available literature on voluntary risk management disclosures (SRMD, TRMD, ERMD & ORMD) and organizational sustainability (OS) concludes that voluntary risk management disclosures have a positive relationship with organizational sustainability. This is to say that effective risk management practices of firms drive performance. The implication of this is thatrisk management policy not well implemented would have an adverse effect on the organizational sustainability which could also lead to its liquidation.

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Chapter Twelve

Clean Energy and Sustainable Infrastructure as a Panacea for Disruptive World Ecosystem

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ABSTRACT

The negative impact of non-renewable energy resources as a means of global power generation on Earth's Climate calls for serious concerns. The increase in greenhouse gas emissions and rise in oceans levels across globe is a threat to human existence and there is need to encourage alternative energy resources to mitigate the negative impact of non-renewable energy resources to world ecosystem. The clean energy and sustainable infrastructure are intimately related and they are keys to sustainable economic growth and are important weapons to combat climate change as well as promote better development. Bad infrastructure accounts for about 60 percent of world's greenhouse gas emissions and when properly structured mitigates carbon emissions as well as builds resilience for adaption to climate change. The use of renewable energy technologies to provide electricity, heating and cooling, and transportation is now wide spread across globe and the investment in it increased more than fivefold over the period 2004-2014. The consumption of renewable energy resources has increased among the continents of the world within the same period of time. Asia Pacific has been tracked as major consumer of solar energy, followed by Europe &Eurasia, North America and Middle East countries are the least. Europe &Eurasia is high on wind energy consumption, followed by North America and least is the Middle East Countries. North America is the leading continent with respect to consumption of Geo-thermal, Biomass and other forms of renewable energy resources followed by Europe &Eurasia and least is also Middle-East Countries. Development in Sustainable infrastructure and upgrading technology to provide clean energy sources are keys to economic, social and environmental sustainability.

1. Introduction

Energy is the capacity to do work and it is at the core of every economic activity, whether farming, industry, services or transport. Energy is an important index of the socio-economic and technological development ofany society [Garba *et al,* 1999]. The sources of energy can be divided into two major parts namely renewable and non-renewable energy resources. Renewable energy resources are resources that are replenished by the environment over relatively short periods of time. It includes resources like solar, wind, bio-fuels, geo-thermal, biomass,

hydroelectric etc. Non-renewable are resources that are not easily replenished by the environment. Such resources include coal, natural gas, petroleum, etc. Infrastructure is the set of structural elements that supports the day-today function, and influences the direction of human society. Infrastructure like roads, bridges, ports, power plants, water supply, communication drive economic growth in many countries by facilitating manufacturing, services and trade. Sustainable infrastructure refers to the designing, building, and operating of these structural elements in ways that do not diminish the social, economic and ecological processes required maintaining human equity, diversity and functionality of natural systems [https:// crcresearch, 2017]. The clean energy and sustainable infrastructure are intimately related and are keys to sustainable economic growth and important weapons to combat climate change as well as promote better development. Infrastructure accounts for around 60 percent of the world's greenhouse gas emissions. Done badly, it is a major part of the problem and done rightly, it is a major part of the solution vital to both climate change mitigation and adaption. Between 1990 and 2010, the number of people with access to electricity has increased by 1.7 billon and as the global population continues to rise so will the demand for cheap energy. And there is need to opt out of carbon -based energy and transport systems in favour of clean energy and electricity. The new infrastructure development must be based on three low-carbon pillars such as high end-use energy (through smart grids and smart appliances); zero-carbon power generation (wind, solar, hydro, nuclear, bio-fuels); and fuel switching from internal combustion engines to electric vehicles, and from boilers burning heating oil to heat pumps run on electricity. Most countries in different continents of the world are now investing in clean energy facilities with Continents like Europe and North America providing leadership in renewable energy consumption [3].

2. Non-Renewable energy and its effects on the Environment

Non-renewable energy resources are resources that are limited in supply and cannot be reproduced. They are derived from sources like coal, crude oil, natural gas and uranium.

2.1. Coal

Coal is the most abundant form of fossil fuel available on earth and it is mostly found below the earth. It is classified as a non-renewable energy source because it takes millions of years to form from remains of prehistoric vegetation that originally accumulated in swamps and peat bogs. Coal is combustible black or brownish -black sedimentary rock usually occurring in rock strata in layers and it is 65-95% carbon with little hydrogen, sulfur, oxygen and nitrogen content.

Coal is the major source of fuel for generation of electricity in most parts of the world today (Table 1). In America, coal is the largest domestically produced source of energy and is used to generate a significant chunk of the nation's electricity. Other countries of the world that uses coal are China, Japan and India. China is the largest coal consumer accounting for 49% of the world's total coal. The total consumption for China increased by more than 2.3 billion tons over the past

10 years accounting for 83% of the global increase in coal consumption. The next largest is the United States followed by India, Russia, Japan etc.

Table 1: Global coal consumption (Cassie Werber)

Country	**Metric tons**
China	3,526
United States	807
India	775
Russia	275
Germany	245
Japan	190
South Africa	186
Poland	141
Australia	132
South Korea	126
Turkey	101
Kazakhstan	81

2.2. Coal, Environment and Health implications

Coal is the dirtiest of all fuels, from mining to coal cleaning, from transportation to electricity generation to disposal. It releases numerous toxic pollutants into the air, water and land. All these disrupt ecosystems and endanger human health. Some cause cancer, damage the nervous and immune systems and impede reproduction development [Keating, 2001]. The environmental effects of coal use range from the poisoning of local rivers by acid mine drainage to the global problem of climate change caused by CO_2 (carbon dioxide) emissions. Coal-fired power plants release more than 60 different hazardous airpollutants. Some of these pollutants and its health implication are shown in Table 2.

Table 2: Health implications of using coal-fired power plants

S/N	SUBSTANCE	HEALTH IMPLICATION
1	Sulphur dioxide	Lung irritant, triggers asthma. Also contributes to acid

		rain and poor visibility
2	Nitrogen oxides	Susceptibility to respiratory diseases. Also Forms Ozone smog.
3	Hydrogen chloride	Gastritis, chronic bronchitis and dermatitis
4	Arsenic	It affects the gastrointestinal system and central nervous system leading tolung, skin, bladder and liver cancer.
5	Cadmium	Inhalation exposure causes bronchial and pulmonary irritation.
6	Chromium	High exposure leads to renal toxicity and internal hemorrhages
7	Mercury	It results in central nervous system problem and other developmental effects in infants
8	Dioxin	impairment of the immune system and lung cancer
9	Particulate matter	Asthma attacks and cardiovascular disease

Though emerging technologies like" clean coal technologies "offers a promising means of removing harmful emissions from coal-fired power plants but it is quite expensive to implement.

2.3. Crude oil

Crude oil is a naturally occurring, unrefined petroleum product composed of hydrocarbon deposits and other organic materials. It can be processed to produce usable products like gasoline, diesel and various forms of petrochemicals. According to statistics, the Countries that are among the world's top daily 10 consumers of oil as at 2010 are listed in Table 3 below.

2.1.Oil, Environment and Health implications

Petroleum products help us in some many ways like we use them to fuel our airplanes, cars, trucks, heat homes and to produce medicines and plastics but the impact of their emissions and byproducts are quite devastating to our environment. They give off the following emissions when burn as fuel, carbon dioxide (CO_2), Carbon monoxide (CO), Sulfur dioxide (SO_2), Nitrogen Oxides (NOX), Volatile organic compounds (VOC), particulate matter, lead and various air toxics such as benzene, formaldehyde, acetaldehyde, 1,3-butadiene. All these byproducts have negative impacts on the environment and human health as shown in Table 4.

Table 3: Consumption of Oil daily by top 10 Countries (BP's Stats)

S/N	Country	Barrels (Million)
1	United State	19.15
2	China	9.06
3	Japan	4.45
4	India	3.32
5	Russia	3.2
6	Saudi Arabia	2.81
7	Brazil	2.6
8	Germany	2.44
9	South Korea	2.38
10	Canada	2.28

These countries account for more than 58% of the World's Consumption of oil daily.

Table 4: Impact of oil byproducts on environment and human health

S/N	By product	Effect on environment and human health
1	$C0_2$	Greenhouse gas and a source of global warming
2	$S0_2$	Acid rain which causes respiratory illness and heart diseases mostly in children and elderly
3	NOX and VOCs	Contribute to ground-level Ozone which irritates and damage the lungs
4	PM	Contributes to hazy conditions in cities, asthma, chronic bronchitis, emphysema and lung cancer
5	Lead	Air toxics and severe health impacts especially on children. It is also responsible for causing cancer.

Though laws and policies are being formulated to reduce problems emanating from using petroleum products the impact is yet to be felt.

2.2. Natural gas

Natural gas is a naturally occurring hydrocarbon gas mixture consisting primarily of methane but with varying amounts of other higher alkanes and sometimes a small percentage of carbon dioxide, nitrogen, hydrogen sulfide or helium. It is formed when layers of decomposing plant and animal matter are exposed to intense heat and pressure under the surface of the Earth over millions of years. The energy that plants originally obtained from the sun is stored in the form of chemical bonds in the gas. Natural gas is a fossil fuel used as source of energy for heating, cooking and electricity generation. It is also used as fuel for vehicles and as a chemical feedstock in the manufacture of plastics and other commercially important organic chemicals.

According to 2013 statistics from International Energy Agency, the list of 10 top countries that produces natural gas is depicted in the Table 5 below.

Table 5: Top 10 Countries that produce natural gas

S/N	Country	Production in billion cubic meters
1	United States	689
2	Russia	671
3	Iran	255
4	Qatar	161
5	Canada	155
6	China	115
7	Norway	109
8	Netherlands	86
9	Saudi Arabia	84
10	Algeria	80

All these countries produce two third of the total world production of 3,479 billion cubic meters (IEA, 2014)

Natural gas is a fossil fuel, though the global warming emissions from its combustion are much lower than those from coal or oil. It emits 50 to 60 percent less carbon dioxide (CO_2) on combustion when compared with emissions from a typical new coal plant [NETL, 2010). Combustion of natural gas also produces negligible amounts of sulfur, mercury, particulates, and nitrogen oxides (NOx) which are precursors to smog but at lower levels than gasoline and diesel used for motor vehicles.

DOE analyses indicate that every 10,000 U.S. homes powered with natural gas instead of coal avoids the annual emissions of 1,900 tons of NOx, 3,900 tons of SO_2 and 5,200 tons of particulates [Alvarez et al, 2012]. Reduction in these emissions translate into public health benefits as these pollutants have been linked with problems such as asthma, bronchitis, lung cancer and heart disease for hundreds of thousands of Americans [California EPA, 2012]. Other negative impacts of natural gas include;

(i) Gas drilling can alter land use and harm local ecosystems by causing erosion and fragmenting wildlife habitats and migration patterns

(ii) Unconventional oil and gas development may pose health risks to nearby communities through contamination of drinking water sources with hazardous chemicals used in drilling the wellbore

(iii) Ground water near oil and gas wells have been noted to being contaminated with fracking fluids as well as with gases including methane and volatile organic compounds,

(iv) Unconventional oil and gas development also poses contamination risks to surface waters through spills and leaks of chemical additives, spills and leaks of diesel or other fluids from equipment on-site and leaks of wastewater from facilities for storage, treatment and disposal.

(v) Earthquakes have been observed to result from natural gas harvesting as the disposal of fracking wastewater by injecting it at high pressure into deep Class II injection wells has been linked to larger earthquakes in the United States [NRC, 2013].

2.3. Uranium

Uranium is a chemical element with symbol U and atomic number 92. It is a silvery-white metal in the actinide series of the periodic table. It is weakly radioactive because all its isotopes are unstable with half-lives varying between 159,200 years and 4.5 billion years. Energy from Uranium is called nuclear energy and the power generated from a nuclear reaction is similar to that of fossil fuels because they all use heat to turn blades (turbines) to generate power. A nuclear power plant uses uranium as fuel. Uranium pellets are combined into large fuel assemblies and placed in a reactor core. In that chamber (reactor), uranium atoms can be made to split or fission to release heat. A kilogram of natural uranium produces as much heat as 20 tons of coal. This is harnessed to make steam and generate power.

Nuclear energy has one of the lowest impacts on the environment of any energy sources because it does not emit air pollution or greenhouse gases and it requires a relatively small amount of land.Nevertheless, conventional uranium ore treatment mills create radioactive waste in the form of tailings which contain uranium, radium and polonium. Uranium

mining results in the unavoidable contamination of the environment by solid, liquid and gaseous wastes. The dangerous aspect of nuclear energy is when there is a case of meltdown like the ones in Fukushima or Chernobyl where enormous amounts of radiation was released into the surrounding communities forcing hundreds of thousands of people to evacuate. Beyond the risks associated with nuclear power and radioactive waste, there is also threat of nuclear weapons.

3. Renewable Energy and its Effects on the Environment

Renewable energy is energy that is collected from renewable resources which are naturally replenished on a human timescale such as sunlight, wind, Hydro, tides, waves and geothermal heat [Ellabban et al, 2014]. Renewable energy often provides energy in four important areas: electricity generation, air and water heating/cooling, transportation and rural (off-grid) energy services.

3.1. Solar energy, Environmental and Health Implications

Solar energy is radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaic, solar thermal energy, solar architecture, molten salt power plants and artificial photosynthesis. It is an important source of renewable energy and its technologies are broadly characterized as either passive solar or active solar depending on how they capture and distribute solar energy or convert it into solar power.

Active solar techniques include the use of photovoltaic systems, concentrated solar power and solar water heating to harness the energy. Passive solar techniques include orienting a building to the Sun, selectingmaterials with favorable thermal mass or light-dispersing properties and designing spaces that naturally circulate air.

3.1.1. Solar energy and Environment

Solar power systems derive clean, pure energy from the Sun. The main benefit of solar energy is that it does not produce any pollutants and is one of the cleanest sources of energy. Installing solar panels on your home helps combat greenhouse gas emissions and reduce our collective dependence on fossil fuel. However, using solar energy may have indirect negative impacts on the environment as some toxic materials and chemicals are used to make the photovoltaic (PV) cells that convert sunlight into electricity. But this negative effect is quite negligible. The top 10 countries that run on solar power with respect to total PV installed capacity are shown in Table 6.

Table 6: Top 10 Countries that run on solar power

S/N	Country	Installed Capacity (MW)
1	China	78,100
2	Japan	42,800
3	Germany	41,200
4	United States	40,300
5	Italy	19,300
6	United Kingdom	11,600
7	India	9,000
8	France	7,100
9	Australia	5,900
10	Spain	5,500

Many African countries receive on average a very high number of days per year with bright sunlight especially the dry area which includes the deserts (such as the Sahara) and the steppes (such as the sahel). This gives solar power the potential to bring energy to virtually any location in Africa without the need for expensive large scale grid level infrastructural developments. The distribution of solar resources across Africa is fairly uniform with more than 85% of the continent's landscape receiving at least 2,000 kWh/(m^2 year). A recent study shows that a solar generating facility covering just 0.3% of the area comprising North Africa could supply all the energy required by the European Union [German A.C]

3.2. Wind Energy and Environment

Wind is a source of clean energy that has virtually no polluting properties or side effects. Wind energy is a form of solar energy. It describes the process by which wind is used to generate electricity. Wind turbines convert the kinetic energy in the wind into mechanical power and a generator is then used to convert mechanical power into electricity. Wind energy is the second fastest-growing source of electricity in the world with a global installed capacity of 432,883 megawatts (MW) at the end of 2015.The ten countries with the most wind power capacity in 2014 according to the Global Wind Energy Council are indicated in (Table 7).

Table 7: Countries and installed wind power capacity (Allianz 2016)

S/N	Country	Installed Capacity (Mw)
1	China	114,763
2	United States	65,879
3	Germany	39,165
4	Spain	22,987
5	India	22,465
6	United Kingdom	12,440
7	Canada	9,694
8	France	9,285
9	Italy	8,663
10	Brazil	5,939

Apart from the use of wind energy to generate electricity, it can also be used for charging batteries, pumping water and grinding grain. Wind energy technologies can be used as stand-alone applications, connected to a utility power grid or even combined with a photovoltaic system. For utility-scale sources of wind energy, turbines are usually built close together to form a wind farm that provides bulk power.

Wind energy is a clean, renewable energy source and offers many advantages like;

i. It does not pollute the air like power plants that rely on the combustion of fossil fuels such as coal or natural gas. A wind turbine doesn't produce atmospheric emissions that increase health problems like asthma or create acid rain or greenhouse gases.
ii. Wind power does not use water unlike conventional electricity sources. For instance, producing nuclear, coal or gas-fired power uses water for cooling.
iii. Wind is a domestic source of energy
iv. Wind power is in-exhaustible. For as long as the sun shines and the wind blow, the energy produced can be harnessed to send power across the grid
v. Wind power is cost effective. It is one of the lowest-cost renewable energy technologies available today with power prices offered by newly built wind farms averaging 2 cents per kilowatt-hour
vi. Wind turbines can be built on existing farms or ranches. The rural dwellers can benefit immensely since most of the best wind sites are found in rural areas. Farmers and

ranchers can continue to work the land because the wind turbines use only a fraction of the acreage

vii. Wind creates jobs. In 2016, the wind energy sector invested more than $8.8 billion of private capital in the U.S. economy to build projects and employ more than 101,000 workers (approximately 30% women, 11% veterans, and 25% minorities) according to the 2017 U.S. Energy and Employment Report

The challenges of wind power include the following:

i. Good wind sites are often located in remote location far from cities where the electricity is needed and takes much money to bring the electricity from the wind farm to the city.

ii. It has been observed that wind power could damage wildlife. Birds and bats have been killed by flying into spinning turbine blades. Turbines might cause noise and change view shed. Though the impact on the environment and Communities are minimal yet concern exists over the sound sometimes produced by the turbine blades and visual impacts to the landscape.

3.3. Hydro Energy and Environmental Impacts

Flowing water creates energy that can be captured and turned into electricity. The most common type of hydroelectric power plant uses a dam on a river to store water in a reservoir. Water released from the reservoir flows through a turbine, spinning it which in turn activates a generator to produce electricity.Hydroelectricity is electricity produced from hydro power. In 2015, hydropower generated 16.6% of the world's total electricity and 70% of all renewable electricity [GSR, 2016]. Ten countries with largest hydroelectric producers as at 2014(Table 8).

Table 8: Top ten countries and hydropower installed capacity

S/N	**Country**	**Installed Capacity (GW)**
1	China	311
2	United States	102
3	Brazil	89
4	Canada	76
5	Russia	51
6	Japan	50
7	India	40
8	Norway	31

9	France	25
10	Venezuela	15

Some of the advantages of hydropower include:

i. The major advantage of conventional hydroelectric dams with reservoirs is their ability to store water at low cost for dispatch later as high value clean energy. Operating labour cost is low as plants are automated and have few staff on site during normal operation.
ii. Since hydroelectric dams do not use fuel, power generation does not produce carbon dioxide.
iii. Though some methane is given off annually by reservoirs, hydro normally has the lowest lifecycle greenhouse gas emissions for power generation compared to fossil fuels generating equivalent amount of electricity.
iv. Reservoirs created by hydroelectric schemes often provide facilities for water sports and become tourist attractions themselves.
v. In some countries, aquaculture in reservoirs is common. Multi-dams installed for irrigation support agriculture with a relatively constant water supply

The major disadvantages of hydropower are as follows:

i. Ecosystem damage and loss of land- large reservoir associated with traditional hydroelectricity power stations result in submersion of extensive areas upstream of the dams sometimes destroying biological rich and productive lowland and riverine valley, forest, marshland and grasslands.
ii. Damming interrupts the flow of rivers and can harm local ecosystems and often involves displacing people and wildlife Generation of hydroelectricity changes the downstream river environment as the water exiting a turbine usually contains very little suspended sediment which can lead to scouring of riverbeds and loss of riverbanks.
iii. Water loss by evaporation.
iv. It can result to natural disaster when there is failure due to poor construction.

3.4. Wave energy

Wave power is the transport of energy by wind wave and the capture of that energy to do useful work such as electricity generation, water desalination or the pumping of water into reservoirs. A wave energy converter (WEC) is a machine used to exploit wave power. Wave power is quite different from the diurnal flux of tidal power and the steady gyre of ocean currents. Wave power generation is not currently widely employed as commercial technology, yet, attempts have been made to use it since 1890 [Miller, 2004]. The first experimental wave farm was

opened in portugal at the Agucadoura wave park in 2008 [Lima *et a*\, 2008].The top ten countries (Table 9) that run on wave power are as follows:

Table 9: Countries and Installed wave energy capacity

S/N	Station	Country	Capacity (MW)
1	Mutriku Breakwater Wave Plant	Spain	0.3
2.	Agucadoura Wave Farm	Portugal	2.25
3	Islay Limpet	United Kingdom	0.5
5	SDE Sea waves Power Plant	Isreal	0.04
6	Azura wave power device	USA	0.2
7	SINN Power wave energy converter	Greece	0.02

3.4.1. Wave energy and Environmental Impact

All energy sources have some impact on our environment. The advantages and disadvantages of using wave power include:

A. Advantages

i. Renewable- The best thing about wave energy is that it is not exhaustive. Unlike ethanol a corn product, waves are not limited by a season. And they require no input from man to make their power.

ii. Environmentally Friendly- Power from waves creates no harmful byproducts like gas, waste and pollution. The energy from waves can be taken directly into electricity producing machinery and used to power generators and power plants nearby.

iii. Abundant and widely available- It is widely available and big cities and harbors that are close to ocean can harness the power of the waves for their use.

iv. Easily predictable- The biggest advantages of wave power as against most of other forms of renewable energy sources is that it is predictable and can be used to calculate the amount that it can produce.

v. No damage to land-: Wave power does not cause any damage to earth,it is safe and one of the preferred methods to extract energy from ocean.

B. **Disadvantages**

i. Suitable to certain locations- The major disadvantage of wave power is location. Only power plants and towns near the ocean will benefit directly from. Landlocked Nations and Cities far from the sea have to find alternative source of power.

ii. Effect on Marine Ecosystem- Large machines that are used to gather energy from the waves disturb the seafloor, change the habitat of near -shore creatures (crabs & starfish) and create noise that disturbs the sea life around them.
iii. Disturbance to private and Commercial Vessels- It impedes the movements of cargo ships, cruise ships, recreational vehicles and beach goers due to installation of a wave energy gathering source.
iv. Noise and Visual Pollution- Wave energy generator may be unpleasant for some people who live close to coastal regions. They look like large machines which destroys the beauty of the ocean.
v. Weak performance in Rough Weather-The performance of wave power drops significantly during rough weather.

3.5. Tidal energy

This is a form of hydropower that converts the energy of the tides into electricity or other useful forms of power using generator. Tidal energy has potential for future electricity and tides are more predicable than the wind and the Sun. Tidal power is the only technology that draws on energy inherent in the orbital characteristics of the Earth-moon system and to lesser extent in the Earth -Sun system. Because the Earth's tides are ultimately due to gravitational interaction of the Moon and Sun and the Earth's rotation, tidal power is practically inexhaustible and classified as a renewable energy resource.The Countries (Table 10) that run on tidal power include:

Table 10: List of World's biggest tidal power plants including those operational and under construction

S/N	Station	Country	Capacity (MW)
1	Sihwa Lake Tidal Power Station	South Korea	254
2.	La Ranee Tidal Power Plant	France	240
3	Swansea Bay Tidal Lagoon	United Kingdom	240
4	MeyGen Tidal Energy Project	Scotland	86
5	Annapolis Royal Generating Station	Canada	20

3.5.1.Tidal energy and environmental impact

Tidal energy is a renewable source of electricity which does not result in the emission of gases responsible for global warming or acid rain associated with fossil fuel generated electricity. The advantages and disadvantages of using Tidal power include;

A. Advantages

(i) It is an inexhaustible source of energy

(ii) It is environmentally friendly and doesn't produce greenhouse gases

(iii) The life of tidal energy power plant is very long

(iv) Tidal energy doesn't require any kind of fuel to run

(v) The energy density of tidal energy is relatively higher than otherrenewable energy sources

(vi) Efficiency of tidal power is far greater as compared to coal, solar orwind energy. Its efficiency is around 80%.

B. Disadvantages

(i) Cost of Construction of tidal power plant is high

(ii) Intensity of sea waves is unpredictable and there can be damage topower generation units

(iii) Influences aquatic life adversely and can disrupt migration offish

(iv) They are too localized to coastal regions

(v)The actual generation is for a short period of time. The tides onlyhappen twice a day so electricity can be produced only for that time.

3.6. Geothermal energy

Geothermal energy is heat energy generated and stored in the Earth. It is Clean and Sustainable, and it is contained in the rock and fluids beneath the Earth's Crust. It can be found from shallow ground to several miles below the Surface and even farther down to the extremely hot molten rock called magma. The top ten countries that run on geothermal energy are listed in Table 11.

3.6.1.Geothermal energy and Environmental Impact

The environmental effects of geothermal energy depend on how geothermal energy is used or how it is converted to useful energy. Direct use applications and geothermal heat pumps have almost no negative effects on the environment. Some of the advantages and disadvantages of using geothermal energy include:

A. Advantages

i. It is environmentally friendly- The carbon footprint of a geothermal power plant is quite minimal. The CO_2 released by Geothermal Plants is $l/8^{th}$ of that due from equivalent coal power plant

ii. A stable Resource- The power output of the plant can be predicted and not subject to the same low-energy fluctuations like solar or wind.

iii. A renewable resource- Geothermal reservoirs are naturally replenished

iv. No Fuel required: After installation, no mining or transportation activity is necessary
v. Small land footprint- small land is needed for its plant installation.
vi. Economic factors- Cost-competitive in some areas
vii. Accessibility- Some level of geothermal energy available most places.

Table 11: Top ten Countries of the world geothermal energy installed Capacity (TGE Research, 2016)

S/N	Country	Installed Capacity (MW)
1	United States	3,442
2	Philippines	1,968
3	Indonesia	1,339
4	Mexico	1,005
5	New Zealand	957
6	Italy	941
7	Iceland	665
8	Kenya	607
9	Japan	502
10	Turkey	410

3.6.2.Disadvantages of Geothermal energy on the environment

i. Potential emissions- Greenhouse gases (sulfur, CO_2, silica) are usuallyfound in the vicinity of the plants. The reservoirs can contain traces oftoxic heavy metals like mercury, arsenic and boron.
ii. Location specific: Good geothermal reservoirs are hard to come by.Prime sites are often far from population centers,
iii. Cost of powering the pump- Geothermal heat pumps need a powerSource
iv. High cost for electricity- Total costs is usually between $2-7 million for a 1MW geothermal power plant,
v. Surface instability- Construction of the plant can affect the stability of land. The construction of the plant in Switzerland in 1997 triggered an earthquake with a magnitude of 3.4 on the Richter scale

vi. Distribution cost- If the energy is transported long distances, cost can become prohibitive

vii. May run out of steam- If heat is not taken care of properly, it can cause a meltdown or other issues where the energy is not properly distributed or used.

4. Biomass energy

Biomass is organic material that comes from plants and animals and it is renewable source of energy. It contains stored energy from the Sun. When biomass is burned, the chemical energy in it is released as heat. As trees and plants grow, the process of photosynthesis uses energy from the sun to convert CO_2 into carbohydrates (Sugars, starches and cellulose). Carbohydrates are the organic compounds that make up biomass. When plants die, the process of decay releases the energy stored in carbohydrates and discharges CO_2 back into the atmosphere. Biomass is a renewable energy source because the growth of new plants and trees replenishes the supply. Table 12 presents the top ten countries that run on biomass energy.

Table 12: Countries and Biomass Energy Installed Capacity

S/N	Country	TW.hr/year
1	United States	64.2
2	Germany	49.4
3	China	42.0
4	Japan	35.5
5	Brazil	35.3
6	India	25.5
7	Italy	21.2
8	Canada	9.0
9	Russia	3.0
10	Norway	0.2

4.1. Biomass energy and Environmental Impact

Biomass is the first-ever fuel used by humankind. The most obvious environmental benefit of biomass is the displacement of fossil fuel usage and the corresponding reduction in air pollution and acid rain.Some of the advantages and disadvantages of using biomass energy include;

A. Advantages

i. Renewable energy source- Biomass energy is generated from organic material, plant or animal waste and these products never run out. Trees can be replaced by planting,
ii. Better than fossil fuels- The burning of biomass does release CO_2 but captures CO_2 for its own growth. But CO_2 released by fossil fuel is released into the atmosphere and are harmful to the environment,
iii. Very easily available- Biomass is cheap and readily available source of energy. If the trees are replaced, biomass can be a long-term, sustainable energy source
iv. Reduce landfills- By burning biomass for energy, we can take waste that is harmful to the environment and turn it into something useful
v. Less dependency on fossil fuels- Using biomass as an alternate source of fuel reduces our dependency on fossil fuels which is better for the planet and more cost effective.

B. Disadvantages

i. Cost- The initial cost of a biomass boiler is higher than a regular gas or oil boiler
ii. Space- Biomass boiler systems are generally larger than gas or oil boilers and require a separate storage area for fuel,
iii. Harmful to environment- Since biomass makes use of animal and human wastes, the emission of methane gas is harmful to both humans and environment,
iv. It can lead to deforestation
v. Inefficient energy- Biomass fuel's performance is less compared to fossil fuel. The biodiesel obtained from biomass, that is, ethanol is relatively inefficient when compared to gasoline,
vi. Affecting the biodiversity- it can lead to the extinction, habitat loss fragmentation and etc.

5. Infrastructure

Infrastructure refers to the fundamental facilities and systems serving a country, city or area. It includes structures like roads, bridges, tunnels, water supply, sewage plants, housing, schools, hospitals, airports, cable networks, electrical grids, telecommunications and etc. In fact, everything that modern life needs in the way of built facilities.

5.1. Sustainable Infrastructure

Sustainable infrastructure then means the designing, building and operating these structural elements in ways that do not diminish the social, economic and ecological processes required to maintain human equity, diversity and the functionality of natural systems.

5.2. Clean Energy and Sustainable infrastructure

A. Lighting of Buildings

Buildings can be constructed in such a way that solar panels are wrapped around it and angled to capture solar radiations. The zero-carbon desert city of Masdar which is a planned city just south of Abu Dhabi in the United Arab Emirates is a typical example of city with reduced carbon emission.

B. Transport Systems

The transport system anchored around personal rapid transit pods will be electric like hybrid electric vehicles. This type of transport systemdoes not rely on dwindling natural resources but on renewable or regenerated energy. Other examples of sustainable means of transportation include cycling, sailing and walking.

C. Sustainable water supply

Access to drinking water and sanitation is essential for development. The reticulation of water supply can be done in such a way that there will be no pollution of the environment. Instead of using generator that runs on fuel; solar plants should be used in pumping water to the desired destinations and water boards should be established for its management and sustainability

D. Generation of electricity

Policy makers should ensure that power generating companies' runs on renewable energy resource. An area where there is an abundant solar radiation, the power stations in such areas should run on solar energy. Areas close to oceans should use wave energy, and ones close to windy region should use wind energy for energy generation and usage.

E. Innovative road construction with walkways

Road construction should be done in such a way that walkways for pedestrians are separated from the roadway and be properly lighted. Providing walkways for pedestrians off travel lanes increases how well non-motorized public needs are being met along roadways and ad hoc staff should be engaged to keep it clean for its sustainability. Moderate exercise such as walking contributes to both physical and mental wellbeing.

F. (F) Schools and Hospitals

Provision of power supply to schools and hospitals should be done using solar power or any other clean energy sources for twenty-four power supply.

6. Conclusion

Energy is at the core of every human activity on planet Earth. The wrong use of energy has created serious problems in the world today. There is serious climatic changed occasioned by emission of greenhouses gases into the atmosphere through the use of non-renewable

energy resource. The solution of combating climatic problems lies in the use of renewable energy resources.

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Chapter Thirteen

Enhancing Capacity of Agricultural Extension Officers for Sustainable Community in Post Covid-19

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ABSTRACT

Increased urbanization, changing consumption patterns, rising per capita income and globalization increased the scope of agriculture. Interestingly, agriculture faces challenges of enhancing production, in a situation of dwindling natural resource base, climate change, insecurity and virulent disease. This has led to the growing demand for agricultural products, particularly high quality/value farm produce/products that will offer opportunities for producers to sustain and improve the livelihoods of rural communities amidst poor extension and advisory services. The principal objectives associated with agricultural extension and advisory services are concerned with transferring technological goals for the development of agricultural research facilities and capabilities in research and academic institutions. Capacity strengthening and the right tools and channels are necessary to provide modified Agricultural Extension/Advisory Services (AEAS). Furthermore, different strategies and measures need to be taken to ensure timely and quality AEAS by reorienting extension priorities in pandemic emergency situations now and in the future. In this context, an effort to review/reorient the extension mechanism across Nigeria on extension priorities post COVID-19 development through human capital development is germane.

Keywords: AES, Capacity development, community development, COVID-19 Pandemic

Introduction

The effect of the COVID-19 pandemic on the development of rural communities is still seriously felt. This has negatively affected the food economy by seriously threatening food availability, affordability and utilization. Across the globe, governments are faced with series of challenges especially in prevention of continuous spread of the deadly corona virus. FAO (2020) report showed that between present disruptions and future threats to the food supply chain, the COVID-19 outbreak has generated extreme vulnerability in the agriculture sector. It is, therefore, crucial to mobilize all available instruments, institutions and stakeholders from both public and private sectors and civil society to ensure appropriate and timely response.

The established the seventeen sustainable development goals (SDGs) are geared to transform the world no matter the consequence (Meludu and Akaninyene, 2021); they include**:** Goals 1: No Poverty, 2: Zero Hunger, 3: Good Health and Well-being, 4: Quality Education, 5: Gender Equality, 6: Clean Water and Sanitation, 7: Affordable and Clean Energy, 8: Decent Work and Economic Growth, 9: Industry, Innovation and Infrastructure, 10: Reduced Inequality, 11:

Sustainable Cities and Communities, 12: Responsible Consumption and Production, 13: Climate Action, 14: Life Below Water, 15: Life on Land, 16: Peace and Justice Strong Institutions, 17: Partnerships to achieve the Goal. These goals are interwoven and the achievement of one leads to the achievement of the order and they are geared towards building on the principle of "leaving no one behind", which emphasizes a holistic approach to achieving sustainable development for community. The role of agricultural extension advisory services is key in disseminating information and adoption of SDGs as safety measures that creates an opportunity that will lead to sustainable development.

No doubt that the safety measures put in place have also affected the normal pattern of extension service delivery in most rural communities in Africa especially Nigeria. In order to sustain agricultural production across communities, there is an urgent need to devise other useful and effective means of delivering extension services in the post Covid-19 eras. These means of delivering extension services should not only consider the safety of the rural communities, but also take into cognizance the security of the extension services providers and other relevant stakeholder in extension service delivery. Agricultural extension and advisory services (AEAS) systems play an indispensable role at the frontline of the response to the pandemic in rural areas. However, to adapt to the emergency context within the government regulations, AEAS providers need to rapidly change their way of operating. This calls for a need for digitalization of agricultural extension to help reduce face to face contact to adhere strictly to government regulations and effectively engage in agricultural extension service delivery and rural advisory services and building the production capacity of the rural dwellers.

The role of agricultural extension in community development in post Covid-19 era

Agricultural extension has the following roles in community development in the post Covid-19:

1. Increasing community-based awareness of COVID-19 and other deadly diseases: This will enhance a decrease in the spread of the deadly coronal virus and other deadly diseases while ensuring that adequate support is given to rural producers in terms of both production and compliance with government regulation (FAO, 2020). In doing this the extension personnel should not only be acquitted with the basic knowledge in the delivery and extension packages but also be aware of the various health regulatory policies put in place by the government and the World Health Organization (WHO). According to Chen, Leclair, Kanamidiehkordi, Lersen and Babu (2020), the COVID-19 pandemic is not the first time EAS have been called to action in an unfolding disaster. As an institution with skilled technical staff who aretrusted by communities, and within local reach and communication skills, extension has supported efforts and educated communities on crises such as HIV/AIDS, Ebola, avian influenza, natural disasters, and pest infestations. Therefore, the case of Covid 19 pandemic will not be different if the needed operation facilities are made available.
2. Assessing the field situation and advocating for urgent solutions to farmers' needs: agricultural extension and rural extension service providers being reliable partners with producers and rural communities, are uniquely positioned to assess the field situation, provide tailored services, and keep governments informed, thus allowing rapid and adequate decision-making for ensuring health and food supply. According to Onyemekonwu (2015), it is the duty of AEAS providers to assist farmers to identify and analyze their production problems and increase awareness opportunities for improvement among farmers. This

becomes very crucial in the post covid-19 era as most agricultural production and rural community development activities have been affected by the pandemic. In order to maintain a sustained and adequate food production, there is an immediate need for extension personnel who are trained in the principle and practice of agricultural extension and rural advisory service delivery to access and identify the field situation and identify possible areas of interventions.

3. Ensuring continuous support to rural producers in a situation of physical distancing: AEAS are known for supporting rural dwellers in their production and development activities, targeting men and women, elderly and youth to overcome new and unfamiliar challenges in their production activities so as to contribute meaningfully to national development and improve their living standards. It is expected that the same activities should be continuously maintained in this current health regulatory policy of physical distancing. AEAS can provide trusted sources and contact details to ensure easy access to inputs, seeds, transport and finances that are critical to guarantee food production during COVID-19 in the field. To that end, the AEAS providers are increasingly being challenged to cope with physical distancing, in particular when using remote communication and digital extension, or when playing an information and brokerage role in a specifically rural community COVID-19 reality. However, it is advised that the AEAS provider should as much as possible utilize available physical distancing extension delivery facilities to avoid a disconnection in the contact between the AEAS provider and the contact farmers.

4. Building effective partnerships to avoid market disruptions and ensure supply chain functioning: owing to the fact that many AEAS actors operate at the agricultural production level of the value chain, COVID-19 imperatives can push them to take action in addressing the critical problems of the farmers, in partnership with other stakeholders in the agricultural innovation system. The promotion of short value chains and homegrown production – both in urban and rural areas and virtual matching food and labour demand and supply – facilitating farmers' access to storage facilities – while encouraging e-commerce where applicable, is among the most frequent AEAS actions. Most importantly, the AEAS providers bearing in mind the safety health regulatory policies should ensure that there is an effective flow in the food value chain.

5. Help address emerging social issues, including facilitating linkages with social protection services, developing social safety nets and applying appropriate health insurance schemes. This can only be possible if the AEAS provider has a robust knowledge about the availability of these services. Therefore, the AEAS provider should get himself acquitted with better insurance policies that will be beneficial to targeted communities.

6. Assist in identifying and advising on alternative income generation opportunities. Studies have shown that famers have improved their living conditions by engaging in alternate income generating activities. Onemolease (2004); Belownu (2017) affirmed that farmers diversification into alternative means contribute to farming household quality of life. It is therefore important for the AEAS provider to help targeted communities to identify potential alternative income sources that will enhance their living standards especially in the post covid-19 era where some neglected plant species are gaining popularity because of their contribution in boosting human immune system and other medicinal importance.

7. Help in resolving local conflicts. The post Covid-19 era is not immune to conflicts among rural communities. The AEAS providers should be well oriented in community conflict resolution strategies so as to guide against sudden eruption of crises among rural communities. No doubt conflicts, when not handled can skyrocket to jeopardize the overall target of the extension package of a targeted community. It is therefore important for the AEAS provider to have special training in conflict resolution.
8. Assisting in home management. When the production performance of the farmers in terms of income is not translated into the wellbeing of the rural dwellers, it implies that the AEAS provided by extension agencies has not met its overall objective. This is because the long-term objective of extension service is to improve the living standard of the rural populace in order for them to cope with the pandemic.
9. Providing relevant health information. Irrespective of the fact that AEAS providers are not professionally trained health personnel, there are some basic health tips available to them which may not be available to rural communities especially in the post Covid-19 era. It is the duty of the AEAS providers to make this useful health available to the rural communities.
10. Conducting worthwhile research that will be useful to the rural community. The outbreak of Covid-19 has resulted in certain situations which may be affecting agricultural production in targeted communities. The AEAS providers should passionately identify these areas and bring them up for research in order to proffer solutions. Notwithstanding the social distancing regulation put in place by the government, useful data gathering tools that take into cognizance the social distancing rules should be utilized.
11. Identifying the immediate felt needs of the farming communities. It is the duty of AEAS providers to identify the immediate felt needs of the target communities and help address these needs. This will help the farming community gain confidence in the AEAS providers,

The need for digitalization of agricultural extension and advisory services

Digitalization of agricultural extension and advisory services becomes necessary to meet up with the situation demand across the globe as social distancing has been advocated as a means of reducing the spread of Covid-19 and other infectious diseases. Digitalization helps in the efficiency and management of agricultural food supply chains, and to bridging the urban-rural division by increasing public awareness and participation. Hence, the application of specific digital technologies can have a significant impact on the productivity of crops, livestock, forestry, fisheries and aquaculture, improving farmers' incomes and welfare. In line with the digitalization of the agricultural food supply chain, it becomes imperative for agricultural extension to work in this direction by digitalization of AEAS.

Food and Agriculture Organization (FAO) (2020) ascertained that digitalization benefits all actors in agriculture, as its implementation can help reduce crop losses, decrease herd deaths, improve yields, manage risks, optimize product storage, avoid food spoilage, and maximize profits. The use of technology throughout the value chain translates into tangible improvements in food security, being especially relevant in the most vulnerable populations (USAID, 2018); for example, it helps to reduce production losses, due to better risk management, or to allow better

farm product marketing. The use of digital technology in the provision of agricultural extension and advisory services helps to reduces a myriad of problems known to plague especially in developing countries

The application of digital technology at the field level assist farmers and AEAS providers to make evidence-based decisions that will enhance the production performance of the farmers in the rural communities. Data on soil, climate, irrigation, markets, diseases and pests, as well as the availability of private loans or government subsidies are part of the information available for decision-making at the on-farm level. Decision-makers will have real-time (or near real-time) information on market prices, projected end-of season yields, the number of beneficiaries of government programmes and subsidies, the effectiveness of preventive actions to protect against diseases and pests or of disaster mitigation measures (FAO and ITU, 2019). Traders and wholesalers should also have a better understanding of the quantity of products available and plan appropriate activities to improve prices and product quality based on the available evidence. Banks, insurance and other financial institutions will also be able to better design their products, customizing them for rural communities. Consumers will benefit from traceability, food safety, quality and price of food products. This will also make it easy for AEAS providers to make decisions on adoption of innovation by the farmers easily in the field.

Digitalization of agricultural extension and advisory services for sustainable community development

Agricultural Extension and Advisory Services (AEAS) refers to any public or private organization (farmers' organizations, private companies, non-governmental organization) that facilitates the access of farmers and other rural actors to knowledge, information and technologies, enabling interaction with other actors and helping them to develop their own organizational and management skills, practices and techniques in order to improve their livelihoods and well-being (Christoplos, 2010). Previously in Nigeria, AEAS were found to be the duty of the public extension service provider of the government, but recent studies by Igene et al., (2018) have found non-governmental becoming interested in AEAS provision. However, irrespective of the agency involved in AEAS delivery, the need of digitization cannot be overestimated.

The AEAS requires active participation from various actors within and outside the community which include formal and informal, public extension agents, advisors and private companies; producer, community-based organizations, and Non-Governmental Organizations (NGOs). All these actors working in synergy brings to reality the focus of AEAS delivery. Going by the restriction and health policies regarding the control of the spread of Covid-19, there is an urgent need for digitizing AEAS.

According to FAO (2020), one trend in agricultural extension and advisory services is the use of emerging digital technologies and tools, which enable more efficient communication between people and organizations. These include a wide range of digital services, tools and technologies, which are used according to local needs and capabilities of the targeted communities: these range from mere simple message services (SMS), radios, television, email to drones and artificial intelligence. The "state of the art" technology is generally used by private actors and agricultural technology companies; public extension systems and advisory services, on the other hand, they usually use tools – based on ICTs – to facilitate communication between producers and advisors.

The agricultural sector can be improved by agricultural extension and advisory services through access to digital technologies with innovation to meet local needs of the farming communities, thereby enhancing the production performance of the rural dwellers who are majorly farmers so as to better their living standard and contribute to national development.

What are digital technologies in agricultural extension?

The definition of digital technology covers all electronic tools, automatic systems, technological devices and resources that generate process or store information. The difference between analogue and digital technology is that in analogue technology, data is converted into electric rhythms of multiple amplitudes, while in digital technology; information is converted into the binary system that is zero or one, where every bit is the symbol of two amplitudes (Johnson, 2021).

Digital tools in agricultural extension can be generally described as technologies that facilitate effective communication and the processing and transition of information through electronic means. This definition incorporates all digital tools, communication tools ranging from internet, GSM phones to the use of Drones to facilitate and enhance effective extension service delivery (Johnson, 2021).

Digital Technologies is the natural home for ICT Capability, it is important to understand that the content area deals with the deeper concepts of technology. The ICT Capabilities are about using and working with technology, while the Digital Technologies is about understanding technology and developing a particular way of conceptualizing and using.

Digital tool with high potential for AEAS delivery

Regarding the use of digital technology, the interest of agricultural extension centers most on effective communication to build the capacity of farmers so as to improve their production capability and improve oval wellbeing. Digital tool with great potential to improve AEAS delivery include

1. Website

Websites provide all kinds of information and have gradually become the best way of communication irrespective of location. The internet as a whole is the definition of multiple parts of digital technology, and the website is one of the most common parts of the internet that people excessively access nowadays. The use of the website if adapted fully to AEAS delivery can help to reach a large majority of farmers at the same time providing them with key information that can be accessible at low cost. According to Lawal-Adebowale (2009), this development is yet to be showcased in Nigeria. The use of websites in AEAS delivery is gradually gaining popularity in developing countries like Nigeria; various agricultural websites have been created by experts in the field of agriculture. But a very critical question is to which extent is it utilized among farming communities. This therefore calls for trained experts in extension service delivery, who are aware of the prevailing condition in the farming communities to facilitate development. However, a major limitation to the use of websites is the unavailability of internet network and facilities in most farming communities, illiteracy and poor electric supply among farming communities.

2. Online Buying and Selling

Online banking was developed to provide customers with a variety of options and values. Interested consumers and retailers can buy from a number of options available. Buying and selling online have been effective for a variety of products where interested buyers place orders online and their products are delivered. Selling online can be performed on a large scale as a viable enterprise. Online buying and selling is one of the ways farmers can make sales of their product by applying the physical distancing rule to help reduce the spread of Covid-19.

3. Smartphone

The invention of smartphones enhanced the communication system. With the use of smartphone voice messages can be recorded, text messages and recorded video can be sent across to farmers irrespective of the location provided, there is the presence of internet networks that facilitate its use. With the use of smartphones extension teaching and learning can be effectively done observing the physical distancing rules. There are so many smartphones, which include various applications for other kinds of digital technology like calculators, cameras, mapping and so on which are necessary for AEAS delivery.

4. Blockchain Technology

This technology is a framework that stores the track records of transactions, it is often referred to as block, of the general public in various records, called as "chain", in a system joined through peer-to-peer knots. Normally, this storage is known as a "digital ledger". Every transaction in this ledger is certified by the digital signature of the holder, which verifies the transaction and protects it from damage (Johnson, 2021). This can help improve farmers in making transactions regarding the purchase of farm inputs as other buying and selling.

5. Artificial Intelligence (AI)

Artificial intelligence is seen as the capacity of machines to learn and perform intelligently and smartly. There is a serious concern that AI will totally transform the world in no distant time. It is also the influential power behind various other digital technology movements which are expected to be seen in the coming years. Currently certain machines are programmed to perform some farm operations with little human manipulation. However, the use of artificial AI requires machines to be programmed to perform farm operation or AEAS without human manipulation. This can also be an effective way to carry AEAS service delivery maintaining physical distancing rules at the community level.

6. Cloud Computing

Cloud Computing is a system where big data is recorded and stored on other processors and retrieved through the internet. It has helped to expose the data and analytics to the masses. Here the data is managed on smart devices (like smartphones or smart LCDs); it will take this to the following level. Cloud computing can assist both the farmers and AEAS provider to store wide range of information which will be useful to them in the farm operations.

7. Robotics

Digital robotic technology is becoming classier and commonly used in various areas of human endeavor. Emphasis on the use of robotic equipment more popular in the medical field during the Covid-19 outbreak as it was seen as an option for the treatment of patients to avid the spread of the virus. Robotic equipment can still be usually found in the production industry. They are also used for tasks that are riskier to humans, like identifying and neutralizing bombs. Technologists are also working on tiny nano-robots, which can be inserted into the body of human beings to perform medicinal investigations and measures. In the same vain, digital robotic material can be adapted to perform AEAS in agriculture.

8. Drones and Missiles

Drones and missiles are digital technologies and are popularly used as armed digital technologies. Drones which fight with flying vehicles and channeled missiles integrate digital technology in order to perform successfully. Drones are normally directed in real-time by a far-flung human control. Missiles use digital technology for their management, direction, and flight structures. These technologies can be programmed to perform agricultural activities and AEAS services.

9. Video Streaming

This can be used for multiple reasons such as social media, online games, multimedia and mobile phone apps. We can watch movies or shows online. We can communicate virtually by using applications like Skype. We can watch or stream live shows with the help of live streaming. Websites like YouTube give several other viewing choices for information or entertainment. Video streaming can be accessed through a number of digital gadgets like laptops, smart screens, and smartphones. The use video streaming can be AEAS services where information can be made available to farmers in communities YouTube. The use of Skype can also facilitate AEAS service delivery irrespective of the distance.

Challenges to digitalization of agricultural extension and advisory services

1. Limited network coverage: the network coverage in most rural areas of least developed Countries (LCD) and Developing countries remains limited. Despite 4G becoming the most common mobile connection globally and 90% of being able to access the internet through 3G or higher quality network, only around a third of rural populations in LDCs receive coverage by 3G networks (GSMA, 2019).
2. Although there is growth in the use and ownership of mobile smartphones in developing countries, affordability remains a major concern. The continuous upward review of the price of smartphones creates a barrier to its use.
3. High poverty level in the rural areas. In developing countries, poverty is more in the rural areas where farmers reside and major agricultural activities are carried out. Poverty is a multi-faced affliction. It is a ranging economic and social phenomenon that manifests in the inability of the victims to acquire basic necessities of life (Ajayi, 2009).

4. Poor communication policies of most developing countries and policy inconsistencies in the sector that discourage private investors to invest in communication.
5. High level of illiteracy among farmers. In some farming communities, farming activities are left for the aged and illiterates who were not privileged to have formal education. In most cases, the educated one migrates to cities in search of white-collar jobs. These therefore pose a challenge to the use of digital technologies that require reading and writing.
6. Poor power supply. Most digital technologies require electrical power charge and put the active. Unfortunately, in most farming communities there is the lack of electrical power supply; in area where there is supply it is mostly not constant. Also, possible alternatives such are electrical power generator and solar system are expensive to purchase and maintain
7. Maintenance problem. Maintenance has always been a problem to technologies developed outside. In some cases when these tools develop fault, it might export it back for repairs or bring experts to put the tool in good shape

Factor influencing the use of digital technologies in AEAS

The use of digital technology for AEAS is influenced by the following

1. Availability and affordability of digital facilities. Even if AEAS providers are willing to adopt the use of digital technologies in their operations; the availability is of major concern. In most cases, even if they are available, they are very expensive
2. Availability of digital infrastructure. Infrastructures that facilitate the use of digital technologies are not readily available in rural communities where the bulk of agricultural activities concentrate. In some cases, even if digital networks are available, the network is not reliable as it is characterized by poor signal. This is because there is reliance on digital infrastructures from neighboring towns. But when these digital infrastructures are available and reliable AEAS providers will be moved to utilize them.
3. Opportunities for training for both farmers and AEAS providers. Training opportunities in the handling of digital technologies will help to increase the interest of farmers especially youth. This can start with computer training to expose them to the basic computer-based trainings
4. Awareness of digital information management and processing tools. The first step to the use of digital tools is to be aware of the availability of digital tools that can enhance the dissemination of agricultural extension and advisory services
5. Relevant and suitability of technology to the felt need of the farmers. When the digital tools fit for use in the solving of farmers' problems, its use becomes easily accepted.
6. Conceptualizing the use of digital technologies by public and private AEAS providers to meet farmer's needs.

Conclusion

The role of agricultural extension advisory services is key in disseminating information and adoption of SDGs as safety measures that creates an opportunity that will lead to sustainable development. Human capacity development is a procedure by which individuals, groups,

organizations, institutions, and societies develop their abilities both individually and collectively to set and achieve objectives, perform functions, solve problems and to develop the means and conditions required to enable them to achieve their own developmental goals.

If capacity is built, AEAS can offer support during uncertainty and sudden changes that come with the pandemic, and strategies to bounce back from shocks and enhance resilience. The perceived lack of success of public agricultural extension systems in Nigeria has resulted in new approaches being tried in reorganizing extension services. Information technologies (IT), including computers, cell phones and related tools, such as geographic information systems (GIS), are used more effectively to manage information dissemination. Most of these technologies, plus the accompanying software, are private possessions. Capacity development and strengthening and the right tools and channels are necessary to provide modified AEAS messages to be utilized to cushion the effect of the post covid-19 consequences.

Recommendation

There is the need for synergy among all actor/stakeholder in extension and advisory services to work together;

a. Formulation of policy guidance for the governments on recovery of institutional needs of AEAS for post covid-10 and future emergencies;
b. Need for social communication training to encourage preventive and behaviour change messages through community sensitization meetings and radio discussions;
c. Continuous wash of hand with soap & water, use sanitizer, wear a face mask/shield, covering of mouth while sneezing, maintain social distance, avoid crowded, and void unnecessary travels;
d. Promoting delivery of online market information to guide farmers on crop selection to maximize economic benefits;
e. Create data disaggregation and availability at the community scale;
f. Teach AEAS to publish timely forecasts and early warning and prevention and control measures through the use of smartphones.

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Chapter Fourteen

Effects of Women–in– Agriculture (WIA) Programme on Income Status of the Rural Women in Enugu State, Nigeria

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ABSTRACT

This study assessed the effect of Women-In-Agriculture (WIA) programme on the income of the rural women in Enugu State and some developing countries; Women plays significant roles in production and processing of agricultural product. Women as farmers face some constraints in accessing productive resources, market, finance, other inputs and services which hinders their effective participation in socio-economic and political activities thereby reducing their contribution to the attainment of the broader societal goal. The objectives of this study are; to determine how the years of participation in WIA has affected women access to farm productive resources such as fertilizer, seedlings, extension service and credit, to access how the productive resources such as fertilizer, seedlings, extension services and credit obtained through WIA has increased the productivity of rural women farmers, to determine the effect of adoption of WIA introduced agricultural processing and marketing innovation on the rural farmers income, to determine the challenges facing participants of WIA Programme. Primary data were collected using a structured questionnaire administered to 300 WIA participants selected through multi-stage random sampling technique. Results indicate that there is discrimination against women farmers in the distribution of farm input, extension services are inadequate, members lack storage facilities and as such has loss most of their produce, the result also shows that there is no significance difference on effect of production input on income al 0.05 level significance. The result also indicates that the productive resources such as fertilizer, seedlings and credit have significance effect on access to farm production resources. This study recommends sustained governmental assistance to women farmers in the form of appropriate policies and strategies to ensure their access to extension service, land resource, credit and subsidized inputs. Also, the WIA programme should include more income generating activities and training for improved production.

Keywords: women–in– agriculture, rural livelihood enhancement, Enugu women, Nigeria

Introduction

In Africa and some developing countries, women play significant role in production and processing of agricultural products (Rahaman, 2008). Women in Africa account for between 60 - 80 per cent of agricultural production (Sabo, 2006; Adisa and Okunade. 2005). Food and Agriculture Organization (FAO, 2000) reports further shows that in Sub-Saharan Africa, agriculture was still the most important sector for female employment. (Ekong 2003) notes that it was not an exaggeration that food security in rural and urban Nigeria depended largely on the women. Ekong states that the roles of women in agricultural production included land preparation for farming, planting of crops and vegetables, weeding, harvesting, processing of harvested crops and storage, transportation of agricultural produce, fishing. fish processing and marketing of sea foods, processing and sale of dairy products and homestead livestock husbandry.

Women play important roles in agriculture, undertaking a wide range of activities relating to food production, processing and marketing; and beyond farming, they are involved in land and water management: most often they are collectors of water, firewood and fodder. They have access to a store of local knowledge on the medicinal use of plants; they have been in the forefront of soil conservation programmes; and it is the women who perform most of the household Labour devoted to animals (Commonwealth, 2005). Women participation in agricultural production therefore cut across various subsectors: planting, weeding, harvesting, processing, and marketing as well as tending livestock (Soubh, 2006). This necessitates their integration into planning, policies, and programmes for effective and sustainable development of a nation (FAO, 2002).

The foregoing underscores the inestimable role of women in agricultural production in the country. Unfortunately, women were often classified as invisible farmers, while the men were the visible farmers. (Akello and Sarr, 2000) affirm that with new challenges arising from political and economic liberalization processes, the demand for gender specific information has seen growing on yearly basis. According to the Technical Centre for Agricultural and Rural Cooperation, (CARN. 2000) women constituted about 80% of the agricultural labour force yet their role in this important economic activity remained obscured. Food and Agriculture Organization (FAO, 2000) state that in Sub-Saharan Africa, women farmers, entrepreneurs, and wage earners contributed significantly to the National Gross Domestic Product and to national welfare but their efforts were hampered by lack of capital, modern implements, distribution facilities and market outlets. In addition, it was common for men to take over the sale of women produce and control women's income. The report further revealed that the contribution of women to household food security and income has not been fully recognized.

International fund for Agricultural Development (IFAD, 2010) said rural women are resourceful economic agents who contribute to the income of families and the growth of communities in a multitude of ways. They work as entrepreneurs, as farm and non-farm labourers, in family businesses, for others and as self-employed; while they take on a disproportionate share of unpaid work at home. However, their contribution is limited by unequal access to resources.

(Roy 2006) notes that since women constituted nearly half of the population, they could become a great resource in the development process if they were properly mobilized and organized.

Perhaps, this admonition together with the variegated problems afflicting women farmers led to establishment of programmes like the Women-In-Agriculture programme. The Women-In-Agriculture programme was established mainly to contribute to their welfare and give the 'men their pride of place in the agricultural development industry. (Sabo 2006) assert that Women-In-Agriculture programme was designed to address the gender imbalance in agricultural extension delivery. She maintained that the programme evolved from three pilot projects to a nation-wide programme. According to (Agu, 2000; Adisa and Okunade 2005) Women-In-Agriculture programme was formed in the ADPs by the National Council on Agriculture in 1989. The specific objectives were to: (i) develop gender specific programmes and technologies for women farmers in close collaboration with research institutions, (ii) promote the use of appropriate technologies which would meet the needs of women farmers; (iii) assist in linking women farmers to sources of credit; (iv) support group and individual women activities aimed at increasing the animal protein resources of the country; (v) increase agricultural production and income of women farmers; (vi) improve the skills of women in food processing, utilization and marketing (vii) organize women into cooperative societies for purpose of acquiring credit and information; and (vii) encourage women farmers to keep livestock in order to improve the nutritional status of the family.

The Enugu State WIA programme was set-up under the Enugu State Agricultural Development Project (FNADP) in 1991. This programme was established to mobilize women in gender specific activities, which include post-harvest activities like processing, utilization, storage and marketing of agricultural products. The major activities of WIA still remains to form women group and assist them establish group-farms. It is through these groups that WIA extension agent transfers recommended technologies to the women for adoption. However, the WIA programme places much emphasis on off-farm activities of the women and has concentrated in the transfer of the following Home Economic technologies as:

i. Cassava processing and utilization pancake, flour and odourless fufu.
ii. Processing and storage of maize, garri, cassava flour, tapioca, maize flour, malted maize drink, com meal, pap (wet and malted maize flour).
iii. Processing and utilization of soybean into soymilk, flour paste and soy meal
iv. Processing and storage of fresh tomatoes into tomato paste.

v. Rabbit meat processing and utilization
vi. Processing and storage of melon
vii. Cocoyam processing and utilization into cocoyam flour for soup thickening and cocoyam chips
viii. Dry season vegetable gardening
ix. Harvesting and storage of paddy rice.

Statement of the Problem

Globally, about 1.6 billion rural women depend on agriculture for their livelihoods, International Fund for Agricultural Programme (IFAP), 2000). Studies have shown that when women increase their income and have access to more resources, they invest their money in their children's nutrition, education and health care, creating a multiplier effect that strengthens families and communities over time. Despite the benefits for both agricultural productivity and poverty reduction. Many development programmes and services do not adequately invest in women's agricultural productivity. (Nadia, 2003).

Women as farmers, workers, and entrepreneurs face more constraints than men in accessing Productive resources, markets. finance, other inputs and services which hinder their effective participation in socio economic (including agriculture) and political activities thereby reducing their contributions to the attainment of broader societal goals (FAO, 2011). In addition, there are evidence to demonstrate structural discrimination against women with respect to access to credit and other farm inputs despite evidence that show low default rate and lower cases of corruption and bribery among women (World Bank. 2004; Whitehead, 2003); Blackden and Bhanu, 2000); World Bank 2001. 2002); Bamberger, 2002).

The major problem facing rural women farmers is the need to transform their agricultural enterprise from depending on traditional inputs with low productivity to one based on modern inputs with higher productivity (Uwegbuonu 2010). The agricultural production of women farmers, probably due to the fact that appropriate technologies have not adopted. (Okwoche and Asogwa 2012) note that there are been poor yield in cassava production, compared to when extension service where given.

Women farmers who toil all days in the farm only to produce a little quantity using local technologies at their disposal Sabo (2006). Low labour productivity is mainly a consequence of poor agricultural practices resulting from lack of production resources, poor investment in inputs due to lack of credit availability and reticent management techniques due to the absence of modern technology or poor behavioral approach to its adoption (FAO 2015). Previous studies have shown that women participation in agriculture contributes significantly to Household income, family asset and increased productivity attempts are being made by researchers and policy makers to promote Women-in-Agriculture. In particular, the Nigerian Government

introduced WIA under the Enugu State Agricultural Development Programme ENADP amongst other objectives to increase the productivity and income of women farmers. Based on my findings, no empirical study has evaluated the WLA programme on household income.

Objectives of the Study

The broad objective of the study is the effect of women in agriculture (WIA) programme on the household income of the rural women. Specific objectives are to:

1. determine the years of participation in WIA has affected women access to farm productive resources such as fertilizers, seedlings, extension service and credit.
2. access the productive resources such as fertilizers, seedlings, extension service and credit obtained through WIA has increased the productivity of the rural women farmers.
3. determine the effect of adoption of WIA introduced agricultural processing and marketing innovation on the rural farmer's income.
4. determine the challenges facing participants of WIA programme

The Women in Agriculture (WIA) Programme

The women in agriculture (WIA) is s sub-component of the Agricultural Development Programme (ADP) and was instituted in 1988 to address specifically gender related agricultural problems. The focus is on food nutrition, processing, storage and utilization of crop and livestock produce in order to raise women's income and living standards through business-oriented farming and processing strategies. Ever since, the introduction of the WIA programme in Nigeria and with the current emphasis on participatory extension, various efforts have been made to elicit various types and levels of information on the activities and its effectiveness in specific limited areas or States of Nigeria (Akpabio, Etim and Okon 2012).

In Nigeria, (Odurukwe, Matthews-Njoku and Fjiogu-Okereke 2006) contends that the *Agricultural Development Projects (ADPs) of different States of the federation had made important advances in incorporating gender in agricultural extension by modifying the system midstream to provide for women farmers through the creation of Women-in-Agriculture (WIA) programme in the Department of Extension Service of the State ADPs with a gender focus.

The WIA programme sought to improve agricultural extension services for women; it also tends increase food production, food self-sufficiency and sustained reduction of poverty and malnutrition among women. (Saito, Gadzame and Odurukwe 2006) note that focus on female sender led to the retraining of existing Home Economics agent in agriculture and extension methodologies, placing special emphasis on women's activities. They maintained that through the WIA programme every State in Nigeria is meant to have female extension workers at every level of operation from State headquarters in the capital, down to the villages.

At the headquarters, the WIA head holds the rank of deputy director within the State ADP and is responsible for the overall planning and implementation of the WIA programme. He is assisted by Subject Matter Specialist who work for WIA at the zonal level, supervising and monitoring the implementation of the WIA programmes in their various zones. These specialists interact with research and technology institutions, participate in problem identification and field training and provide support to WIA Block Extension Agents (BEAs). At the block level, these BEAs agents work directly with women farmers, identifying and organizing women into groups and registering them into women farmers (Odurukwe 2006). They observed that through formation of WIA farmer's groups that the BEAs facilities the dissemination of agricultural innovation and provides women farmers with better access to farm inputs and credit than they would have as individuals.

Women's Contribution to Household Economy, Food Production and Food Security

Afolabi, (2008) shows that rural women in Ondo State of Nigeria are very strong pillars of the economy in the State. Women in organized groups, often engaged in more than one economic activity, are major contributors to food production; have successfully managed human and economic resources to achieve optimum results; became employers of labour, thereby reducing unemployment; and the farms of these rural women contributed to reduction in food shortage crisis and contributing substantially to national agricultural output, maintenance of the environment and family food security. (Todaro, 1994). In Sub-Saharan Africa, agriculture accounts for approximately 21% of the continent's GDP and women contribute 60-80% of the labour used to produce food (FAO,2003). Estimate of women's contribution to the production of food crops range from 30% in the Sudan to 80% in the Congo, while their proportion of the economically active labour force in agriculture ranges from 48% in Burkina Faso to 73% in the Congo and 80% in the traditional sector in Sudan. Data available support the trend throughout Africa that: smallholder subsistence women farmers substantially contribute to national agricultural production and food security and are primarily responsible for food crops (FAO, 2003).

In most of SSA, the responsibility for the production of household food supply lies with women. As providers of food and nurturers of children, women ought to play a role in any attempt to increase food production and food security (Kotze, 2003). Aside from household duties, women carry out a variety of agricultural labour, performing almost all tasks and activities associated with subsistence production and produce more than 74% of household food in African countries and up to 70% of food consumed by families in rural areas (Todar 2015, Geier ,2014 and Melamed 2016). The gender division of labour and social responsibilities in the household is to a large extent the deciding factor in women's commitment to subsistence production and to fulfil their responsibility to feed the family and ensure food security for the household. Most women in the Low-Income Food-Deficit Countries (LIFDCs), especially in rural areas, are therefore over-burdened with a wide range of activities and tasks in agriculture, animal husbandry and in the

household (Gueye, 2003). Belonging to disadvantaged groups in most rural communities in LIFDCs they arc main poultry owners in LIFDCs, though there are actions within and between countries. * According to (Gueye, 2003) more than the 70% of chicken owners in rural areas of SSA are women. On the whole, women's involvement in poultry farming tends to decrease with increased levels of intensification. Any serious attempt to eradicate poverty must address the role of women as producer's food as income earning capacity for women and ensure that they have in policy and decision-making (Yemisi and Aisha, 2009). Any program to increase food security among the poor, particularly the rural poor, must ensure not just representation but full participation of women. (Kotze, 2005) concluded that the role of men in the household economy and their contribution towards food production and food security as a matter of urgency need to be acknowledged in any policy, program and project aimed at promoting food security and rural and agricultural development.

Methodology

Area of Study

The area is Enugu State and is one of the five (5) States that made up South-Eastern Geo-political zone of the Federal Republic of Nigeria. There are seventeen (17) Local Governments Area and two hundred and one (201) communities in Enugu State. The capital area and seat of government in Enugu. The 2006 population census indicates that Enugu has the population of 4,267,837 million people. The indigenous ethnic group in Enugu state is Ibo. The State was created on the 27th August 1991. Enugu State covers 7,161 square kilometres, it is bounded at the west by Anambra State, Abia and Imo state on the south, Kogi State on the North and Ebonyi State to the East. The State is noted for its coal deposit, the largest in Africa, the State is also rich in natural gas, bauxite. It is a tourist attraction state and plays host to some tourist site which includes Iva valley mine, Awhun waterfall, Opi lake complex, Ngwo pine forest, and Miken Hill.

Population of the Study

The population of the study comprises of selected registered women farmers in Enugu State. Enugu State has membership strength of twelve thousand (12,000) members according to data from Enugu State Agricultural Development Programme ENADP (2015).

Sample Size determination and Sampling Procedure

To determine the same size, for the purpose of questionnaire distribution, muilti-stage the state was divided into three agricultural zones. The agricultural zone was selected from the senatorial zones of the state. In the second stage, a sub-sampling also called a two-stage sampling was carried out by judgmentally selecting two local governments area (LGAs) each from the agricultural zones making a total six. According to Michael, Oparaku (2012), judgmental sampling makes use of typical cases among the population to be studied, which the researcher believes will provide him or her with the necessary data needed. In the third stage otherwise called the three-stage sampling, the sampling random sampling technique was used to select two

towns each from each of the six selected local governments in the agricultural zone. The fourth stage was random selection of two women groups from each of the two communities. Finally, the total membership size of the six women groups which is three hundred (300) was selected for the study.

Method of Data Collection

The researcher used both primary and secondary source of data collection. Primary data were sourced through the structured questionnaire which was administered to the women farmers, while secondary data were obtained from reviews of relevant textbooks, journals, seminar papers, articles and web pages on the internet were extensively used.

Administration and Collection of Questionnaire

One research assistance was trained on the data sourcing. The researcher administered the 300 questionnaires to the women group through the head of department (HOD) of Women in Agriculture (WIA) in the study areas. The 300 copies collected back.

Method of Data Analysis

Data collected were analyzed using descriptive statistic such as frequency, tables and percentages were used. Regression, correlation and Likert scale model were used for further analysis. The Likert rating scale was as follows:

- Strongly Agree (SA) 5 points
- Agree (A) 4 points
- Neither agree nor Disagree (NAND) 3 points
- Disagree (D) 2 points
- Strongly Disagree (SD) 1 point

Data Analysis and Result

Table 1 Distribution of respondent according to Socio-Economic characteristics

1.Sex	Frequency	Percentage
Male	-	-
Female	300	100
Total	300	100
2. Marital Status		
Single	100	33.33
Married	200	66.66
Total	300	100
3.Age (years)		
18-30	170	56.66
31-50	100	33.33

51-70	30	10
Total	300	100
4. Farm Experience (in years)		
1-2yrs		
3-5yrs	125	41.66
6-10yrs	100	33.33
Above 10yrs	75	25
Total	300	100
5. Highest Educational qualification		
No formal education	100	33.33
FSLC (primary)	80	26.66
SSCE (secondary)	100	33.33
OND/NCE	20	6.66
B.Sc/HND	-	-
Total	300	100
6.Occupation		
Farming	180	60
Trading	90	30
Civil service	20	6.66
Pension	5	1.66
Others (crafts)	5	1.66
Total	300	100
7. Annual Income(N)		
10.000-100,000	150	50
101,000-200,000	100	33.33
201,000-300,000	50	16.66
Total	300	100
8. Household Size (Children/dependents)		
0-4	50	16.66
5-8	150	50
9-10	100	33.33
Above 10	-	-
Total	300	100
9 years Experience		
1-3	80	26.66
4-6	170	56.66
7 and Above	50	16.66
Total	300	100

Source: Field Survey data, 2021.

Table 1 show marital status of the 33.33% of them are single and 66.66% are married, the table also shows that 56.66% are between 18-30 years, 33.33% are between 31-50, while 10% are between 51-70. The farm experience of the respondent are 0% between 1-2years, 41.66% between 3-5years, 33.33% between 6-10years and 25% above 10years. Their educational qualification shows that some of the respondent that did not go to school are 33.33%, those that attended primary school are 26.66%, secondary school 33.33%,6.66% have OND/NCE certificate and 0% have B.sc/HND. On the occupation of the respondents, 60% of them are farmers, 30% of them are traders, 6.66% of them are civil servants, 5% of them are pensioners and 5% are others (craft). The annual income of the respondents' states that 50% have ₦10,000 ₦100,000 annually, 33.335 have between ₦101,000-₦200,000 annually, while 16.66% have between ₦201,000- ₦300,000 annually. On the family size, (children/dependents) of the respondents, 16.66% have between 0-4 children/dependents, 50% have between 5-8 children/dependent, 33.33% have between 9-10 children/respondents. The analysis revealed that none of the respondents have above 10 children/dependents. The table also showed that the experience of respondent on group experience is 26.66% of them have 1-3years of experience. 56.66% have 4-6 years' experience while 16.66% have 7 and above years experiences.

Access to Productive Resources

Table 2 Mean Responses to Improvement on Access to farm Production Resources.

S/N	Item	N	Mean	Std. Dev.	Decision
1	Fertilizers	300	3.5633	.64346	Very good
2	Seedlings	300	3.5233	.60884	Very good
3	Credit	300	3.4233	.66754	Very good
4	Extension services	300	3.3367	.74285	Very good
	Grand mean	**300**	**3.4617**	**.40196**	**Very good**

Source: Field survey data, 2021

Table 2 indicates that with respect to the mean response to improvement on access to farm production resource. The form production resources such as fertilizers, seedlings, credit and extension services were obtained at three (3) units respectively. It implies that all these variable have significant effect on access to farm production resources.

3 Effect of Marketing and Processing Methods

Table 3 Mean Response to effectiveness of Marketing and processing Innovations in Output disposal.

S/N	Factors	N	Mean		Decision
1	Grading and packaging of produce	300	3.5833	.63593	Effective
2	Bulking and selling to processing firms	300	.3.5300	.58616	Effective
3	Semi processing of produce before disposal	300	3.4533	.63443	Effective
4	Exploring markets outside the local community	300	3.3667	.73985	Effective
5	Collaborating with local cooperatives on produce disposal	300	3.1567	.83333	Effective
6	Producing according to the needs of processors	300	3.4900	.73373	Effective
	Grand mean	**300**	**3.4180**	**.36182**	**Effective**

Source: Filed Survey data, 2021.

Table 3 displays the mean responses on effect of marketing and processing innovations on marketing. The factors such as grading and packaging of produce, bulking and selling to processing firms. Semi processing of produce before disposal. Exploring markets outside the local community. Collaborating with local cooperatives on produce disposal, producing according to the needs of processors obtained at three (3) units respectively. It implies that all the factors for marketing and processing innovations are effective.

4 Effect of Production Inputs on Income

Table 4 Effect of Production Inputs on Income (Regression Analysis)

Variable	**Linear**	**Semi-Log**	**Double-Log**
Constant	-96317.991	-6548749.557**	5.396**
Fertilizer	11.521**	594608.813**	8.431E-006**
Seedlings	5.460**	500679.732**	1.749E-006**
Credit	3.889**	503180.468**	2.559E-006**
Extension contacts	15097.325	25944.210	.000
R^2	.875	.788	.847
Adj. R^2	.873	.786	.845
F ratio	515.193**	274.853**	409.459**

Dependent variable: farm yield

**Significant @0.001.

Table 4 shows that there is no significant difference on effect of production input on income at 0.05 level of significant. It implication is that, effect of WIA programme has more access on

household income of the rural women therefore the null hypothesis is rejected and the alternative is accepted.

5 Challenges Facing Participants

Table 5 Mean Responses on the Challenges Facing the participants of WIA Programme

S/N	FACTOR	N	N	Mean	Decision
1	Discrimination against women farmers in the distribution of farm input	300	3,0400	.97720	Disagree
2	Inadequate extension agent	300	2.8200	.75907	Agree
3	Inadequate capital	300	2.6433	.78198	Disagree
4	Lack of storage facilities	300	2.9867	.95719	Agree
5	High rate of illiteracy	300	3.2433	1.04615	Disagree
6	Inadequate land	300	2.9533	1.06534	Agree
7	Lack of market	300	2.9500	.88889	Agree
8	Lack of information	300	2.4800	1.31225	Agree
9	Income level	300	3.2700	.90913	Agree
10	Family size	300	2.9100	.88573	Agree
	Grand mean(x)	**300**	**2.9297**	**.34431**	**Agree**

Source: Field survey data, 2021.

Table 5 displays challenges facing the participants the distribution has agree and disagree level of 3.0 meaning rating to each variable. From the distribution, there is no distribution, there is no discrimination against women farmers in the distribution of farm input, it has a mean rating of 3.0 which is agreed level. It implies that there is discrimination against women farmers in the distribution of farm input. Members are expected to handle any issues relating to farm input. Inadequate extension agent has a mean of 2.8 which is agree level on challenges facing the participants. It implies that extension agents are inadequate. Inadequate capital has a mean rating of 2.6 which is agree level. It implies that there is no enough capital to participants in WIA programme hence there is need to provide enough capital. Lack of storage facilities has as variable has a mean rating of 2.9 which is agree level. It implies that there is no enough storage facilities for the participants hence, provision of more storage facilities will be needed. High rate of illiteracy has a mean rating of 3.2 which is disagree level. It implies that the participants of WIA are not illiterate. Inadequate land has a mean rating of 2.9 which is agree level. It implies that the participants have difficulties in acquiring land for agricultural purposes. Lack of market has a mean of 2.9 which is agree level. It implies that the participants lack market were their agricultural produce can be sold. Lack of information has a mean rating of 2.4 which is agree level. It implies that the participants lack adequate information that should be of great help to them. Income level has a mean rating of 3.2 which is agree level. It implies that the income level

of the participants is poor. Family size has a mean of 2.9 which is agree level. It implies that the family size of the participants affects their participation in WIA programme.

Test of Hypotheses

6 Test of Hypothesis one

Ho_1: Years of participation in WIA have not improved famers' access to farm production resources such as fertilizers, seedlings, extension services and credits.

Table 6: Correlations to Test Hypothesis One

		Years of Participation	Access to Resources
Years of Participation	Pearson Correlation	1	.883**
	Sig. (2-tailed)		.000
	N	300	300
Access to Resources	Pearson Correlation	.883**	1
	Sig. (2-tailed	.000	
	N	300	300

**. Correlation is significant at the 0.001 level (2-tailed)

Table 6 indicates that there is a strong and positive correlation between years of participation and access to resources. It implies that the more the years of participation the access to resource will be made available.

7 Test of Hypothesis Two

Ho2 Production resources such as fertilizer, seedlings, extension services and credit obtained through WIA intervention have not significantly influenced the farm yield of the woman farmers.

Table 7: Regression Summary to Test Hypothesis Two

R^2	.875	.788	.847
Adj. R^2	.873	.786	.845
F ratio	515.19**	274.853**	409.459**

Dependent variable: Farm yield

**Significant @0.001.

Table 7 show that fertilizer, seedlings and credit have significant increase on income while extension service does not. It implies that the more fertilizer. Seedlings and credit are made available to the woman farmers, it will yield more harvest.

4.8 Test of Hypothesis Three

Ho_3Adoption of WIA introduced agricultural processing and marketing innovations does not have significant positive relationship with rural woman's income.

Table 8: Correlation to Test Hypothesis Three.

		Marketing/ processing	Annual Income
Marketing/processing	Pearson correlation	1	.200**
	Sig. (2-tailed)		.000
	N	300	300
Income	Pearson correlation	200**	1
	Sig. (2-tailed)	.000	
	N	300	300

****. Correlation is significant at the 0.01 level (2-tailed).**

Table 8: displays a weak and positive relationship between marketing/processing. It implies that their participation in marketing/processing weakly correlate income.

9 Test of Hypothesis Four

Ho_4 there is no significant relationship between annual income and challenges facing participants of WIA programme.

Table 9 Correlations to Test Hypothesis Four

Correlations

		Annual income	**Challenges**
Annual income	Pearson correlation	1	-152**
	Sig. (2. Tailed)		.008
	N	300	300
Challenges	Pearson correlation	-152**	1
	Sig. (2 Tailed)	.008	
	N	300	300

*****Correlation is significant at the 0.01 level (2-tailed)***

Table 9 show there is an inverse relationship between annual income and the challenges facing the woman farmers. The relationship is weak and negative. It implies that their annual income turns to decrease as their challenges increase.

Summary of Findings

From the analysis of the study, the following findings were made:

- Years of participation in WIA has enhanced access to farm production resources such as fertilizers, seedlings, and credit.
- Production resource such as extension services has not led to the increase of farm yield of the women farmers.
- There is no positive relationship between annual income and challenges facing the participants of WIA.
- Storage facilities are inadequate and it has caused the participants of WIA to loss most of their produce.

Conclusion

'The findings of this study are robust, with reference to the topic under consideration - Effect of Women in Agriculture on the household income of the rural women Enugu State. Fertilizers, seedlings, credit, are significant in influencing the household income. From the result, a unit increase of fertilizer, seedling, credit will bring about an increase in farm yield which will in tum increase the income of the women farmers as well as their household income.

Recommendations

Based on the findings;

1. Despite the membership strength, more members should be encouraged to join WIA programme since the years of participation enhance access to farm production resources.

2. The WIA, as a matter of urgency, should embark on training and re-orientation programme on their extension agents so that it can in turn influenced farm yield.

3. WIA programme should address some of these challenges facing their participants so that it can lead to an increase in their annual income.

4. WIA should provide adequate storage facilities through the help of the government to enable them avoid waste and also ensure food security in the study area.

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Chapter Fifteen

Criminology and Environmental Design in Nigeria: Correlations, Impacts and New Directions

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ABSTRACT

This paper expresses the linkage between crime and environmental design with a specific focus on crime prevention. The paper also elucidates on the processes of crime prevention using environmental design as a strategy. As a conclusion, the importance, and the need for crime prevention through environmental design in Nigeria; given the frequency of occurrence of criminalities ranging from banditry, hooliganism and terrorism are highlighted. The recommendation of this paper is the adoption of global best practices in crime prevention and application of counterterrorism measures in Nigerian cities.

INTRODUCTION

The urban environments in Nigeria, in recent years, have witnessed the increasing incidence of criminal activities traceable to the spatial quality of neighborhood design. Indeed, correlations have been established between criminology – the scientific studies and investigations of crime, criminals and the quality of the morphological and typological elements of urban space, namely, streets and squares. The design of streets, buildings and houses may directly affect the level of crimes in a neighbourhood – either making it easier for criminals to operate or discouraging them – according to a recent study in London. The study results challenge many of the assumptions that have guided housing design in recent decades.

DEFINITION OF TERMS:

It is essential to the elucidation of the subject matter of criminology and environmental/neighbourhood design to provide definitions of operational and recurrent terminologies. Some of these terms are:

(a) Criminology:
Criminology is defined as the scientific study and investigation of crime and criminals.

(b) Correlation:

Correlation refers to a mutual or reciprocal relation or to show a meaningful connection between.

THE CORRELATIONS BETWEEN CRIMINOLOGY AND ENVIRONMENTAL/NEIGHBOURHOOD DESIGN:

Recent studies have shown a direct link between crime and neighbourhood design.
The Space Syntax Laboratory at the University College, London, looked at spatial relationship of urban structures. Hillier (1999), a director of the laboratory, explained that the researchers were asking "why cities are, in the main, made up of linear spaces – streets, avenues, alleys, boulevards – linked into networks with buildings opening directly onto them from both sides, so that people going in and out of the buildings mingle with those who are passing through''. One part of the answer, he said, "is that this is the safest way of doing things''.

The technique looked at details of crimes, such as points of entry to dwellings and compared different spatial design characteristics across a range of housing areas (such as the age of buildings, income levels of occupants, etc). This allowed common design characteristics to be identified as influencing crime in their own right, regardless of other social and demographic characteristics.
A computer map of a selected city area was used to analyze the potential of streets to generate movement. Crimes in the area – burglary, for example were superimposed so that patterns and potential of streets to generate movement. Crimes in the area – burglary, for example were superimposed so that patterns and relationship could be statistically correlated.

The analysis showed that certain crimes tend to occur in specific types of locations, even if they are geographically separated.

The results indicate that areas with good linear visibility and good potential for movement area safer. It is less safe where space is broken up, with limited lines of sight and with limited potential for movement. According to Hillier, "We have to get rid of the idea that strangers equal danger. Our results show the opposite to be the case: people using a space are the main agent for policing that space safely – in general, criminals avoid the spaces where people will naturally tend to be''.

Hillier (1999) noted that some popular designs such as the cul-de-sac, where houses face each other around a circular road, are assumed to be safe because strangers are assumed to be less likely to pass through them, or that people would be alerted if they did. There is also a brief, he said, that this work better if the neighbours know each other, so the fewer residents around the cul-de-sac, the better. The study suggests that the opposite is true: the built-in advantage belongs to linear streets with housing on both sides. There are more houses, the lines of sight are better

people (and cars) are passing along the street and the area behind the housing is naturally protected other houses. The laboratory is now researching several different residential areas to see if results differ.

CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN

The interplay between criminology and neighbourhood design and the widespread incidence of crime underscores the importance developing preventive measures against crime in built environments.

According to Kelly (qtd: in building security; 2004), "The relationship between fear of crime, quality of life and the built environment increasingly is of primary concern to the public, business leaders and crime prevention practitioners. Communities experiencing problems with disorder, thefts, robberies, assaults, and other crimes often claim their neighbourhoods and workplaces don't feel safe because streets are empty, properties are abandoned, graffiti covers the sides of buildings, or trash collections is erratic. The intersection of crime prevention, planning and design addressing these issues is called crime prevention through environmental design, commonly abbreviated as CPTED (pronounced "Septed'').

Criminology Dr. C. Ray Jeffrey, of Florida State University (gtd: in Building Security: 2004), who coined the term in his landmark 1971 book, Crime Prevention Though Environmental Design, defined CPTED as: "The proper design and effective use of the built environment that can lead to a reduction in the fear and incidence of crime, and an improvement in the quality of life".

The built environment can be designed and modified to reduce vulnerability; CPTED programs examine access control, surveillance and territoriality, providing residents and business leaders with opportunities to improve public safety.

Collaboration among law enforcement, government agencies, local residents, planners, design professionals, and business people can identify crime and quality of life issues before they become serious and address public safety and security concerns during renovation and new construction projects.

CPTED examines decisions about:

- Absolute and relative locations of specific land use
- Relative sitting of buildings and open spaces
- Interior and exterior design details such as color, lighting, entrances, exist and landscaping.
- When to use indoor and outdoor spaces, and for what purposes.

Kelly (2004) highlighted the scenarios in Connecticut and Toronto: In Bridgeport, Connecticut's Phoenix Project to control street-level drug trafficking, street barriers were constructed in areas adjacent to highway exist. Bridgeport developed a ten-point CPTED plan, with traffic control devices, one-way street design, increased tactical enforcement, and mobilization of area businesses and

residents. The initiative resulted in a 75 percent crime decrease, the lowest crime rate in the area since 1972. In Toronta, a program to prevent assaults and robberies changes local law to increase security standards for existing parking structures, the site of passing the CPTED-related law, providing security reminders to divers and supporting driver escort programs, over 97 percent of the garages had adopted the security measures''.

CPTED BASICS:

CPTED encourages communities to be proactive in fighting crime. Environmental design decision by planners, architects, designers and law enforcement officials, along with residents and businesses, can affect a community by influencing human behavior and public perception of community safety. By evaluating urban design elements contributing to crime, decision-makers can assess where problems might occur and implement changes,lest they become permanent in a building or neighbourhood.

CPTED involves city agencies, community members and economic interests, by providing alternative methods of addressing crime and underlying problems, instead of expending energy on patchwork responses to individual incidents. CPTED differs from other crime prevention strategies by emphasizing the role design within the environment.

Traditionally, crime prevention emphasized opportunity reduction through property. Bars on windows and doors, alarm systems, cameras, gates and other so-called "target-hardening'' techniques were used to protect people and property and reduce potential for revictimization. These measures are essential for resident and businesses, and some facilities, such as banks, cannot function without them. Beyond a certain level, hardening of potential crime target can be expensive and disruptive.

Alarms, cameras and school guards can mask symptoms, but cannot successfully address causes if criminal opportunity results from the design of.

As a crime control strategy, CPTED uses resources effectively by relying on existing programs and activities. The most successful CPTED programs include community residents, business professional and public agencies officials, through a multidisciplinary approach CPTED is most effective when those most a building or property. Affected by problems and solutions, the collaborators, participate in an ongoing dialogue to participants and stakeholders, can anticipate safety and security issues, rather them react to them. CPTED programs enlist agencies and community groups to resolve problems, rather than assume law enforcement will take on the task.

Communities and business leaders often fail to take greater advantage of CPTED because they don't understand CPTED, or how it can address crime and quality of life issues; believe CPTED conflicts with crime prevention goals; believe CPTED conflicts with crime prevention goals; assume that CPTED will add costs to private business owners, and perceive that CPTED will create additional burdens on local government decision makers. However, CPTED programs and partnerships have successfully reduced crime in many cities.

Knoxville, Tenness Police traffic engineers, public works officials and resident is collaborated on CPTED and crime-prevention training by forming a task force to address drug trafficking and neighbourhood nuisances, such as excess vehicle traffic in residential areas. The group effort resulted in street redesign, revised park schedules, and volunteer-led security survey teams. Police officers worked with design professionals to make projects compatible with CPTED, thus reducing through traffic and drug trafficking.

Sarasota, Florida-CPTED guideline planned to reduce crime in one neighbourhood became an accepted part of the planning process. The CPTED task force of planners, law enforcement officials, agencies and architects, organized by the city manager, recommended amendments to the zoning law for a special zoning district.

CPTED became part of successful business district revitalization project. Sarasota passed resolutions incorporating CPTED principles into all development.

Cincinnati; Ohio, A partnership of housing authority management, residents and police officials developed a CPTED plan, consisting of community clean ups, increased maintenance, new fencing, lease enforcement and on-site programs for parents and community youth. As a result, crime decreased 13 percent in each of three successive years after the partnership began.

Benefits

A well-crafted CPTED approach can enhance the safety goals of a community or business by using existing programs and resources to prevent crime. Benefits of CPTED within communities include:

Municipal

- Lower crime rates in neighbourhoods and business areas.
- More tax revenues from safer business districts
- Enhanced public safety in planning, development and redevelopment projects.
- Increased use of parks and recreation facilities by residents.

Local Law Enforcement

- Improved community relations with residents through ongoing communication and crime prevention partnerships.
- Enhanced crime prevention training for officers.
- Increased crime prevention partnerships with residents.
- Fewer minor incidents allow more efficient community policing and coverage.

Business Interests

- Lower crime rates result in reduced maintenance, repairs, and insurance and liability risks.
- More business revenues and sales tax generated.

Community Residents

- Improved sense of security and quality of life.
- Fewer victimizations of residents
- Increased interaction among residents and law enforcement to enhance relationships.

CPTED Theory, History and Practice

Environmental design affects human behavior and influences fear of crime, opportunities for crime and quality of life. Fear and the perception of some locations and unsafe can drive away customers, clients, employees and residents. People form impressions of an environment based on what they hear, see and smell, combined with personal experiences. Looking at area, potential offenders consider activities and predictability factors.

CPTED is base on three basic principles to reduce crime; access control, surveillance, and territorial reinforcement.

Access control includes elements like doors, shrubs, fences and gates to deny admission to a crime target and create a perception among offenders there is a risk in selecting the target. Technology and mechanical access control, including locks, bars, and alarm systems, collectively providing "target hardening'', supplement natural access-control measures. Fencing around a neighbourhood playground provides access control, by protecting children from wandering off and discouraging potential offenders from entering.

Surveillance utilizes design to increase visibility of a property or building by strategic location of windows, doors, corridors, paths, gates, lighting and landscaping. Proper placement increases the likelihood individuals with observe intruders and regular users, challenge inappropriate behavior or call the police or property owner. Natural surveillance detects crime by making the offender's behavior easily noticeable to passing resident, employee, customer, police patrol or private security detail.

Territorial reinforcement employs design elements such as signage, sidewalks, landscaping and parches to distinguish between public and private areas. Users exhibit signs of ownership, sending "hands off'' message to would-be offenders. Supplementing design with regularly scheduled staff or activities, routine inspections and maintenance enhances territorial reinforcement.

CPTED's History

Many civilizations have manipulated the natural and built environment to meet public safety needs. CPTED has evolved as a multidisciplinary area of study, developed from theories in different fields, each contributing to the links between environment and behavior. After the World War II, these theories converged to form an important, widely recognized urban planning and design concept.

Within the context of CPTED, the design field professions, architecture, urban design, landscape architecture and planning, address how land use, sitting and building design contribute to creating or reducing opportunities from crime. The social and behavioural sciences, sociology, criminology, psychology, anthropology and geography, address how political, economic and social conditions motivate offenders to commit crimes and how offenders respond to environmental cues. Environmental psychology studies how people respond to their surroundings.

According to Kelly (2004), the first highly publicized studies of crime and the environmental were conducted at the University of Chicago crime patterns in Chicago were highest in the inner city and decreased in concentric circles away from the central business district. This pattern was explained with reference to "social disorganization'', land use, and the city historical development process. Since the Chicago studies, others of urban areas and change produced by homelessness, deteriorating housing stock, and traffic congestion.

In 1961, Jane Jacobs, in the Death and life of Great American Cities, (qtd; in Building Security 2004), recounted her experiences as a resident of New York City's Greenwich Village were productive and safe, while other areas only a few blocks away were nearly abandoned and frightening. The more productive neighbourhoods included a mix of land uses generating round-the-clock activity; consistent block, site and building designs; and opportunities for people to watch out for one another. These observations forever change urban design and planning, and influenced research on crime and offenders.

Dr. C. Ray Jeffery, whose interest in crime prevention through environmental design was precipitated by Jacob's work, called for an interdisciplinary approach to crime prevention focusing on changing the offender's behavior by changing the offender's environment. His work opened a new era in criminology, addressing the built environment and circumstances surrounding a crime incident, not just behavior.

In 1972, architect Oscar Newman published Defensible Space: Crime Prevention through Urban (qtd: In Building Security: 2004). Newman worked in public housing to determine how design and social characteristic corresponded to safe and productive neighbourhood.

Newman's research was based on urban planning and architectural design, with less emphasis on criminology and behavioural sciences. This work became the foundation for CPTED.

Newman identified the importance of territory and surveillance in creating safe places. When design created and defined public, semiprivate and private spaces, residents exhibited greater indications of territoriality, deterring criminal activity by creating spaces that were defensible and defended. In the public housing study, he found crime was for visibility and surveillance, based on building orientation and street location.

He also found that the crime rate for buildings with minimal opportunities for visibility and surveillance was more than 100 times higher.

Defensible space concepts were refined and tested by the U.S. Department of Justice in four demonstration programs operated through the Westinghouse Electric Corporation in the mid-1970s.

These includes:

- A school demonstration in Broward Country, Florida.
- A commercial demonstration in Portland, Oregon.
- Residential projects in Harford, Connecticut, and Minneapolis, Minnesota.

Research on the program, conducted by the National Institute of Justice, noted that in Hartford, traffic diversion, community policing, increased lighting and clean-up campaigns made residents feel more in control of the neighbours and influenced the use of neighbourhood facilities.

The Westinghouse model-maintained Newman's territoriality and surveillance themes and addressed the social cohesion and control issues criticized in Newman's work. Westinghouse researchers asserted residents needed to be involved in community and traffic pattern changes could reduce crime prevention.

CPTED and related concepts offer three key points:

- Land-use decisions affect community crime and crime-related conditions.
- Offenders work in areas and against people they know
- Daily routines affect crime and crime risks.

Research and experience indicate land-use decision have a direct bearing on the types of crimes committed. For example, specific types of businesses, such as adult-oriented establishments, contribute to increased crime rates in surrounding areas. In Young v. American Mini Theaters (qtd: In Building Security: 2004), the U.S. Supreme Court agree and found zoning is the community interest if used to control secondary effects attributed to adult businesses, such as increased crime rates and neighbourhood deterioration. Lax enforcement of land-use standards and building codes contributes to crime. A study of abandoned buildings in Newport News, Virginia revealed burglary rates in a crime-ridden apartment complex dropped 35 percent after 100 vacant, dilapidated apartments were boarded up.

Offenders tend to commit crimes in places they know well, near home, work, school, because in these places they know those who live and work there, and who regularly visits; they understand what days and time of day people will be around, are aware of the potential crime targets in the area and know routes of quick access and aggress and of concealment.

Daily routines, combined with local rules, regulations, policies and procedure, create or reduce opportunities for crime. For example, when large geographic areas are zoned exclusively for single-family and when the people who live in these neighbourhoods are away from home between 8.00am and 6.00pm for work or school. No one creating the perfect environment for crime.

Seniors-only residential complexes or apartment buildings with many children present different crime prevention challenges and imply that those who remain at home to observe activity in the community may also feel particularly vulnerable to the risk of crime.

Bringing CPTED to Communities

Understanding the connections between CPTED and crime prevention, planning and design creates are effective approach to crime problems. By gaining an understanding of the three key concepts of access control, surveillance, and territorial reinforcement, business and community leaders can move from theory to action and address community disorders and incivilities, as well as more serious and violent crimes.

ADDRESSING CRIME WITH CPTED

CPTED programs result from problems at a site or facility, such as a street intersection, convenience store, school, park or abandoned building. Crime may be related to the following:

Existing Land use

- Vacant buildings or lost are taken over by juvenile gangs, drugs users or other undesirables.
- Office and commercial uses are interspersed with residential dwellings and bring outsiders through an otherwise "private'' neighbourhood. With so much traffic, residents no longer know each other, and homes are burglarized.

Site Characteristic

- Fencing, landscaping and inadequate lighting create opportunities to hide
- Parking lots or garages are sited or designed without any opportunities for surveillance, making them good locations for theft or assault.

Traffic and Transit Issues

- Drug dealers establish themselves at important street intersection
- Street creates a convenient path for through traffic.
- Bus stops serve as regional transfer points and bring outsiders to the area.
- Parks may be play areas during the day, but virtually empty at night if inadequate lighting leaves residents feeling unsafe.
- In an area with a single industrial or commercial use, passersby do not notice property or other crimes committed on or near facilities, especially if they occur when facilities are not operating. With employees and business-related traffic unavailable as observers, the facility and environs are vulnerable to crime.

Demographic Change

- Owners convert their homes into rental properties and tenants are not invested in the neighbourhood. They don't know other residents, property owners, and managers or report criminal activity visible through surveillance.
- New residents are younger, less affluent and established homeowners. Elderly neighbourhood are afraid and stay indoors unless escorted.
- New business owners are from non-English-speaking cultures and they are in familiar with security needs, safety techniques and working with law enforcement and community groups.

Ineffective Policies

- Nonresident landlords own high percentages of properties. They hold on to their investments but make few improvements, while deteriorating structures attract drugs users to the neighbourhood.The city does little to enforce building codes.
- Trash collection is scheduled in frequently, but the neighbourhoods or business districts experience high turnover rates and trash accumulates. Lack of municipal garbage collection on vacant property gives the impression that residents and property owners don't care about their neighbourhood.
- Office buildings in neighbourhood are occupied only between 8.00am and 6.00pm. Monday through Friday and are vandalized or burglarized on weekends.
- Warehouses are heavily oriented to truck or automobile use, rather than pedestrian traffic. Pickup and delivery are limited to a few hours and day, warehouses are burglarized and vandalized, and truck drivers are assaulted.
- Convenience stores or discount retail outlets are open when other commercial establishment are not, and are the targets of late-night robbery and shoplifting.
- Speeding and traffic problems are worst when the high school lets out for the day and most neighbourhood thefts occur mid-to late afternoon.

Each of these sceneries suggest different programs and activities to change environmental conditions and reduce crime and fear. No two situations will be resolved the same way. CPTED team must consider characteristic and strategies. However, CPTED principles remain the basis of all efforts.

Designing an Effective Strategy

Decisions about strategies involve all community members affected by crime. During implementation, communication should be maintained with the neighbourhood, through neighbourhood associations, tenant group, community policing officers, service agencies, websites and newsletters, as shown on table i.

Once the list of strategies is established, the team estimates implementation costs. Many strategies do not require additional expense. Local residents and businesses may opt to cover some costs. When estimating costs and financing options, communities, business leaders and facility managers

should consider the benefits-such as increased property values, sales tax revenues or decreased property insurance premiums, resulting from new initiatives. When businesses and government leaders understand the return on their investment from CPTED, they are more willing to participate.

Data collection during early project phases generally provides more accurate estimates.

Business leaders and facility managers applying CPTED must define roles and responsibilities at the outset of the planning process.

A facility-improvement program should be the responsibility of property owners and businesses, although they cannot achieve these goals alone. Other stakeholders, who stand to gain from improved communities and increased qualities of life, should be identified and kept aware of ongoing CPTED efforts. Even if they are not team members, many stakeholders and groups can provide assistance or advice throughout implementation on tactics and logistics, funding sources and scheduling as shown in table 2.

TABLE 1: SUCCESSFUL CPTED STRATEGIES

1. Neighbourhood festival or block party
2. Neighbourhood watch program
3. Public education and advocacy program
4. Target code enforcement
5. Cleanup campaign
6. Installation of upgraded target-hardening measures such as locks, fencing alarm system, metal detectors.
7. Installation of mechanical surveillance tools such as closed-circuit television
8. Community ganders
9. Landscape maintenance
10. Lighting upgrades
11. Traffic enforcement
12. Security surveys
13. Infill construction or new development
14. Property acquisition, demolition, redevelopment and rehabilitation
15. Changes in zoning or development regulations, such as landscaping
16. New or modified traffic signed systems or changes to turning movements
17. Street closings or street privatization
18. Change to bins routes or schedules

TABLE 2: CPTED STAKEHOLDERS AND PARTICIPANTS

1. Planning, growth management and/or economic development agencies.
2. Design professional: architects, engineers, landscape architects and interior designers
3. Community residents

4. Real estate developers
5. Public works department
6. Local utility company
7. Code enforcement and licensing
8. Traffic engineering
9. Transit authority
10. Schools
11. Local law enforcement, public officials and elected leaders
12. Chambers of commerce and merchant's associations

Evaluating the Strategy

The final element of the plan, evaluation, determines the effectiveness of CPTED strategies. Measures of success reflect how well prioritized goals and objectives were met. Evaluations should measure whether people feel safer, if there is less trash, fewer weeds and stray animals and whether vandalism and graffiti have declined. For example, if the goal is to improve facility stability, evaluation might include changes in

- Residential or commercial vacancy rates
- Assessed valuation
- Code violations or citations
- Building permits
- Owner occupancy

CPTED teams review how to project affected other neighbourhood problems including

- Greater neighbourhood used and control of streets, parks and other public spaces.
- Less frequent or less noticeable drug or gang activity
- Lower traffic volumes and slower speeds, so children can cross the streets more safely.
- Increased property maintenance, cleaning and repairs by owners and tenants.
- Better relationships and communication between owners and renters, residents and businesses, the neighbourhood and government agencies.

TABLES 3.2: CPTED STAKEHOLDERS AND PARTICIPANTS

1. Planning, growth management and/or economic development agencies.
2. Design professionals: architects, engineers, landscape architects, and interior designers.
3. Community residents
4. Real estate developers
5. Public works department
6. Local utility company
7. Code enforcement and licensing
8. Traffic engineering

9. Transit authority
10. Schools
11. Local law enforcement, public officials and elected leaders
12. Cambers of commerce and merchants' associations Establishing & CPTED Team

To achieve the full benefits of CPTED for a business or facility, decision makers should assemble a multidisciplinary team. Together with owners, managers, and employees, CPTED leaders will identity problems, analyze options, make recommendations, select solutions and implement strategies. Ideally, team members should include a core of regular members, but composition may vary based on the problem, issue or project.

Framework for Success

Incorporating CPTED into business operations can includes:

1. Know how a business operates: Familiarity with business operations ensures CPTED will be considered in long-and short-term decisions, such as during plan review of new construction and redevelopment projects. Appropriate stakeholders should be including during decision making. In South San Francisco, California, an ordinance requires police involvement during planning for security and safety and prohibits occupancy until the police representative signs off on the project. Community input at public hearing eliminated adult-oriented entertainment or other crime-prone businesses.

2 Adopt laws, rules, regulation, policies and procedures supportive of CPTED or at least not conflicting with or contradiction the CPTED Program.

Community leaders can seek interpretations of existing laws, policies and zoning regulations consistent with CPTED.

3. Incorporate CPTED into training and professional development for law enforcement officers, planners and public agency personnel.

Officers and government personnel can use CPTED best practices to do their jobs effectively. Baltimore, Maryland's crime control and prevention strategy incorporated CPTED training for community organizers, law enforcement officers, and agencies working with residents to mobilize neigbourhoods in combating drug trafficking and other crimes.

4.Offer CPTED educational materials to community groups and association.

Community groups establish partnerships with government agencies and receive information about crime-related problems. Educational materials with examples of small-scale projects communicate CPTED's benefits to neighbourhood associations and identify ways to solve problems. In Tucson, Arizona, during the late 1980s, the police department training community volunteers to install crime

prevention devices in homes of elderly residents. Officers worked neigbourhood watch groups on residential security surveys.

5.Allocate necessary resources to achieve CPTED goals. Resources need not involve cash. Examples of agency support for staff participation include incentives and allocation of staff time during plan review and CPTED Projects. Ann Arbor, Michigan, assigned personnel to participate in plan review for development and redevelopment projects.

Computing a CPTED Audit

The first task for the team is auditing laws, rules, regulations, policies and procedures governing planning, design, used and maintenance of neighbourhoods and facilities and related to CPTED principles. The audit is time-consuming but worthwhile, and will identify potential legal and institutional barriers to CPTED principles.

These documents govern how the built environment is developed. Each document should be reviewed and contradictions noted. The inventory should cover.

- Comprehensive master planning, land-use plane, and development review.
- Zoning, subdivision, landscape, or other ordinances
- Capital improvement plans and programs.
- Building, fire and life safety code and code enforcement policies.
- Ordinances and policies relating to neigbourhood disorder problems, such as loitering, vagrancy, drinking in public, and graffiti.

For each policy or process, the review should address the following:

- Agency or agencies controlling a process or policy, and enforcement powers.
- Steps or early decisions in the planning process for presenting CPTED Principles.
- Frequency and context of the plans and policy implementation and review.
- Participants in review or assessment meetings.
- Key people involved and contact information

Planning and CPTED

Planning and design professionals are responsible for protecting public, health, safety and welfare, by addressing building and life safety codes. Crime prevention should be considered as one of many important design criteria during preliminary project and plan review phases.

The comprehensive plan, also known as the land-use or masterplan, allocates design, social and economic resources to meet future needs. Although not a legal document in the strictest sense, the comprehensive plan illustrates future land-use options. Ideally, the comprehensive plan should

address safety, crime and crime prevention, along with housing neighbourhoods, civic building, public institutions, recreation and parks.

Development Regulations

Several types of land-use regulations are often considered during community planning and project design, including zoning, subdivision and landscape ordinances.

Zoning Ordinances

Zoning regulations are designed to provide light and air, provide security and safety from danger, prevent over crowing and achieve a logical pattern of land use.

CONCLUSION AND RECOMMENDATIONS

The frequency of occurrence and widespread incidence of terrorist attacks specifically bomb attacks in Nigerian cities underscores the expediency of adoption of crime prevention in measures by the Federal and State Governmental and cities.

The 9/11 Commission Report (2002), of the National Commission on Terrorist attacks upon the United States, propose counterterrorism measures by way of adaptations/ non adaptations in the law enforcement Community. In this regard the Commission stipulated that legal process were the primary method for responding to the early manifestations of a new type of terrorism. The stipulations embody an overview of U.S. capabilities for dealing with terrorism that began with the nations vast complex of law enforcement agencies.

Towards a global strategy of protection against terrorism, the Commission proposed reiterated/proposed the Biometric Screening System and Border Screen System.

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Chapter Sixteen

Innovative Approaches to Meeting Water Deficit Challenges in Rural Areas in Nigeria

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ABSTRACT

The United Nations Sustainable Development Goals towards achieving a better and more sustainable future has ensuring availability and sustainable management of water and sanitation for all as its sixth goal. So many programmes have been put in place by the Nigerian government towards improving water supply and sanitation but are yet to meet the United Nations targets towards achieving this goal. This study aims to discuss innovative approaches to meeting water deficit challenges in rural areas in Nigeria as a step towards achieving the SDGs. The evolution of water supply and a historical review of rural water supply and sanitation in Nigeria was analysed. The benefits of improved water supply were deduced and subdivided into direct – relatively quick changes at individual household level - and indirect – longer term - benefits. Approaches towards solving water deficit such as Management strategy, capacity development, stakeholders' workshop, stakeholders' collaborations and promoting standards and surveillance was recommended.

SUSTAINABLE DEVELOPMENT GOALS

According to the United Nations (2017) the Sustainable Development Goals (SDGs) or Global Goals are a collection of seventeen (17) interlinked global goals designed to be a "blueprint to achieve a better and more sustainable future for all". The SDGs were set in 2015 by the United Nations General Assembly and are intended to be achieved by the year 2030. They are included in a UN Resolution called the 2030 Agenda or what is colloquially known as Agenda 2030 (United Nations 2015). The resolution identifies specific targets for each goal, along with indicators that are being used to measure progress toward each target (United Nations, 2017). The year by which the target is meant to be achieved is usually between 2020 and 2030. For some of the targets, no end date is given.

Each goal typically has 8-12 targets, and each target has between 1 and 4 indicators used to measure progress toward reaching the targets. The targets are either "outcome" targets (circumstances to be attained) or "means of implementation" targets (Bartram et al., 2018) The latter targets were introduced late in the process of negotiating the SDGs to address the concern of some Member States about how the SDGs were to be achieved (Bartram et al., 2018).

SUSTAINABLE DEVELOPMENT GOAL 6: CLEAN WATER AND SANITATION

The Sustainable Development Goal Number Six is to “Ensuring availability and sustainable management of water and sanitation for all". Water is essential for sustenance of life and determines the overall socio-economic development of any nation. In Nigeria, so many programmes to improve water supply and sanitation situation had been put in place by different administrations. Despite this, the hope of meeting the UN Sustainable Development Goals (SDGs) target of safe water supply by the year 2030 is still uncertain. The SDG in water supply and sanitation aims to half the proportion of people without access to potable water supply and basic sanitation. Water supply means the delivery of 30 L per capita per day of safe water within 250 m of the community and serving about 250 to 500 persons per water point; and safe water means water that meets the National Drinking Water Quality for Nigeria. In rural water supply and sanitation, demand for community water supply services are localized demands.

Access to water is measured by the number of people who have reasonable means of getting an adequate amount of water that is safe for drinking, washing and essential household activities expressed as a percentage of the total population. It reflects the health of a country’s people and the country’s capacity to collect, clean and distribute water to consumers. Safe water includes treated surface water, as well as untreated but uncontaminated water from source such as natural springs and sanitary wells and protected boreholes. On average, a person needs about 20 litres of safe water each day to meet his or her daily metabolic, hygiene and domestic needs. In urban areas the source may be public standpipe located not more than 200 meters away. In rural areas the definition implies that members of the household do not have to spend a disproportionate part of the day fetching Water. On the other hand, the lack of access to adequate safe water supply contributes to death and illness, especially in children. Thus, the improvement of access to water is a crucial element in the reduction of under age mortality, morbidity, particularly in poor rural areas. Access to water also means that the amount of time women and children spend in fetching water could be used effectively on other tasks, a key component in poverty alleviation efforts. Most but not all of these people live in low-income countries and those at greatest risk are children and the elderly. Millions of people worldwide suffer from other water related disease, such as bilharzia, cholera and hookworm. Improvement in water supply and sanitation services tend to lead to improvement in people’s health and quality of their lives.

Clean and adequate water supply lies at the heart of any development whether urban or rural. Water supply and sanitation development of any nation are a continuous long-term process which requires careful planning and implementation geared towards achieving improved

conditions of life (Babalola, 1990, 1997). Consequently, there is an imperative urgent need for effective integration of theory and practice peculiar to our communities in planning programmes of rural water using local experts. More recently, greater attention has been paid to the broader livelihood benefits of rural water supply, looking beyond direct links between improved water supplies and public health (UNICEF, 1999; Nicol, 2000; Calow et al., 2002; Moriarty and Butterworth, 2003). The direct health benefits of improved rural water supply, especially when integrated with sanitation initiatives, are well known. They are derived mainly from the safe disposal of human excreta, the effective use of water for hygiene purposes (washing, cleaning, etc.) and the satisfaction of basic drinking needs with clean water (MacDonald et al., 2005). Rural communities in Nigeria are characterised by a populations less than 5,000 persons which usually do not have electricity, pipe water or tarred roads. The National Standard of water consumption for rural areas is currently 30 L per capita per day and 48 and 44% access to safe water and sanitation (MICS, 1999).

The Joint Monitoring Programme of WHO and UNICEF (JMP) (2017) reported that 4.5 billion people (which represents 58% of the world population) currently do not have safely managed sanitation. Also, in 2017, only 71 per cent of the global population used safely managed drinking water, and 2.2 billion persons were still without safely managed drinking water. With regards to water stress: "In 2017, Central and Southern Asia and Northern Africa registered very high-water stress – defined as the ratio of fresh water withdrawn to total renewable freshwater resources – of more than 70 per cent". (UNESCO, 2020)

Nigeria is globally classified as a developing country - with the water stress of North Africa affecting parts of it - and is ridiculed with clean water availability especially in the rural area. This paper not only focuses on the provision of clean and affordable drinking water but also on innovative approaches on meeting water deficit challenges in rural areas of Nigeria.

EVOLUTION OF WATER SUPPLY IN NIGERIA

Public water supply in Nigeria started in the early 20th century in only a few towns and was managed at the lowest administrative level. Amongst the early beneficiaries were Lagos, Calabar, Kano, Ibadan, Abeokuta, Ijebu Ode and Enugu. The schemes were maintained with revenue from water sales with virtually no operational subvention from the government. With the creation of regional governments in the early 1950s, the financial and technical responsibilities for developing new water schemes were taken over by these regional governments who assigned supervisory manpower to oversee operations and maintenance. The regional governments were however slow in setting up independent bodies to develop, operate and manage the water supply. The first water corporation was formed in the western region in 1966 which took over all the assets and liabilities, including the existing staff. The staff of the Water Division of the Ministry of Works was also transferred to the new corporation.

The Federal Government got involved in the management of water resources in 1976 when the Federal Ministry of Water Resources and the 11 River Basin Development Authorities (RBDAs) were created. The purpose of the RBDAs was to provide bulk water, primarily for irrigation of dry season farming in some selected project sites mostly located in rural areas of the country. They were not involved in any way in the domestic water supply. Today, all the 36 states and the Federal Capital Territory of Abuja have water corporations or public utility boards managing their public water supply. Their efforts are supplemented, in many cases, by local governments who supply water to small villages within their jurisdictions. Following the adoption of the National Water Supply and Sanitation Policy in January 2000, the Nigerian Government considered the provision of water supply services to be the domain of the Federal, State and Local Governments. However, the public sector was not successful in meeting more than a small portion of the demand for water by residential and commercial users. Services were critically in short supply. For example, out of the 85 million people living in urban and semi urban areas, less than half have reasonable access to reliable water supply. Many urban households, often the poorest, end up purchasing water from private vendors at a higher price than the public supply. A few rural communities were provided with hand-operated boreholes and wells which yield little or no water during the dry seasons due to incessant breakdown and fall in the water table.

Water supply services, where they exist, are unreliable and of low quality; and are not sustainable because of difficulties in management, operation and pricing due to failure to recover running costs. Many water supply systems show extensive deterioration and poor utilization of existing capacities, due to under-maintenance and lack of funds for operation. Additionally, the high cost of imported equipment especially in terms of a depreciating currency and inadequate cost recovery policies contributed to large financial deficits in many State Water Authorities (SWAs). This left most SWAs dependent upon state subventions to finance the operations and maintenance of their water systems, to service debt and to finance new investments. But the states' own financial constraints often limited the amount of recurrent capital subventions, requiring the SWAs to defer maintenance and limit new investment. Fiscally, both in small towns and rural areas, the focus must be on phasing out of subsidies for maintenance altogether and restricting such subsidies to partial capital costs to engender greater community ownership. From the foregoing it becomes clear that water supply has suffered a serious management setback despite government.

HISTORICAL REVIEW OF RURAL WATER SUPPLY AND SANITATION IN NIGERIA

For several years now, many governments (both civilian and military) have emphasized and made public the need for sustained rural water supply and sanitation. Up till today, the effects of all these are far from reality. Since independence in 1960, rural water supply and sanitation development in Nigeria has proceeded inconsistently. According to Ajayi et al. (2003), Ezeigbo (2003), Hanidu (2003), Goni (2006), Offodile (2003, 2006), Oteze (2006), Oyebande (2006), Onugba and Yaya (2008), Nwankwoala and Mmom (2008), Nwankwoala (2009), Okeke and

Uzoh (2009), rural water and sanitation in Nigeria suffered from poor co-ordination, poor maintenance culture, poor technical/institutional structure, multiple programmes, lack of data/information for planning, over bearing bureaucratic control by various supervising ministries, lack of professional inputs on projects, lack of community participation, inadequate funding, irregular disbursements of subventions, inappropriate infrastructures as well as lack of adequate quality monitoring and evaluation, lack of clear policy direction, lack of focus in terms of goals and objectives, which resulted in the country's inability to achieve full coverage of the rural population with safe water and improved sanitation services.

Serious efforts at addressing rural water supply and sanitation issues began with the on-set of the International Drinking Water Supply and Sanitation Decade (IDWSSD, 1981 to 1990), which established target of universal coverage. This was followed immediately by the World Summit for Children (1990), which established goals of universal access to safe water and sanitation and complete eradication of Dracunculiasis (Guinea worm). Following this, the National Programme of Action (NPA) for the Survival, Protection and Development of the Nigerian Child envisaged achievements that emerged during this 30- years' period, some of which with the assistance of External Support Agencies (ESAs) undertook (and currently involved) in several massive water supply development projects through the following agencies:

i. National Borehole Programme (1981 to 1986);
ii. UNICEF Assisted State Water and Sanitation Projects (1981 to 2010);
iii. Directorate of Food, Roads and Rural Infrastructure (DFRRI) – Rural Water and Sanitation Programme(RUWATSAN) (1986 to 1992);
iv. World Bank Assisted Agricultural Development Projects (1983 to 1992);
v. UNDP's RUSAFIYA (An acronym in local language) Projects (1988 to 1993);
vi. Japanese International Cooperation Agency's (JICA) Rural Water Supply Projects (1992 to1994);
vii. Petroleum Trust Fund (PTF) Rural Water Supply and Sanitation Programme (1996 to 1999);
viii. Improved Access to Water Supply and Sanitation Programme (2000 to 2001);
ix. European Union (EU) Water and Sanitation Programme (2002 to 2009);
x. Department for International Development's (DFID) Water and Sanitation Pilot Project (2002 to 2008);
xi. Water Aid's Rural Water Supply and Sanitation Programme (1996 to 2010);
xii. National Rural Water Supply and Sanitation Programme (2001 to 2010);
xiii. Japanese International Cooperation Agency's (JICA) Rural Water Supply Projects;
xiv. Development of local manufacture of hand pumps (1988 to 2010).

Despite these bold and elegant initiatives, by most conservative estimates, the country is still recording less than 50% access to safe water and sanitary means of excreta disposal. Until recently (in year 2000), there has been no National Water Supply and Sanitation policy framework which defines policy objectives, guidelines and targets for the entire sector. Even then, the will power to ensure co-ordination, streamlining and lending of focus and thrust to all

these initiatives is yet to be translated into action. The Rural Water Supply and Sanitation Sector and Action Plan, developed in 1992 after a major review by a cross-section of stakeholders, did not lead to the planning and implementation of a sound Rural Water Supply and Sanitation (RWSS) programme.

THE CHALLENGING CLEAN WATER AND SANITATION SITUATION

According to WHO, the world is on track for reaching the SDGs clean water target, but the trend appears to be deteriorating on sanitation. On current trends, the world will miss the sanitation target by more than half a billion people.

- Every year, unsafe water, coupled with a lack of basic sanitation, kills at least 1.6 million children under the age of five years, more than eight times the number of people who died in the Asian tsunami of 2004.
- At the beginning of the Water for Life decade, 1.1 billion people did not have access to an improved source of drinking water.
- 84% of the population is without access to an improved source of drinking water live in rural areas.
- 2.6 billion people, more than 30% of the world population, do not use a toilet, but defecate in the open or in unsanitary places.
- In 2004, more than three out of every five rural people, over 2 billion, did not have access to a basic sanitation facility.
- If the current trend persists, nearly 1.7 billion rural dwellers will still not have access to improved sanitation by 2025.
- Although 73% of rural dwellers have access to an improved source of drinking water, only 30% have access to piped water in the home.
- Urban drinking water coverage has remained at 95% since 1990. Urban sanitation coverage has increased by only one percentage point, from 79% to 80%.

BENEFITS OF IMPROVED RURAL WATER SUPPLY AND SANITATION IN NIGERIA

Improved water supply has important socio-economic benefits. Water can be used for a variety of productive uses, generating sources of income (cash and non-cash) for households. Productive uses may include; Farming - irrigation, livestock farming, cottage industries - brewing, brick-making - and other services. Improved water supply does not immediately equate to poverty alleviation. In order to maximize water-related benefits, interventions in other areas or sectors may be required. E.g.,a combination of improved water supply and micro-enterprise development will enable women utilise time saved from water sourcing to their best advantage, thereby creating new sources of income for the household. Generally, water supply interventions – rehabilitation, repair, well deepening etc. – coordinated with food security/asset rebuilding efforts, can help sustain income, production and consumption in the early stages of drought, or in the aftermath of a bad year (Calow et al., 1997, 2002; DFID, 2001).

The key objective of improved rural water supply and sanitation is the provision of potable water on a continuous basis, which addresses security of supply across seasons, and between wet and dry years, and is also essential if health and wider poverty alleviation benefits are to be met and sustained. The direct health benefits of improved rural water supply, especially when integrated with sanitation initiatives, cannot be over emphasized. It is interesting to note that the full range of health benefits can only be realized through intensive community sensitization campaigns around water, sanitation and health. Unlike demand for a better water supply, demand for improved sanitation facilities is often weak or non-existent. It may therefore need to be stimulated before it can be responded to.

An impact assessment exercise aimed at establishing the long-term effects of water supply in most parts o Sub-Saharan Africa carried out by the Non-Governmental Organization (NGO) WaterAid (2001, 2004) highlighted the following:

A. **Direct benefits** – relatively quick changes at individual household level

i. Time and energy savings, particularly for women and children. Savings can be 'invested' in new income earning opportunities; school enrolment and attendance – particularly for girls- increases;
ii. Reduced sickness especially among children, reduced expenditure on medicines and care and increases in the number of working days;
iii. Expenditure savings – a resultant effect of reduced expenditure on more expensive water from vendors.

B. **Indirect benefits** – longer term, more diffuse

i. Development and diversification of the local economy as productive water use increases and money and time is invested in industrial and service enterprises;
ii. Development of management and negotiation skills in village communities which can be deployed in other areas. Particularly important where decentralization policies are placing new demands on local institutions;
iii. Household and community empowerment through taking control of important decisions relating to the selection and management of water systems
iv. Improved food security and greater resilience to shocks such as drought.

More importantly, the decline in the incidence of water-borne disease and water–related diseases in rural areas are expected to reflect in lower patronage of health institutions and lower expenditure on drugs. The savings made through this lower expenditure and hospital bills can thus be channelled to other productive ventures. However, it has always been presumed that 'water is life' thus, safe water guarantees good health; an important condition for increased productivity. The provision of clean potable water in rural areas among others will encourage cottage industries and hence provide a catalyst for the reduction of rural poverty and enhancement of quality of life through employment generation.

UNITED NATIONS TARGET ON CLEAN WATER AND SANITATION

The United Nation in the SDGs 2030 listed targets used measure the progress in ensuring availability and sustainable management of water and sanitation for all. There are eight targets which are classed into six outcome-oriented targets and two means of achieving target. The six "outcome-oriented targets" include:

i. Safe and affordable drinking water;
ii. End open defecation and provide access to sanitation and hygiene,
iii. Improve water quality,
iv. Waste-water treatment and safe reuse,
v. Increase water-use efficiency and ensure freshwater supplies,
vi. Implement Integrated Water Resource Management (IWRM), protect and restore water-related ecosystems.
vii. The two "means of achieving" targets are:
viii. To expand water and sanitation support to developing countries,
ix. To support local engagement in water and sanitation management

WAY FORWARD FOR MEETING WATER DEFICIT CHALLENGES IN NIGERIA

Ideally, the National Programme should pursue an integrated approach for the delivery of clean water supply and improved sanitation and hygiene services, targeting communities, health centres, schools and other public and private institutions in the rural areas of Nigeria. This is in line with the recommendations of (World Bank1991) which seeks to:

i. Promote and foster community management of services;
ii. Give districts assemblies a central role in supporting community management;
iii. Give government a role in promoting provision of service;
iv. Give the private sector a role in the provision of goods and services;
v. Initiate demand-driven programs with self-selection and commitment by communities to enhance sustainability (in other words, communities would have their water resources developed if they could afford the costs of establishment and maintenance);
vi. Focus on women as users and on the active involvement of women as planners, operators, and managers of community systems.

OTHER APPROACHES FOR SOLVING RURAL WATER DEFICIT

i. Management strategy must be formulated and implemented for sustainable groundwater resources development using the appropriatemechanism that ensurescommunity ownership, operation and maintenance.
ii. Capacity development to improve knowledge and skills of professionals in the water industry and also advocate for attitudinal change for people to take responsibility of managing the water facilities in their communities.
iii. Strengthen the National Water Resources Institute or other existing institution to coordinate the conduct of research in groundwater development and management and serve as the data bank for Nigeria's groundwater resources.
iv. Conduct stakeholders' workshop to sensitize professionals and the public on the significance of practical implementation of the "code of practice" for water well industry and enforcement of the regulations. Boreholes are being drilled all over the country without "hydro-geological control" and therefore, the need to enforce regulations for sustainability of the resource has become more imperative than ever before.
v. Collaboration between the different stakeholders to understand and address the general and peculiar issues of sustainability with emphasis on the impact of groundwater resources in ensuring national water security, poverty alleviation and improving the health conditions of the people.
vi. Promotion of Water Quality Standards and Surveillance ensures safe water provision. Therefore, capacities should be built at all levels to ensure water quality awareness. Communities should be encouraged to develop and implement water safety plans while the local government authorities should be equipped to provide remedial actions. State water safety strategy should be developed and Water Quality Monitoring and Surveillance Committees established and empowered to undertake periodic water quality monitoring and assessment. In conducting this task, the quality of water to be delivered should comply with the Nigerian Standards for Drinking Water Quality.

CONCLUSION

The development and management of rural water quality require urgent practical reforms to ensure adherence to best practices in the exploitation of the resource without undermining itssustainability. This requires the involvement of stakeholders at all levels (Federal, State, Local, the General Public and Private sectors).

However, knowledge and capacity areneeded to effectively solve groundwater issues and challenges. It is also important for the government to review its policies on social-health issues like water. This is a matter that demands urgent attention as the realities of today - the Covid-19 situation - demand social distancing and unavailability of clean water negates social distancing. If health is to be given priority, water supplies to these rural communities should be emphasized and subsidized as its benefits are numerous to mention.

The role for the communities is by no means limited to finance and maintenance. Communities must be involved - in the planning phase - in deciding which water systems that are more convenient, suitable, affordable and ideal locations for the installation of these systems. Such involvement improves decisions about introduction of affordable and accessible technology, both in economic terms and in terms of the acquisition of technical maintenance skills.

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Chapter Seventeen

Achieving Local Government Autonomy for Sustainable Development in Nigeria: A Legal Appraisal

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ABSTRACT

The Local Government as the grassroots government and one closest to the people especially the rural populace has a pivotal role to play in the actualization of sustainable development. However, the lack of autonomy at the local level of governance in Nigeria poses a threat to the actualization of all round sustainable development especially at the rural communities. This work looked at the issues of local government autonomy and how same can be achieved for sustainable development. The methodology employed in the work is doctrinal, primary sources of data used are relevant statutes and case laws while secondary data from textbooks, journals, articles and internet materials were used. The work found that the structure and functions of the local government are not clearly spelt out in the Constitution; the Constitution gave the state government powers to ensure the creation and existence of a democratically elected local government thereby making it a mere appendage of the state government who in turn has abused that position. This work recommends that a chapter of the Constitution should be created and devoted to establishment of local government and clearly providing for its functions, structures and compositions and term in office of its elected officials; complete autonomy from other tiers of government; direct revenue allocation to the local government; and, elections in local government should be conducted by Independent National Electoral Commission.

Keywords: Sustainable development, local government, autonomy of local government and federalism

1.0 Introduction.

According to World Commission on Environment and Development, chaired by Gro Harlem Brundtland of Norway in what is called the Brundtland Commission Report, Sustainable Development was defined as development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs (Schaefer & Crane, 2005:77). Several other scholars have defined sustainable development in various ways. Sustainable development was defined as an approach to development which uses resources in a way that allows them (the resources) to continue to exist for others (Mohieldin, 2017). Evers (2019) defined it as the concept to the organizing principle for meeting human development goals while at the same time sustaining the ability of natural system to provide the natural resources and ecosystem services upon which the economy and society depend.To further appreciate the meaning of sustainable development it is imperative to define the two keywords "sustainable" and "development". Cambridge Dictionarydefined sustainable as "able to continue over a period of time". Development was defined as a process that creates growth, progress, positive change or the addition of physical, economic, environmental, social and demographic components (Society for International Development, 2021).Therefore, Sustainable Development can be said to be the ability to continue over a period of time the creation of growth, progress, positive changes.

In every federal state, powers are shared between the central government, usually called the Federal Government, and component unit(s) which in some cases is just the State Government and in most cases the State and the Local Government. In Nigeria, powers are shared among the Federal, State and Local Government. These tiers of government are expected to work harmoniously to achieve sustainable development goals in Nigeria in line with the United Nations Sustainable Development Goals. However, the local government which is the grass root government and the one closest to the people especially those in the rural communities is bedeviled with a lot of challenges militating against its development and contributions to the achievement of sustainable development in Nigeria. Chief among these challenges is the issue of its autonomy from interferences of the other tiers of government especially the state government.

This article will look at those challenges facing the local government in its bid to achieving sustainable development goals in Nigeria and will seek ways to address those challenges for purposes of actualizing local government autonomy that will aid in the achievement of sustainable development goals in Nigeria.

2.0 Sustainable Development Goals.

At the termination date of the Millennium Development Goals (MDGs) which lifespan was year 2000 to 2015, after assessment of the success and failure of the Millennium Development Goals (MDGs); the United Nations further set out new development target known as Sustainable Development Goals which is aimed at consolidating and improving on the success of

Millennium Development Goals (MDGs). This development plan is expected to be achieved within 15 years, from 2015 to 2030. Nigeria was among the countries that keyed in to this development plan.

These Sustainable Development Goals are:

a. End poverty in all its forms everywhere.
b. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
c. Ensure healthy lives and promote wellbeing for all at all ages.
d. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all potential.
e. Achieve gender equality and empower all women and girls.
f. Ensure availability and sustainable management of water and sanitation for all.
g. Ensure access to affordable, reliable, sustainable and modern energy for all.
h. Promote sustained, inclusive economic growth full and productive employment and decent work for all.
i. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
j. Reduce inequality within and among countries.
k. Make cities and human settlements inclusive, safe, resilient and sustainable.
l. Ensure sustainable consumption and production patterns.
m. Take urgent action to combat climate change and its impacts.
n. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
o. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reserve land degradation and halt biodiversity loss.
p. Promote peace and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
q. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

3.0 Local Government System in Nigeria.

The major Local Government reform that has taken place in Nigeria is the 1976 Local Government reform which unified the Local Government system in Nigeria making it a multi-purpose third tier of government.

The following are the objectives of the 1976 Local Government reform:

1. To make appropriate services and development activities responsive to local wishes and initiatives by devolving or delegating them to local representative bodies.

2. To facilitate the exercise of democratic self-government close to the grassroots of our society and to encourage initiative and leadership potential.
3. Mobilization of human material resources through the involvement of members of the public in their local development.
4. To provide a two-way channel of communication between local communities and government (both state and federal). (Igbuzor, 2009).

The Constitution of the Federal Republic of Nigeria 1979 abolished the provision that 25 percent council members should be nominated by the state government and provided for all local council members to be democratically elected. During the second republic (1979-1983), the civilian administration ignored the constitutional provisions and no elections were held, instead sole administrators were appointed to administer the local governments (Ahmad, 2015).

Subsequent local government reforms were contained in the 1984 Dasuki Report of the Nigerian Local Government, the 1989 Constitution, the 1992 Handbook on Local Government Administration and the Constitution of the Federal Republic of Nigeria 1999 (Amucheazi & Oji, 2014:43).

Section 7(1)Constitution of the Federal Republic of Nigeria, 1999 (as amended) provides that, "the system of local government by democratically elected local government councils is under this Constitution guaranteed; and accordingly, the Government of every State shall, subject to section 8 of this Constitution, ensure their existence under a law which provides for the establishment, structure, composition, finance and functions of such councils."
The functions of the Local Government councils are enumerated in the fourth schedule to the Constitution. Some of these functions include collection of rates, radio and television licenses; naming of roads and streets; provision and maintenance of public conveniences, sewage and refuse disposal, among other functions (section 1 of the Fourth Schedule of the Constitution). These functions extend to participation of such council in the Government of a State as respects the following matters

a. the provision and maintenance of primary, adult and vocational education;
b. the development of agriculture and natural resources, other than the exploitation of minerals;
c. the provision and maintenance of health services; and
d. such other functions as may be conferred on a Local Government council by the House of Assembly of the state. (Section 2 of the Fourth Schedule of the Constitution).

Most of the functions of the Local Government are in tandem with the Sustainable Development Goals hence the need for the Local Government to play a crucial role towards achieving those goals. However, the Local Government has not been allowed to function optimally or given the full autonomy it desires in order to achieve these Sustainable Development Goals. This article

looks at those challenges facing the Local Government which if unaddressed might hinder the achievement of the Sustainable Development Goals by the year 2030.

4.0 Challenges facing the Local Government in Nigeria.

There are challenges facing local government system in Nigeria. These challenges have been perceived to have been hindering the quest to achieve sustainable development goals in Nigeria. The challenges are connected to the controversy surrounding the autonomy of local government system in the light of Nigeria federalism. The challenges will be discussed below.

4.1 Weak legal framework establishing Local Government in Nigeria.

Section 2(2)of the Constitution states that Nigeria shall be a federation consisting of states and a Federal Capital Territory. This provision clearly did not mention the Local Government as a component part of the federation called Nigeria. This puts a question mark on whether the draftsman of the Constitution actually intended Local Government to be a component part of the federating units or mere appendages to the state. The first mention of local government was in Section 3(6) of the Constitution which stated that there shall be seven hundred and sixty-eight local government areas as shown in the second column of councils as shown in part II of that schedule, that section did not state whether those local government areas are part of the federating units in Nigeria. Section 7 establishes the Local Government. It stated in subsection 1 that the Government of every state shall subject to section 8 of the Constitution ensure the existence of a democratically elected local government areas under a law which provides for the establishment, structure, composition, finance and functions of such councils. By this provision, the Constitution casts on the states the mandatory duty to ensure that there is a functional, structured democratic local government in the state. Subsection 5 of the same Section 7 empowers the state legislature to make laws conferring functions on the local government in addition to the ones conferred to them by the Fourth Schedule to the Constitution. Unlike the Federal and States government, there is no other constitutional provision defining the arms of the local governments and their respective functions or tenure of office, all these are left for the states to decide. In *AG. Abia State v AG. Federation*(2002) 6 NWLR (pt.763) 264 SC the Supreme Court voided the portion of the Electoral Act 2001 which provided for the tenure of local government councils and held that the National Assembly has no constitutional power to make laws relating to the tenure of local government councils.

It should be pointed out that there was an improvement in the constitutional framework of the local government from what it was under the 1979 Constitution and what it is in the extant constitution. Under the 1979 Constitution, section 3(1) named all the states of the federation but merely included the list of the existing local government in the second column of Part I of the First Schedule to the Constitution. Section 3(2) merely referred to local government as “area” (Ehi Oshio). Also the 1979 Constitution failed to expressly empower the states to create new local government areas, unlike the extant constitution which empowers states to create new local governments following the laid down procedures stipulated in section 8.

Flowing from the foregoing is the fact that the fate of the local government lies on the hands of the State Government. These constitutional powers over the affairs of the local government granted to states have been severally abused and this has reduced the local governments to mere appendages to the states and has negatively affected their place in the scheme of things as the third tier of government.

4.2 **Conduct of Local Government Council Elections**.

Elections into local government councils are conducted by the State Independent Electoral Commission of the state concerned. Section 197(1) (b) Constitution of the Federal Republic of Nigeria 1999 (as amended) establishes the State Independent Electoral Commission as one of the State Executive Bodies. Its composition and powers are set out in sections 3 & 4 of the Third Schedule to the Constitution; the composition is a chairman and not less than five but not more than seven other persons. The Commission has powers to organize, undertake and supervise all elections to local government council within the state and also to render such advice to the Independent National Electoral Commission on the compilation of and the register of voters in so far as that register is applicable to local government elections in the state. The chairman and members of the Commission are appointed by the Governor subject to the approval of the State House of Assembly (section 198 of the Constitution). The chairman and members of the Commission can be removed from office by the Governor acting on an address supported by two-thirds majority of the State House of Assembly of the state praying that he be removed for inability to discharge the functions of the office or for misconduct (section 201 of the Constitution). The Constitution states that the Commission shall be independent and shall not be subject to the direction and control of any authority or person (section 202 of the Constitution).

An appraisal of these constitutional provisions puts a big question mark on the independence of the State Independent Electoral Commission. The fact that the chairman and members are appointed by the Governor with the confirmation of the State House of Assembly and can be removed by those two arms of government for misconduct or inability to discharge the functions of the office gives a leeway for state control over the Commission. State governments have continuously influenced local government elections and consequently install council members who belong to the same political party with the State Governor and who were handpicked by the Governor to do his bidding instead of exercising independent powers.

Recently, Kano State conducted local government elections into the 44 local government councils, the ruling All Progressive Congress (APC) won all the 44 Chairmanship positions and 484 councillorship positions (Premium Times, 2021). Same happened in Enugu State in 2020 local government polls where the state's ruling Peoples' Democratic Party (PDP) swept the entire 17 chairmanship positions and won 260 councillorship positions (Guardian Newspaper, 2020). This is also the situation in other states of the federation, the local government elections are always won massively by the political party at the helms of affairs in the state, while in some states the ruling party sweeps the entire chairmanship and councillorship seats, in the others, the opposition

parties take a little fraction of the councillorship seats. This puts a question mark on the integrity of the process of election at the local government level and also puts in doubt the independence of the State Independent Electoral Commission.

4.3 **Lack of Financial Autonomy of the Local Government**.

The Constitution makes provision for all revenues collected by the Government of the Federation to be paid into a special account to be known as the Federation Account (section 162(1) of the Constitution). It went ahead to state that the amount standing in the credit of the federation account shall be distributed among the three tiers of government in a manner to be prescribed by the National Assembly (section 162(3) of the Constitution). The amount for Local Government Councils of a state shall be allocated to the state for the benefits of the local government councils on such terms and in such a manner as may be prescribed by the National Assembly (section 162(5) of the Constitution) Each state is to maintain a special account called State Joint Local Government Account where the allocation of the Local Government Councils in the state shall be paid into (section 162(6) of the Constitution). The amount standing to the credit of Local Government Councils of a state shall be distributed among the Local Government Councils of that state on such terms and in such manner as may be prescribed by the House of Assembly of the State (section 162(8) of the Constitution).

From the constitutional provisions, the National Assembly prescribes the modalities for the distribution of the amount in the federation account among the three tiers of government, while each state government takes what is due for the state, the amount due for the local government councils in each state will be paid into the State Joint Local Government Account from which the State House of Assembly will then determine how the amount will be shared among the local government councils of the state. The implication is that each local government council is left at the mercy of the state government to determine how much it gets from the joint account. It presupposes that a local government council that is not dancing to the tune of the state government might get lesser sum from the joint account. There have also been cases of seizure of local government revenue. Under the Presidency of Chief Olusegun Obasanjo, the Lagos state local government allocation was seized by the federal government on the grounds that the Lagos state government created additional 37 local government councils. Despite Supreme Court judgment in the case of *AG., Lagos State v AG Federation* (2004) 18 NWLR (Pt. 904) 1 SC, directing the federal government to release the funds, the federal government remained adamant. There are also cases of state governments that have withheld local government funds, some of the instances of states withholding local government funds are; in Borno State, between March 2002 and March 2003 out of a total of 13.3 Billion Naira made available for the local government councils in the state from the federation account, the state government deducted almost a half of the sum (amounting to about 6.8 Billion Naira), in Rivers State, a total of more than 31 Billion Naira was deducted from the revenues accruing to local governments in that state between 2007 and 2013 (Obidimma & Obidimma, 2016). In some states, there is absence of a democratically elected local

government council and owing to that, the state withholds the local government funds and cannot be questioned by their appointed caretaker chairmen.

Fourth schedule to the Constitution specifies the functions of the Local Government Councils and also states that the State House of Assembly can confer additional functions on the Local Government Councils by a law. The Local Government Councils are meant to generate revenues internally through the performance of those functions conferred on them, for instance, through collections of levies from markets, licensing of bicycles, trucks, barrows and so on. Most times, the state encroaches on these functions and deprives the local government council of the revenue generation opportunities. This hinders the local government council from having funds available to it for the smooth running of that tier of government.

4.4 **Absence of Democratically Elected Local Government Council and forceful removal of Democratically Elected Local Government Chairmen from office**.

As already stated in this article, section 7 of the Constitution makes it mandatory for each state to ensure the existence of a democratically elected local government council in that state. Unfortunately, this constitutional provision has been observed more in breach. The State Independent Electoral Commission (SIEC) is saddled with the sole responsibility of conducting local government elections, however, the duty of maintenance and compilation of register of voters for local government elections is that of Independent National Electoral Commission (INEC). The state government always hide under the cover that as at the time of expiration of tenure of local government councils, INEC has not been able to compile the register of voters so as to enable SIEC conduct elections. Some state governments also cite paucity of funds for local government elections as reason for inability to conduct the elections and hence the need for a caretaker committee. One begins to wonder, since there has never been a time in the democratic history of Nigeria, a caretaker committee was appointed to be in the helms of affairs at the federal or state government level owing to inability to conduct elections in those tiers of government for whatever reason, why then is that of the local government justified?

The appointment of caretaker committee at the local government councils in place of democratically elected local government councils has received judicial condemnations in *Akpan v. Umah*(2002) 7 NWLR (pt. 767) p. 701the court stated inter alia, that any law made by the House of Assembly which provides for the nomination of membership of a council or appointment of an administrator or caretaker committee to replace a democratically elected council is inconsistent with the clear and unambiguous provisions of section 7(1) of the 1999 Constitution which guarantees democratically elected Local Government Councils and is therefore unconstitutional to the extent of the inconsistency (Obidinma). The cases of *Akan v. A.G. Cross Rivers State*(1982) 2 FRR 177 and *Akinpelu v. A.G. Oyo State*(1982) 2 FNR 428 were also greeted with judicial condemnations of the appointment of caretaker committees at the local council. In *A.G. Plateau State & Ors v. Hon. Chief Anthony Goyol & Ors*(2007) 16 NWLR (pt. 1059) 57 in that case, the respondents were elected Local Government Council chairmen in

Plateau State, they were inaugurated on 14 April 2004, the third appellant passed a Bill entitled Local Government Council Bill 2007, and the second respondent purporting to act under the law, on 12 January 2007 dissolved the Councils constituted by the respondents whose tenure of office was to expire on 19 April 2007, the court held that irrespective of the powers conferred on the State House of Assembly to make laws, such laws must be made in accordance with the provisions of the Constitution. The Court further stated that House of Assembly does not have the power to make any law giving the Governor power to truncate a democratically elected Local Government Council and that the purported law upon which the dissolution of the councils was done is null and void for being inconsistent with the Constitution. In *A.G. Benue State v Umar & Ors*,(2008) 1 NWLR (pt. 1068) 311 CA the respondents were elected Councilors representing their respective Local Government Councils of Benue State. They were inaugurated on the 13 and 14 April 2004 for three years' tenure. The second appellant, acting on section 154(1) of the Local Government (Establishment) Law of Benue State, 2003 (as amended), dissolved the elected councilors of the 23 Legislative Councils in the state and appointed caretaker committees in their stead on 4 April 2006. The respondents approached the High Court challenging the constitutionality of the second appellant in bringing their tenure to an end before its expiration. The trial court gave judgment in favour of the respondents. Aggrieved, the appellants appealed to the Court of Appeal which dismissed the appeal and held that the said law is inconsistent with section 7 of the Constitution and thus null and void. Also, in *Eze v Governor of Abia State*, (2014) 14 NWLR (pt. 1426) 192 cited in (Oladele, 2020:34) the Governor of Abia State dissolved all elected Local Government Councils on June 2006 when they still had 23 months to complete their tenure and replaced them with caretaker committees. The appellants, that is, the dissolved chairmen, vice chairmen and councilors, approached the court to seek redress. The trial court held that the appellants were wrongfully removed but declined an order of reinstatement on the ground that their tenure in office has elapsed, and instead ordered that they should be paid their salaries and allowances from the time of dissolution of the Council to the date of expiration of their term in office. Dissatisfied, the appellants appealed to the Court of Appeal which affirmed the judgment of the trial court. At the Supreme Court, the apex court stated thus:

> Section 7 of the Constitution of Nigeria imposes a duty on the Governor of a State to ensure that the system of Local Government continues unhindered. Accordingly, a Governor's act of dissolving Local Government Councils and replacing them with caretaker committee amounts to the Governor acting on his whims and caprices, unknown to Nigerian laws, and clearly illegal and undemocratic. It is the duty of the Governor of a State to ensure the existence of Local Government Councils instead of destroying them. In this case, the Court of Appeal was right when it found that the Governor lacked the legal competence to dissolve the elected Local Government Councils and appoint caretaker committees in their stead and that this act was illegal, ultra vires, and of no effect whatsoever. Since general elections are held every four years to elect the President, Governors and members of the National and State Legislatures, there is no justifiable reason, except where a state of emergency has been declared, for a State Governor to dissolve a Local Government Council and

> appoint a caretaker council in its place. Persons elected for a fixed term of years can only be removed from office if found to be in breach of the rules governing their offices or for infamous conduct. If such a person is removed from office in a manner the court finds to be wrong, he shall be entitled to all his entitlement, to wit: salaries, allowances, etc. Thus, since the appellants, were adjudged to be entitled to a three-year tenure of office the which they did not fully utilize due to the deliberate actions of the Governor – respondent, they were entitled to a remedy by way of monetary compensation for the unexpired period of their truncated tenure, in view of the fact that they could not be reinstated to complete their tenure.

The Supreme Court also rose to the occasion in the case of *Governor of Ekiti State & Ors. v Olubunmo & Ors.*,(2016) LPELR-48040(SC) the fact of the case was that on 25 October 2010, the respondents; elected officers of the Local Government Councils in Ekiti State, brought an action against the appellant for a declaration that section 23(B) of the Local Government Administration (Amendment) Law 2001 of Ekiti State which amended Local Government Law 1999 of Ekiti State to the effect that the Governor of Ekiti State can dissolve democratically elected Local Government Councils and replace them with caretaker committees, was in conflict with section 7 of the Constitution of the Federal Republic of Nigeria and thus, null and void; and a declaration that the tenure of the respondents was statutorily set at three years with effect from the date of their election, specifically from 20 December 2008 to 19 December 2011. While the matter was still in court, the 1st appellant, Governor of Ekiti State, by a radio announcement on 29 October 2010, dissolved the Local Government Councils and removed the respondents, who were elected to the Councils and appointed caretaker committees to oversee the affairs of the Councils (Oladele, 2020:35). This development necessitated an amendment in the reliefs to include three additional reliefs, to wit: i. A declaration that the Governor's unilateral dissolution of the democratically elected Local Government Councils in the sixteen Local Government Councils of Ekiti State through radio announcement on 29 October 2010 was a breach of section 7(1) of the Constitution of the Federal Republic of Nigeria and therefore is undemocratic, unconstitutional, null, void and of no effect whatsoever; (ii) A declaration that the composition, constitution, inauguration and/or setting up of caretaker committees in the sixteen Local Government Councils by the Governor was unconstitutional; (iii) A declaration that the tenure of the respondents is statutorily set at three years with effect from the date of their election, specifically from 20 December 2008 to 19 December 2011 (Oladele, 2020:35). Upon a preliminary objection filed by the appellants, the trial court declined jurisdiction and the case was struck out. Aggrieved by the decision of the trial court, the respondents approached the Court of Appeal, and the Court of Appeal invoking its powers under Section 15 of the Court of Appeal Act heard the originating summons on its merits and in its judgment, their Lordships held that section 23B of the Local Government Administration (Amendment) Law 2001 of Ekiti State which empowered the State Governor to dissolve elected Local Government Councils and replace them with caretaker committees as null and void for being inconsistent with section 7 of

the Constitution of the Federal Republic of Nigeria 1999 (as amended). The Court of Appeal ordered the Governor to pay the respondents (as appellant before it) their outstanding allowances and emoluments. The appellants dissatisfied by the judgment of the appellant court, approached the Supreme Court which affirmed the judgment of the Court of Appeal and dismissed the appellants' appeal.

Currently, there are so many states in the federation that do not have a democratically elected Local Government Council, in Anambra State there were no elected Local Government Council from 2002 when the tenure of the then Local Government Councils expired up till 2014 and after the expiration of the tenure of those elected in 2014, there was no other election till date, rather it is a caretaker committee that is currently running the affairs of the Local Government in the state. Some states Houses of Assembly have made enabling legislation that made it possible for these caretaker committees to be legally appointed, for instance, in Delta State, the State House of Assembly enacted a law titled Local Government Transition Law 2011 which enables the state appoint caretaker committee instead of conducting local council elections (Obidinma). In Ebonyi State in 2015, the State House of Assembly had to amend the Laws of Local Government to enable the Governor appoint a caretaker committee (Obidinma).

4.5 Usurpation of Taxation Powers of the Local Government by the State Government.

The Fourth Schedule to the Constitution provides functions of the Local Government Council which includes areas where the Local Government Council can levy taxes and rates. These includes; collection of rates, radio and television licenses; licensing of bicycles, trucks (other than mechanically propelled trucks), canoes, wheel barrows and carts; assessment of privately owned houses or tenements for the purpose of levying such rates as may be prescribed by the House of Assembly of a state; among others.

Taxes and Levies (Approved List for Collection) Act Cap T2 Laws of the Federation of Nigeria, 2004 stipulates list of taxes and levies each tier of government can collect. For the Local Government Council, the Act provide for the following list(Part III of the Act):

i. Shops and Kiosks rates;
ii. Tenement rates;
iii. On and off liquor license fees;
iv. Slaughter slab fees;
v. Marriage, birth and death registration fees;
vi. Naming of street registration fee, excluding any street in the State Capital;
vii. Right of Occupancy fees on lands in rural areas, excluding thos collectable by the Federal and State Governments;
viii. Market taxes and levies excluding any market where State finance is involved;
ix. Motor park levies;
x. Domestic animal license fees;
xi. Bicycle, truck, canoe, wheelbarrow and cart fees, other than a mechanically propelled truck;
xii. Cattle tax payable by cattle farmers only;
xiii. Merriment and road closure levy;

xiv. Radio and television license fees (other than radio and television transmitter);
xv. Vehicle radio license fees (to be imposed by the local government of the State in which the car is registered);
xvi. Wrong parking charges;
xvii. Public convenience, sewage and refuse disposal fees;
xviii. Customary burial ground permit fees;
xix. Religious places establishment permit fees;
xx. Signboard and advertisement permit fees.

In *Eti-Osa Local Government v Mr. Rufus Jegede & Anor*(2007) 10 NWLR (Pt. 1043) 537 CA the appellant enacted Bye-Laws No. 10, 1998 (Corporate Outfit Bye-Laws) outside the scope as contained in Part III of Taxes and Levies (Approved List for Collection) Act No. 21, 1998. The respondents filed an originating summons praying the court to determine, among other things, whether the appellant laws imposing tax on corporate outfits is inconsistent with Part III of Taxes and Levies (Approved List for Collection) Act No. 21, 1998 and thus invalid, null and void. The trial court held, among other things, that Local Government Council does not have the powers to make laws in relation to collection of taxes and levies outside the subject matters contained in the Taxes and Levies (Approved List for Collection) Act and thus the bye-laws imposing corporate outfit taxes was declared null and void and of no effect. This decision was affirmed by the Court of Appeal.

Various state governments have enacted laws on matters which the Local Government Council have the right to collect taxes and levies, this is especially in states where there is absence of elected Local Government Council. The Anambra State House of Assembly in 2011 enacted Anambra Property and Land Use Charges (APLUC) LawNo. 15, 2011 which provides for levies and land use charges. The Law provides that Property and Land Use Charge for the purposes of the Law includes; property rate; tenement rate; ground rent and infrastructural development and maintenance levy (section 3(2) of the Law). These are matters within the scope of Local Government Council to make laws and levy taxes on in accordance with the Fourth Schedule to the Constitution and the Taxes and Levies (Approved List for Collection) Act No. 21, 1998. The Law provides that subject to the provisions of section 3 of the Law each Local Government Council shall be the assessment and collecting authority in respect of Property and Tenement Rate payable for privately owned houses in its area of jurisdiction (section 3(3) of the Law). The Law further provides that the collecting authority can delegate the powers to collect property and tenement rates in writing to the State Government (section 3(4) of the Law). In practice, however, these taxes and levies are collected by the State Government in usurpation of the powers of the Local Government Council, moreover, the intendment of the Constitution and the Taxes and Levies (Approved List for Collection) Act No. 21, 1998 is each tier of government shall have the powers to make the necessary legislation for the collection of taxes and levies under its authority, and not for such laws to be made on its behalf by another tier of government. In the absence of a democratically elected Local Government Council, these taxes

and levies are collected either directly by the State Government or indirectly through the state appointed caretaker committee which will in turn remit the monies so collected to the state government.

4.6 Other Interference in the Affairs of the Local Government by the State Government

There are other areas by which the state government interfere with the affairs of the local government, for instance, through the establishment of Local Government Service Commission by state governments which takes care of the appointment, promotion and discipline of local government employees in Grade Level 07 and above; the Commission also monitors the activities of each local government employees in Grade level 01-06.

4.7 Dearth of Skilled Technical and Professional Personnel

Local Governments experience dearth of skilled technical and professional staff to carry out their duties in collection of taxes, rates, construction/maintenance of markets, schools, health centers and in budgetary and financial management system and so on (Izeoma, 2014).

5.0 Conclusion.

Sustainable development entails the ability to continue in growth, positive physical and economic changes in a given society in such a way that the growth of the next generation will not be put in jeopardy. To achieve Sustainable Development Goals there is need for concerted efforts of the three tiers of government, each contributing its quota to these developmental plans. The Local Government, being the government closest to the people especially the rural communities, has a crucial role to play in achieving the Sustainable Development Goals within the timeframe of year 2030 which is just 9 years from now. The state of affairs has hindered the local government from playing its part towards the achievement of Sustainable Development especially at the rural level. It also raised the query whether the local government is truly an independent tier of government or mere department of the state government. There is therefore need for a reform aimed at an autonomous local government which will in turn aid in the achievement of the Sustainable Development Goals at the grass root level. An autonomous Local Government will be better positioned to carry out developmental plans and attend to the yearnings of the local populace.

The local government is faced with lots of challenges in its bid to achieve sustainable development goals which include the weak legal framework of local government which occasioned the undue interference in the affairs of that tier of government by the other tiers of government especially the state government. The Constitution did not make adequate provisions to ensure the autonomy of the local government especially its financial autonomy with the existence of the state-local government joint account. There have been cases of state governments seizing or embezzling the funds of the local government in the state-local government joint account. The responsibility for the conduct of election into local government council is bestowed on State Independent Electoral Commission, this gives room for the

manipulation of the electoral process by the state government whose duty it is to appoint chairman and members of the electoral commission, the result is that in all local government elections in Nigeria, the state's ruling political party always secures all or majority of the chairmanship and councillorship slots. There is always absence of democratically elected local government council in most states with caretaker committees who owes their royalty to the state government appointed in place of elected local government councils as constitutionally provided. In some cases, elected local government councils are dissolved by the state government before the expiration of their tenure and replaced with a caretaker committee. Some state legislators have laws backing this unconstitutional act. Some State Governments have usurped the powers granted to Local Government Council to collect taxes and levies. There is a dearth of professionals in the local government council and also other controls through the establishment of Local Government Service Commission established by state governments.

6.0 Recommendations.

The work recommends a constitutional amendment creating a chapter in the Constitution specifically for local government councils. The chapter should state the functions, composition of the local government. Local Government in Nigeria should be autonomous from other tiers of government especially state governments; it should have its own checks and balances within the three arms of government, *viz*; the executive, legislature and judiciary existing at the local government level. There should be sanctions for any state government that dissolves an elected local government council, whether the dissolution was made pursuant to a state legislation or not; also, courts should award punitive damages to be paid from personal funds of any state governor that dissolves an elected local government council and such dissolved council should be reinstated into office irrespective of the fact that as at the time of judgment the term of office of the council would have expired. Election into local government council should be conducted by INEC or in the alternative; the power of appointment of the chairman and members of State Independent Electoral Commission should be removed from the executive and legislative arms of the state government and given to representatives of various professional bodies. The Constitution should clearly state the term in office of chairmen and councilors of local government councils, the term should be the same four years as that of the other two tiers of government. Also, local government elections should be held periodically and the appointment of caretaker committees instead of conducting elections should cease and be outlived. Local government allocations should be paid directly to the various local government councils, and state-local government joint account should be abolished. The local government staff welfare package should be improved upon in other to attract professionals and intellectuals from different fields into the local government system. Each local government council should have their own civil service commission that controls, disciplines and checks corruption among the staff. The powers of collecting taxes and levies due to the Local Government Council should be left for each Local Government Council without any interference from other tiers of government. When the above recommendations are implemented, Nigeria shall actualize a local government

system that is autonomous to the other tiers of government in the Nigeria federalism thereby achieving sustainable development goals in Nigeria.

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Chapter Eighteen

Assessment of Architectural Design Strategies for Control of Pollution in Automobile Workshop in Anambra State

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ABSTRACT

An automobile repair shop - also known as a garage - is where auto mechanics and technicians repair automobiles. To many, the words "mechanic workshop or garage" portrays the picture of a dirty and unplanned environment where mechanics repair cars.Following the influx of roadside mechanic workshops, there has been a significant increase in the environmental pollution in Awka. Fortunately, employing proper techniques in combating pollution through the architectural spaces provided in the automobile workshop will help solve pollution. In doing so, I employed the literature review and descriptive research method. Additionally, I reviewed related literature to determine the best forms of automobile workshop design; data were collected and analyzed.The study of existing projects all helped in carrying out the research work. Per the research, I set specific objectives to guide the case studies. I considered pollution, circulation, ventilation, lighting, and fire safety in the planning process. The concept here is sustainability, which puts together all the components and functions of the automobile workshop into a unified, organic whole to ensure an environmentally friendly industrial activity without compromising efficiency and effectiveness. This research is geared towards assessing architectural design strategies to combat pollution in the workshop environment and provide the comprehensive service needed in a technologically changing world.

INTRODUCTION

There's no gainsaying that automobiles play a significant role in the transportation industry in this 21st century. Ever since French engineer Nicolas Joseph Cugnot designed the first car in 1769, car designs have continued to evolve. Unlike Cugnot's design that ran on steam, modern vehicles run on gas or electricity.

Interestingly, Cugnot's car crashed into a brick wall, making it the first-ever automobile accident. Henry Ford's role in the revolution that hit the automobile industry was to perfect the assembly line that made cars relatively affordable.

With the introduction of cars came the need for repairs and maintenance. It is debatable that since most early mechanics were previously carriage repairmen, they also worked on cars. In 1917, two mechanics formed a union in Seattle, Washington, and two years later, membership had grown to 500 (Qeenborough,1960).

In the forties and fifties, young men began tinkering with their cars. But as cars became more complicated, it became necessary to provide schools for proper training to certify as an auto technician. Moreover, many technicians have since had a real problem being called mechanics since they have worked hard and spent a lot of money for the privilege to be called technicians (Jason Ross, 2013).

With the development and growth in the automobile industry came the need for private and public transportation services. According to Obiadi (2019), transportation by land is the most used, making automobiles powered by petrol, diesel, or electricity predominant.

However, as long as the equipment is in use, there will be breakdown and wearing out of the parts, which will lead to maintenance (Kaiser, 2009).

Maintenance has been defined as the discipline and profession of applying engineering concepts to optimize equipment, procedures, and departmental budgets to achieve better maintainability, reliability, and availability of equipment (Dhillon, 2006).

The design of automobiles has advanced to a very sophisticated level. Unlike the old mechanically operated vehicle system, modern vehicles are being run and controlled by computerized electronic sensors. For example, mechanics use auto scanners to check for faults in automobiles at workshops. Additionally, the brainbox of cars and other electronic gadgets that sense instant faults in the automobile and immediately notify the driver through the dashboard display.

Therefore, this modern trend in mechanical services requires sophisticated and highly technological equipment to analyze automobile efficiency, safety, comfort, and style. Also, competent professional hands are required (Dhillon, 2001).

The high level of vehicles used for private and commercial activities coupled with the inflow of second-hand cars, popularly known as "tokunbo," sparked the need for efficient and effective maintenance.

Most of these mechanic workshops where these cars are maintained are situated along the streets, under tree sheds, or slippery terrains. We'd both agree that no effective maintenance can take place in such environments. More so, most mechanic workshops suffer pollution problems, including, but not limited to, liquid waste pollution, noise, and air pollution.

Nwachukwu et al. (2014), found that there is no enforcement of any rule guiding automobile workshops and mechanic practices in Nigeria. If automobile workshops are well planned and built with proper waste collection, recycling, and disposal, there would be a general improvement in the area's environmental quality. The need for an automobile workshop to be environmentally friendly cannot be overstated.

An automobile workshop is an area of open land allocated to automobile repair workers in a vicinity of an urban center, where automobile owners must go for repairs and services of their motor vehicles (Nwachukwu, M.A, Umunna, N.A, Ntesat, B, & Umunna C.P, 2014).

A typical mechanic workshop is synonymous with oil and smoke pollution. According to Alsaraira (2012), there are numerous forms of environmental pollution, but relating to automobile workshops, oil waste, metal scraps, and noise pollution are the most significant problems challenging the modern era of advanced and sophisticated technology.

Instead of human activities being consistent with this progress and development, it took place at the expense of the environment due to the negligence of workers to regularly maintain their facility. Besides, the usual substandard automobile workshops are littered with oil waste.

In Awka, Anambra state, automobile workshops are poorly developed, with little or no thought to their environmental impacts. They are typically located along the roads, and all waste generated is dumped behind them.

AIM OF STUDY

This paper aims to create awareness of the deplorable conditions of the automobile repair shops in Awka, Anambra state, and to proffer architectural design strategies in combating pollution in automobile repair workshops.

METHODOLOGY

This paper adopted a qualitative research method dealing with information from previous works of other authors as applied to the issue at hand. An assessment of architectural design strategies to control pollution in an auto workshop in Awka, Anambra state.

PLATES

When you engage some of these mechanics, you will discover that they know nothing about environmental regulation guiding the activities of auto mechanics, talk less of the regulatory body enforcing any rule. Moreover, most automobile workshops in Awka are situated within residential areas, and their structures are make-shift and ill-equipped. The ones that operate by the road side constitute nuisances to the environment.

IMAGES SHOWING SOME ROADSIDE AUTO WORKSHOPS IN AWKA

Plate 1.0 Auto workshop at Umuokpu, Awka
Source: Okafor (Nov 2019)

Plate 2.0 Auto workshop Awka.
Source: Okafor (Nov 2019)

Plate 3.0 Auto workshop along St PatricksAwka.
Source: Okafor (Nov 2019)

Plate 4.0 Auto workshop along Zik avenue, Awka
Source: Okafor (Nov 2019)

Plate 5.0 Auto workshop opposite Nigerian Correctional Facility Amawbia
Source: Okafor (March 2019)

Plate 6.0 Auto workshop opposite Nigerian Correctional Facility Amawbia
Source: Okafor (March 2019)

Table 1: Activities of mechanics and their environmental implications

S/N	Activities	The Wastes	Environmental Impacts
1.	**Change of oils.** Repair of fuel tanks. Repair of braking systems. Repair of clutch systems. Greasing and oiling of parts. Battery issues.	Waste engine oil, petrol, diesel, brake fluid, hydraulic, grease and Petrol, kerosene, detergent oil spillage on ground. Used electrolyte and lead plate spillage.	Oil spillage on the ground affects the soil by killing the soil nutrients and making it hard for living organisms in the soil to survive. It also contaminates the ground water.
2.	**Panel beating.** Welding. Spray painting. Car washing. Vulcanizing Electrical/Rewiring	Metallic coats, dusts and metal bits. Litter carbide, solder and electrode. Air pollution, paint pills. Petrol, kerosene, detergent. Rubber materials from tyres and waste electrical wires.	Scrap metals are wastes which are recalcitrant to degradation. Their existence in the soil contaminates the ground water. The burning effect kills the soil nutrients.

RECOMMENDATION

The concept of an authorized auto workshop is geared towards reducing environmental pollution and improving urban aesthetics. Here are my recommendations to achieve proper waste management and environmentally friendly auto workshops.

1. An auto workshop should not be sited at relatively high elevated areas to reduce the transport distance of contaminants.
2. An auto workshop not be sited in areas with shallow water basins (water table <45m in the bay) to prevent easy transport of pollutants to groundwater and surface water wells.
3. It should also have an emission testing facility, concrete flooring, tarred roads, drainage channeled to a storm water treatment facility, also routine parking of metal scraps.

All of these can be achieved with the help of government policies to discourage roadside mechanic workshops and allocate areas for such industrial activity in Awka city.

The advantage of an authorized auto workshop over roadside mechanic workshops is how they handle pollution, looking at the environmental benefits (health and aesthetics), saving automobile owners from incompetent hands, and creating opportunities for knowledge sharing among mechanics.

SITE LOCATION

1. Automobile villages should be isolated from residential areas in a 50 to 100-year development plan. The minimum distance required for the closest farming or garden sites is 350m from the village.
2. Automobile villages should not be sited at relatively high elevated areas to reduce the transport distance of contaminants.
3. They should not be sited in areas with shallow water basin (water table <45m in the basin) to prevent easy transport of pollutants to groundwater and shallow water wells.
4. **FLOORING:** The roads within and around the site should be tarred and drainage systems linked to storm water treatment facilities, as well as concrete floor workshops to reduce infiltration of contaminants to soil.
5. To combat the issue of oil waste, metal scraps, and noise pollution in the facility, an underground storage waste disposal system, with a well drainage path will be introduced, routine parking of metal scraps, also the introduction of trees as a buffer against noise will be made.
6. Have groundwater monitoring wells to enable regular study of groundwater chemistry within the vicinity. This helps to prevent dynamic exposure of citizens to water of low quality.
7. **DESIGN:** Passive design strategies such as sun orientation, wind direction, window placement, and size. These help to control and manage daylighting and natural ventilation for optimum user comfort.
8. High efficiency electrical, plumbing and HVAC systems.
9. Use of durable and affordable building materials and finishes such as steel, concrete, wood, from companies environmentally responsible manufacturing techniques.

CONCLUSION

The structure and performance of an automobile Workshop both domestically and nationally are perceived to be on the average, with challenges such as infrastructural under-development, lack of adequate pollution control measures, and the inability of the technicians to follow the trend of technological advancement, modern tools and equipment, and other support facilities.

Thus, the workshop is with proper use of architectural design strategies, expected to meet up with minimum international standards regarding repair facilities, control measures, equipment, storage, spare parts distribution, etc.

In effect, this will combat the pollutants in automobile workshops. It can also serve as a model to boost the automobile service industry in the catchment area and the Nigerian automobile industry in general, considering the impact of automobile transportation on the economy.

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