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Abstract

The title of the paper has to be suitable, clear, concise and accurate. The abstract should have maximum 200 words and structured using the following sub-headings: Objectives (state the aims and objectives of the research, "What is it about and why is it important?"), Previous works (What extant concepts, research, or experiences is the paper trying to build upon? How does the paper relate to other researches in this topic area?), Methodology (What approach was used to capture the practical/research evidence? What were the main methods employed (e.g. survey, observation, case study), Findings (highlight the key results and conclusions from the empirical studies, evidence or experiences presented; it ensures that results are clear, precise and justified), Implications (summarize the implications of the study for one or more of the following groups – academics, researchers, administrators of the university etc.) and Value (clearly state the key contribution of the paper and what is original or unique. Ensure that the reader is convinced of the paper's added value that it is thoroughly researched and is of high quality). Avoid the use of abbreviations and references.

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The paper must give clear answers on the following 5 - What questions:

1) What is the problem (problem statement)?

2) What have been done by other people (literature - review)?

3) What have I done (research course, method used, and technical solutions)?

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4) What are the findings (results)?

5) What further needs to be done (further research)?

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References and citations should follow the latest APA Citation Style. All references should be cited in the text (Mamman, Gambo & Olaoye, 2022).

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Table 1 Table captions should always be positioned above the tables on the left

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Title (centered)	**How to Write …**	14 point, bold
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Contents:

A REVIEW OF APPLICATIONS OF ARTIFICIAL INTELLIGENCE ON EMERGING AGRIBUSINESS TECHNOLOGY RESEARCH FOR INDUSTRIAL DEVELOPMENT

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Abstract

The agricultural sector is facing several challenges which may be supported by the use of advanced technologies. As the demand for food is increasing, the traditional practices of farmers were not sufficient to meet the daily consumption of food. As a result, new automated processes were developed using AI. Agriculture has changed as a result of the application of artificial intelligence and it is a growing technology impacting several sectors. Artificial intelligence has the potential to solve challenges faced by farmers such as climate change, pest and weed infestations that reduce yields. This technology is designed to protect crop yields from various factors such as climate change, population growth, labor issues and food security concerns. Furthermore, the applications of AI technologies reduce water irrigation, pesticide consumption, improve precise application of herbicides, maintain soil fertility and help in efficient farming. More so, AI is being used in applications such as weather forecasting, allowing farmers to achieve efficient results, help yield healthier crops, predict plant diseases, improve decision making, identify wasteful resource consumption patterns, detect soil defects, identifying locations for sowing specific crops, detect the smallest insects, provide proper guidance on water management, assist food supply chain, increase agricultural yield and productivity, achieve efficient results with lesser efforts, increase farmer profitability, detect anomalies and impurities. This paper assesses the applications of Artificial Intelligence on emerging Agribusiness Technology Research for Industrial Development.

Key Words: *weather forecasting, demand for food, traditional practice, advanced technologies and efficient results*

1.1 Introduction

According to Pawa (2014), agribusiness implies the process by which corporate firms supply agricultural inputs or purchase farm outputs and process them for onward distribution in an integrated pattern. Agribusiness is grouped into three primary tri-aggregates: (i) farm supply (ii) farm production (iii) processing distribution. The benefits of emerging agribusiness research technology is obvious in employment generation, income generation/poverty reduction, food security, complementarity/structural transformation and corporate social responsibility (Pawa , 2014).

Industrial development in Nigeria has been a major concern for scholars. Industrialization is said to be a hallmark for modern economic growth and development but the Nigerian industrial sector has suffered from decades. However, with the application of Artificial intelligence and application emerging Agribusiness research. To attain industrial development in a developing nation like Nigeria, there is a need for strong application of Artificial intelligence and application emerging Agribusiness research. As a precursor, this paper presents a holistic view of the industrial development of Nigeria with particular emphasis on to the application of AI.

The emergence of AI has also led to a wave of innovation that enables companies to gain data-driven insights, improve business processes, and develop new products and services (Gupta & George, 2021). Industries such as healthcare, finance, transportation and energy have already experienced revolutionary developments through AI, and further breakthroughs are expected to follow (Chen et al., 2022). Through the use of algorithms, machine learning, and advanced data analysis methods, AI enables complex task solving, pattern recognition, and decision making (Smith, 2019). These capabilities have led to the automation of work processes, taking over repetitive and manual tasks from AI systems, while allowing people to focus on more demanding and creative tasks (Johnson, 2020).

In the energy sector, AI can help to optimize energy consumption and make more effective use of DOT: inserted by editor 6 renewable energies. AI algorithms can, for example, analyses the energy demand in buildings and make suggestions for efficiency improvements (Lu et al., 2018). In addition, AI supports the forecasting of energy production and demand, which contributes to the efficient integration of renewable energies (Karimzadeh et al., 2019). These examples illustrate the enormous potential of Artificial Intelligence for transformative developments in different industries. However, it is important to note that further research and development is needed to understand and address the effectiveness, safety and ethical implications of these technologies.

Until recently, using the words AI and agriculture in the same sentence may have seemed like a strange combination. After all, agriculture has been the backbone of human civilization for millennia, providing sustenance as well as contributing to economic development, while even the most primitive AI only emerged several decades ago. Nevertheless, innovative ideas are being introduced in every industry, and agriculture is no exception. In recent years, the world has witnessed rapid advancements in agricultural technology, revolutionizing farming practices. These innovations are becoming increasingly essential as global challenges such as climate change, population growth together with resource scarcity threaten the sustainability of our food system. Introducing AI solves many challenges and helps to diminish many disadvantages of traditional farming.

The agribusiness sector includes all farms and firms involved in producing, harvesting, packing, processing, preserving, distributing, marketing, and disposing of food and non-food agricultural products (Elliot,Cora, James and Chidozie, 2022).

Those activities could be classified into the following categories: agriculture, processing, trade and transport, food services, hotels, and inputs. The agriculture segment of agribusiness includes all of the classical agriculture sector GDP: the primary production of all crops, live-stock, forestry, and fishing (Elliot, Cora, James and Chidozie, 2022). The processing segment includes the part of the manufacturing sector GDP that involves processing, value addition, and preservation of food and nonfood agricultural products. Examples include food processing, beverages, tobacco, cotton yarn, and timber.

The trade and transport segment include the part of the services sector GDP that entails transportation, storage, logistics, and trading for agricultural commodities and products between farms, firms, and final consumers. The food services segment is the part of the classical services sector GDP that involves the preparation and sale of food out-side the home (for example, restaurants and street vendors). The hotels segment includes the part of the hotels and accommodation GDP associated with food. The inputs segment includes all GDP generated during domestic production of the inputs used by farmers and processors, excluding the inputs produced by the above five segments.

1.2 Statement of Problem

Agribusiness is a large part of Nigeria's economy, directly providing more than 50 percent of jobs and contributing more than 35 percent to the national GDP. It has enormous potential for transformation because primary agriculture is much larger than off-farm agribusiness. Primary agriculture accounts for 21 percent of the national GDP, whereas off-farm agribusiness contributes 14 percent. The 1.5 ratio of primary agriculture to off-farm agribusiness GDP indicates that transformation is still in the early stages.

Therefore, there are enormous opportunities to design policies and investments to accelerate transformation and create more and better jobs. With the current low level of transformation, primary agriculture provides more jobs (about 21 million) than off-farm agribusiness (about 8 million jobs). However, off-farm agribusiness provides better jobs than primary agriculture does, with GDP per worker at least 1.6 times higher than in primary agriculture and comparable to the economywide average. Within agribusiness segments, labor productivity is highest in input supply and processing and lowest in hotels, food services, and primary agriculture. Labor productivity in primary agriculture tends to be underestimated, however, when measured as GDP per worker because workers in primary agriculture are engaged seasonally and not throughout the year. The GDP attributable to these workers is generated only during the cropping season; therefore, the average annual labor productivity measure is biased downward unless corrected for seasonality. Furthermore, primary agriculture also tends to be a residual employer that absorbs low-skilled rural individuals who cannot find jobs elsewhere.

So many researchers have focused mainly on small scale farming or using AI to solve immediate farmers hardship in mechanized form. Tanha et al (2020) argued that their main concern was to audit the various applications of Artificial intelligence in agriculture such as for irrigation, weeding, spraying with the help of sensors and other means embedded in robots and drones. These technologies save the excess use of water, pesticides, herbicides, maintains the fertility of the soil, also helps in the efficient use of man power and elevate the productivity and improve the quality. Another study kurkute et al (2018), focuses on pesticides spraying using drone. The use of pesticides in agriculture is very important to agriculture and it will be so easy if will use intelligent machines such as robots using new technologies. To them, the use of various technologies used to reduce human efforts in various operations of agriculture like detection of presence of pests, spraying of UREA, spraying of fertilizers. However, this study reviewed the applications of artificial intelligence on emerging agribusiness technology research for industrial development.

1.3 Potentials of Artificial Intelligence on Agribusiness Technology Research and Development

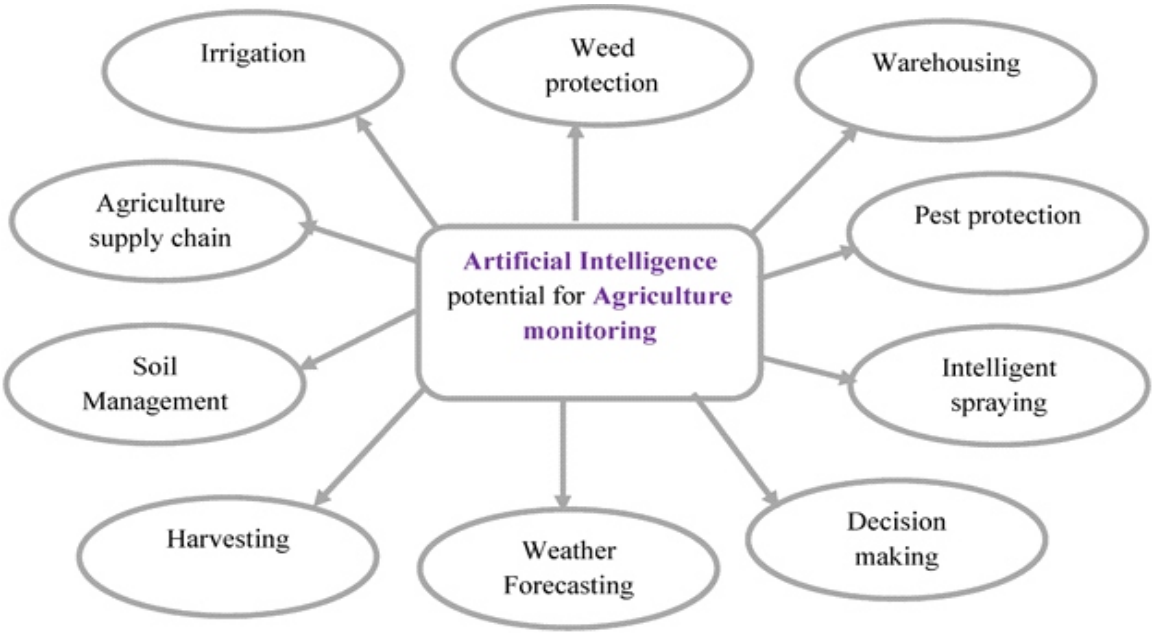


Figure 1: Potential of Artificial Intelligence (AI) in Agribusiness Technology Research and Development

The chart illustrates the importance of Artificial Intelligence in Agribusiness Technology Research and Development. Artificial intelligence has the potential to solve challenges faced by farmers such as climate change, pest and weed infestations that reduce yields. This technology is designed to protect crop yields from various factors such as climate change, population growth, labor issues and food security concerns. Furthermore, the applications of AI technologies reduce water irrigation, pesticide consumption, improve precise application of herbicides, maintain soil fertility and help in efficient farming.

Crop health monitoring is made possible through soil and plant sensors and multispectral photos from satellites or drones. AI programs may watch security cameras or drone footage to look for wild animals, birds, and unauthorized people who might harm crops.

1.3.1 Application of Artificial Intelligence (AI) in Weather Forecasting

According to Mohd, Abid, Ibrahim and Rajiv (2023), the use of AI technology aid in predicting weather and other agricultural conditions such as land quality, groundwater, crop cycle, and plant disease detection, all of which are critical issues. Farmers can plan the sort of crop that can be cultivated and the best time to plant seeds by combining weather forecasts and AI to analyze weather conditions. AI solutions can determine whether more complicated unsupervised ML algorithms are being applied using this data. This increases output while lowering crop loss.

1.3.2 Application of Artificial Intelligence (AI) in promoting farmers to achieve efficient results

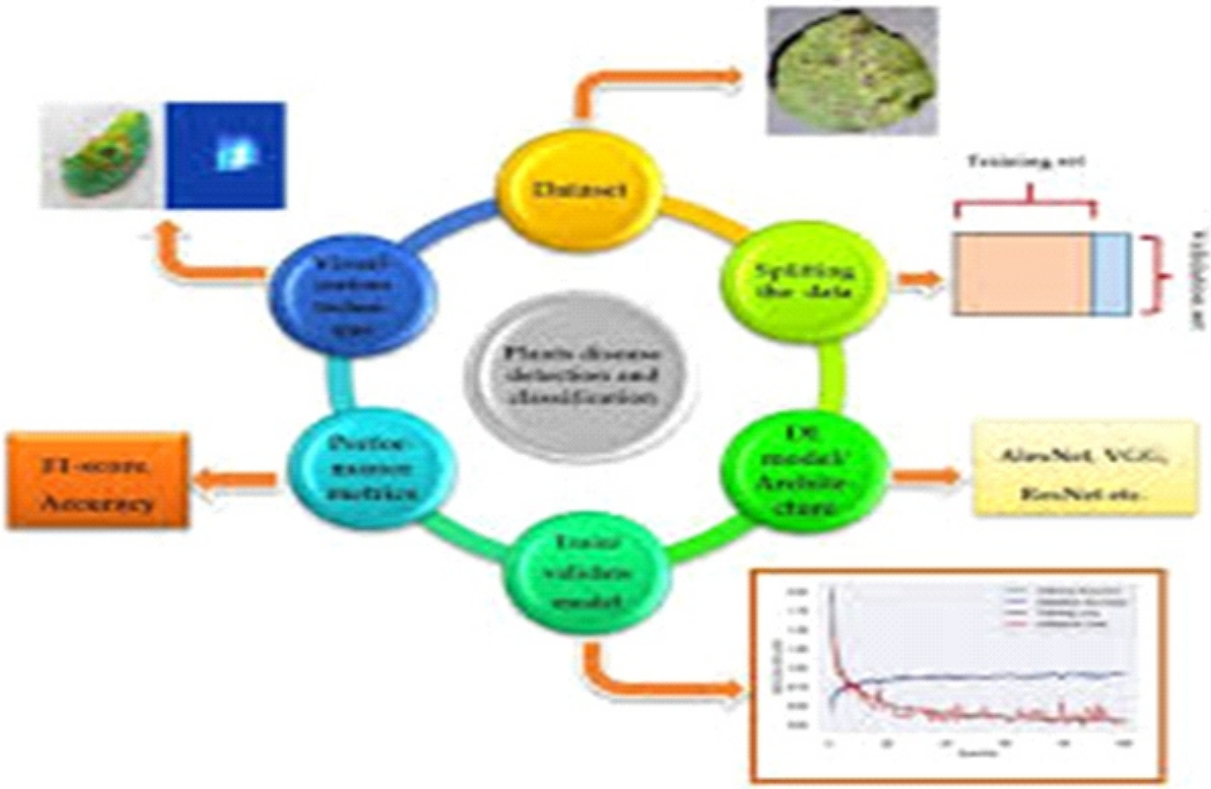
Mohd, Abid, Ibrahim and Rajiv (2023) pointed out that AI can alter how we see agriculture by enabling farmers to produce more with less work while offering various advantages. AI encompasses growth-driven crops via cognitive IoT, which includes imaging, proximity sensing, remote sensing, and soil testing.

AI can be used to comprehend, store, and learn a massive amount of data, allowing it to respond to it to improve efficiency. AI can analyze data using cognitive IoT to provide great insights to improve crop yield. Hardware solutions combine data collection software and robotics to prepare the best fertilizer for specific fields to maximize output. AI in agriculture uses data and tools like autonomous tractors, smart drones, soil sensors, and other technologies to help farmers become more efficient.

1.3.3 Application of Artificial Intelligence (AI) in Yielding Healthier Crops

In order to produce healthier crops, control pests, monitor soil and growing conditions, organize data for farmers, aid with the workload, and enhance a variety of agriculture-related jobs along the food supply chain (Mohd, Abid, Ibrahim and Rajiv, 2023). By making crop selection more straightforward, AI can assist farmers in determining which crops will be the most lucrative. Farmers may lower the risk of crop failure and eliminate mistakes in business operations using forecasting and predictive analytics. By gathering information on plant growth, AI can aid in producing crops that are more resistant to disease and adaptable to environmental circumstances. AI systems can conduct chemical analysis of soil and produce precise estimations of the absent nutrient. Machines can learn historical weather patterns and soil quality, providing valuable insights into how to increase overall yield.

1.3.4 Application of Artificial Intelligence (AI) in Predicting Plant Diseases, Detecting Soil Defects and anomalies



Mohd, Abid, Ibrahim and Rajiv (2023) stresses that AI can identify and eliminate weeds, detect and even forecast plants' illnesses, and recommend efficient pest control measures. Computer vision can detect the presence of pests or diseases. AI can be used in agriculture projects to scan images to find mold, rot, insects, or other threats to crop health which will helps farmers to act quickly in order to exterminate pests or isolate crops to prevent the spread of disease. AI technology in agriculture has been used to detect apple black rot with an accuracy of over 90%. Plant Disease detection systems use various sensors to collect the plant-related data in form of images at different time intervals (Liu and Wang 2021).

1.3.5 Application of Artificial Intelligence (AI)-Self-driving tractors

Labor shortage is one of farming's most prevalent issues which may be resolved by using AI-self-driving tractors. AI-self-driving tractors are more precise and produce fewer errors. These technologies could also be less expensive. The convergence of AI-self-driving tractors is the secret to precision farming.

1.3.6 Application of Artificial Intelligence (AI) in Improving Decision Making

The agriculture industry's adoption of AI technology to enhance decision-making is growing (Mohd, Abid, Ibrahim and Rajiv, 2023). A growing amount of data is being analyzed and used for agricultural decision-making. Surrounding temperature, weather conditions, water usage or soil conditions, and other farm-related data can be analyzed using Artificial Intelligence (AI) to make better agricultural decisions. The more significant usage of sensors, quicker access to satellite photos, lower prices for data loggers, expanded use of drones, and easier access to data archives are just a few examples of industry innovations that have made this feasible for irrigation. This labor-intensive process can be automated to be more efficient. Because of the increase in data in agricultural processes, AI can now operate with the data required to inform better decision-making practices across the board.

1.3.7 Application of Artificial Intelligence (AI) in solving the problem of food shortage

The agriculture industry is turning to AI to solve the dual problem of food shortages and food waste caused by locust swarms, climate change, droughts, and floods (Mohd, Abid, Ibrahim and Rajiv, 2023).

1.3.8 Application of Artificial Intelligence (AI) in crop cultivation and harvesting

The AI-created robots and drones assist farmers with crop cultivation and harvesting. Target irrigation, weed control, and crop management increase field efficiency. Predictive analysis aids in the detection of early problems in the field. Early detection assists farmers and organizations in identifying the issue and preventing significant crop loss or damage. AI may be used to detect flood or drought conditions before they occur. This technology assists in analyzing the weedicide and pesticide requirements for the field. AI also assists in spraying pesticides and weedicides in the field and crop monitoring. AI can help with gardening, lawn care, and landscaping.

1.3.9 Application of Artificial Intelligence (AI) in Increasing farmer profitability

AI contributes to increased food yields and farmer profitability. Pests are one of the most severe threats to crop health. Fortunately, using satellite imagery, AI systems can detect insects that land on crops. AI can then notify farmers of the pest's location via their smartphones. Farmers can then act quickly to eliminate pests and save their crops. Farmers will be able to grow more crops with less water using AI. It is essential in areas prone to drought as it also helps farmers save money on resources.

1.3.10 Application of Artificial Intelligence (AI) in Sorting harvested produce

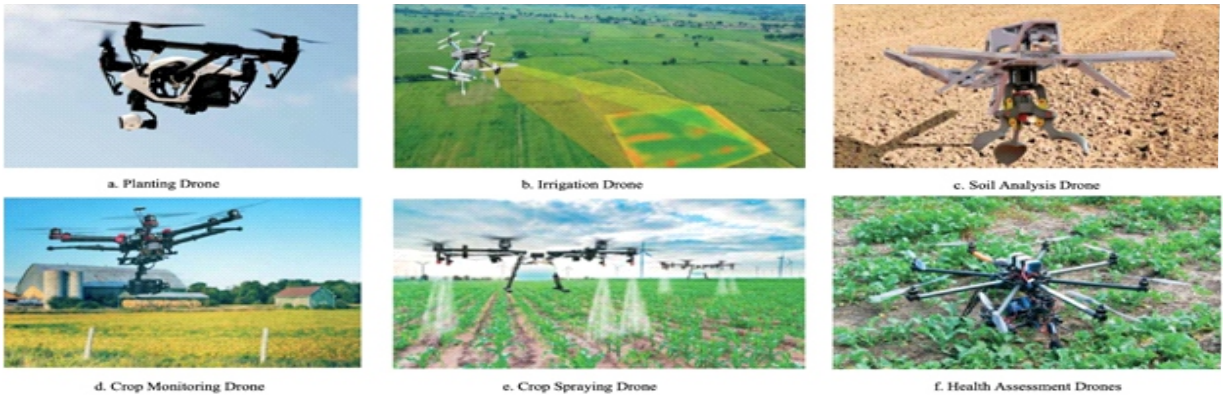
AI is not only useful for identifying potential issues with crops while they're growing, it also has a role to play after produce has been harvested. Most sorting processes are traditionally carried out manually, however AI can sort produce more accurately. Computer vision can detect pests as well as disease in harvested crops. AI can grade produce based on its shape, size, and color that would enables the farmers to quickly separate produce into categories — for example, to sell to different customers at different prices. In comparison, traditional manual sorting methods can be painstakingly labor-intensive.

1.3.13 Application of Artificial Intelligence (AI) in Monitoring livestock health

AI can easier be used to detect health problems in livestock than in crops (Mohd, Abid, Ibrahim and Rajiv, 2023). For example, a company called Cattle Eye has developed a solution that uses drones, cameras together with computer vision to monitor cattle health remotely. It detects atypical cattle behavior and identifies activities such as birthing. Cattle Eye uses AI and ML solutions to determine the impact of diet alongside environmental conditions on livestock and provide valuable insights. This knowledge can help farmers improve the well-being of cattle to increase milk production.

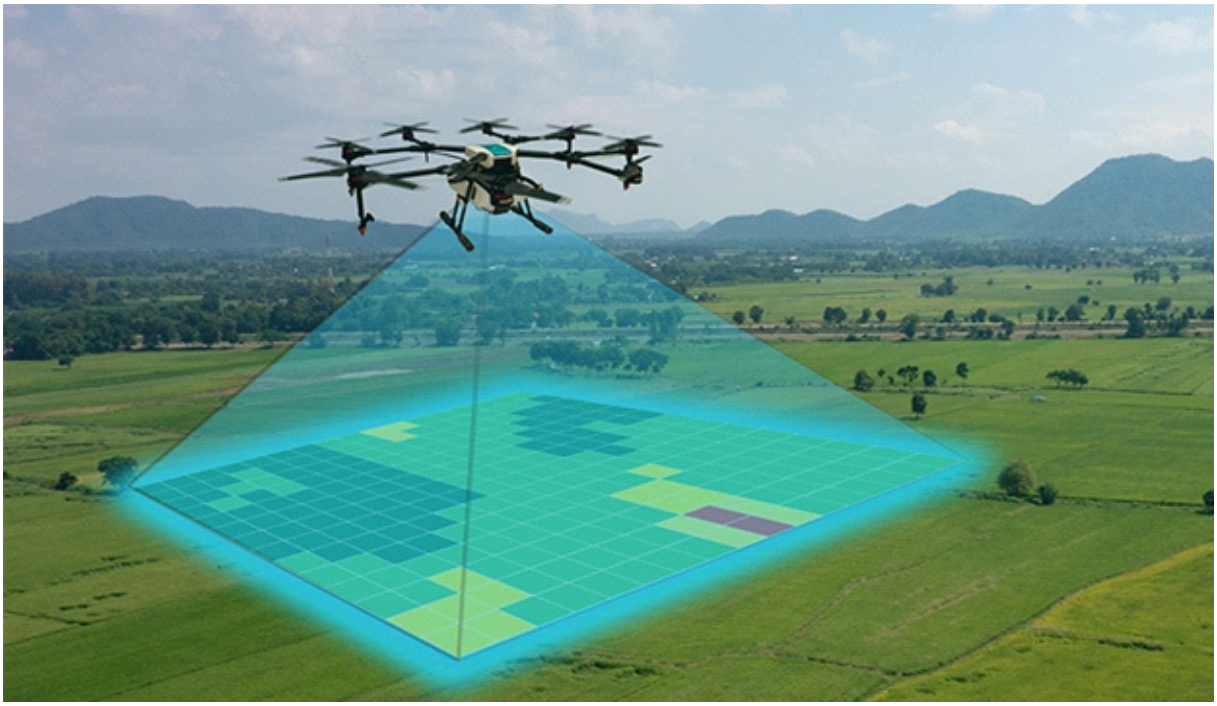
1.3.13 Application of Artificial Intelligence (AI) Drone in precision irrigation management and autonomous farming

Drone can also help in variable rate application of fertilizer, pesticide and water. It helps in precision irrigation management and autonomous farming. It has high aerial imaging, multispectral and hyperspectral imaging and data analysis for insight on crop performance, soil health and weather pattern.



a. Planting Drone b. Irrigation Drone c. Soil Analysis Drone

d. Crop Monitoring Drone e. Crop Spraying Drone f. Health Assessment Drones



1.4 Conclusion

Agribusiness is veritable tool for industrial development as it creates employment, income, poverty reduction, complementarity etc. The applications of artificial intelligence on emerging agribusiness technology research for industrial development improve the commercial value of Agribusiness which culminate into a serious agrarian change that would impact on the greater number of people. Artificial intelligence is applicable in emerging agribusiness technology research in such areas as farm, crops and animal monitoring, diseases and pest detection, intelligent farm chemicals application, automatic weeding, aerial survey and mapping, smart irrigation, intelligent produce grading and sorting, among others.

1.5 Implication of the study

The implications of application of artificial intelligence (AI) in emerging agribusiness technology research for industrial development are multifaceted and transformative. Artificial Intelligence integration into agribusiness technology research has profound implications for industrial development by improving productivity, enhancing sustainability and fostering innovation. Thus, Artificial Intelligence plays a crucial role in shaping the present and the future of agribusiness.

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EFFECT OF ORGANIZATIONAL STRUCTURE ON EMPLOYEES' PERFORMANCE: A STUDY OF COTTON GINNERIES INDUSTRIES IN ZAMFARA STATE

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Abstract
An organization can be compared to a building, the strength of which is derived from the framework and structure supporting it. The way related components (resources) are arranged to allow a building to be stable, resilient to stress, and to provide the proper shape is known as its structure. Therefore, it is critical to comprehend the proper arrangement of interrelated elements (the organization's structure) in order for an organization's performance to be effective. The dependent variables of the study is employee's performance. Also, the study utilized independent variables such as complexity, centralization and formalization organizational structures. This is to show the effects of the independent variable on the dependent variables. The research adopted quantitative design, using survey questionnaire to generate primary data. The population of this study comprises of all staff, comprises of 32 employees from existing three ginneries in Gusau, Zamfara state. Using SPSS/ multiple regression to test the hypotheses, the result shows that there is a statistical positive significant relationship between complexity organizational structure, centralization organizational structure and employee performance while formalized organizational structure has statistical negative significant relationship. It was recommended that there is need to enhance centralization of decision making, embrace complexity and minimize formalization.

Key word; organizational structure, centralized structure, complexity structure, employees Performance,

1.0 Introduction

Organizations operating in the global business environment are expected to adhere to best practices in order to maintain a competitive edge and be taken into account as major players in the global market. Companies that wish to participate in the global market may need to structure their organizational design in a way that emphasizes decentralization and standardization of a control system. This system should center on operational excellence, global competition, innovation, and the collaboration of skilled workers. However, management objectives should align with staff expectations and interests, respectively. Organizational structure is an essential component that makes up an organization. The structure of the organization may work against or in favor of its growth. It is actually expected of businesses that want to thrive in the global marketplace to have a well-designed organizational structure that increases employee engagement and ensures that all goals are reached. The accomplishment of the overall goals of the organization depends on the efforts of its employees (Funminiyi, 2018).

Globally, organizational managers and academics have focused a lot of research and discussion on organizational structure. For instance, the hierarchy of a company is defined by its organizational structure. Every employee's role within the company is specified, along with their function and the person to whom they report. An organizational structure establishes the relationships between the various teams as well as the division of the entire organization into discrete parts.

The organizational structure describes how various activities, such as assigning tasks, supervising employees, and coordinating efforts, are focused on achieving specific objectives. Additionally, it serves as a "viewing glass" or perspective that workers can use to view their company and its surroundings (Ugwu et al. 2019). Analogously, inadequate organizational structure impedes the personal development, sense of fulfillment, and mental well-being of employees, leading to setbacks, annoyances, and disputes that impede the advancement and expansion of the company (Vithanage and Shyaman, 2020). This suggests that employee performance, job satisfaction, and output are all impacted by organizational structure, which in turn has an effect on productivity. Thus, an employee's attitude toward work and motivation for higher performance are both influenced by how much an organizational structure clears up any confusion for them and makes clear issues like what they are expected to do, how to do it, who to report to, and who to meet in the event of a problem.

Cotton ginning is a vital step in the cotton production chain, transforming raw harvested cotton into clean, usable fibers (Radhakrishnan, 2017). The process has evolved significantly from manual methods to sophisticated, mechanized systems that emphasize efficiency, quality, and sustainability. As technology continues to advance, the ginning industry will likely see further improvements that enhance its role in the global textile industry (Dadgar, 2020). Cotton Ginning simply means mechanical separation of cotton lint from the seed cotton. The business managed competent individuals to work within the organization, handling both administrative and operating ginning machine as well as other laborers. The resultant cotton lint is the one that is baled and sold to textile mills or exported by Ginners Factories. The cotton seed is bagged and sold to Oil mills, for replanting and some for-animal feed purposes. The focus of this research is to perform a structural analysis of cotton ginning industry as it strives to attain sustainability, economic relevance in terms of local resource utilization and profit maximization.

1.2 Statement of the problem

The term organizational structure refers to the hierarchical structure that arranges tasks, interdepartmental connections, and levels of authority to enable collaboration, delegation, and free flow of communication for effective decision making (Lankas, 2022). In the context of cotton ginneries industries in Zamfara State, there are concerns about whether the existing structures in these industries are conducive for optimal employee performance. Therefore, the complexity, centralization and formalization in which the structure of an organization operates can lead to either job frustration or job satisfaction among employees at the workplace (Webb, 2023).

Dlamini, Suknunan & Bhana. (2022) cited that adopting a week structure by a firm may lead to reduction in employee morale, lower productivity, and higher turnover rates. This structure is critical to achieving better employee performance, as a result of this Cotton Ginning sector in Zamfara state is faced with mixed performance. Evidences from the subsector confirm that quite a number of ginning firms are performing very poorly in the state, in some cases, they goes into liquidation, while few others are performing excellently (Ayinde, Kwaghe, Jijji, & Agbiboa, 2022). The excellent performances of few of them are still worrisome as about 70% of Cotton ginning firms went under within the last ten years (Tschirley, Poulton, & Labaste, 2009). However, despite the significance of these issues, there is a limited research been conducted with respect to exploring the relationship between organizational structure and employee performance in the cotton ginneries industry in Zamfara State.

1.3 Research Question

The following questions were raised to guide the study

1. What are the relationship between centralization structure and employee performance among cotton ginning industries in Zamfara state?
2. What are the relationship between complexity structure and employee performance among cotton ginning industries in Zamfara state?
3. What are the relationship between formal structure and employee performance among cotton ginning industries in Zamfara state?

1.4 Objectives of the study

The aim of this study is to examine the effects of organizational structure on employee performance in some selected cotton ginning industries in Zamfara state.

1. To determine the effect of centralization structure on employee performance among cotton ginning industries in Zamfara state.
2. To examine the effect of complexity structure on employee performance among cotton ginning industries in Zamfara state.
3. To establish the effect of formal structure on employee performance among cotton ginning industries in Zamfara state.

1.5 Hypothesis of the study

The following hypotheses were formulated to guide the study.

1. H_{01}; There is no statistical positive significant relationship between centralization structure and employee performance among cotton ginning industries in Zamfara state
2. H_{02}; There is no statistical positive significant relationship between complexity structure and employee performance among cotton ginning industries in Zamfara state
3. H_{03}; There is no statistical positive significant relationship between formal structure and employee performance among cotton ginning industries in Zamfara state.

1.3.11 Application of Artificial Intelligence (AI) in Optimizing automated irrigation systems

AI algorithms enable autonomous crop management. When combined with IoT (Internet of Things) sensors that monitor soil moisture levels and weather conditions, algorithms can decide in real-time how much water to provide to crops (Mohd, Abid, Ibrahim and Rajiv, 2023). An autonomous crop irrigation system is designed to conserve water while promoting sustainable agriculture and farming practices. AI in smart greenhouses optimizes plant growth by automatically adjusting temperature, humidity, and light levels based on real-time data. AI plays a crucial role in detecting leaks in irrigation systems. By analyzing data, algorithms can identify patterns and anomalies that indicate potential leaks. Machine learning (ML) models can be trained to recognize specific signatures of leaks, such as changes in water flow or pressure. Real-time monitoring and analysis enable early detection, preventing water waste together with potential crop damage.

1.3.12 Application of Artificial Intelligence (AI) in Crop and soil monitoring

The wrong combination of nutrients in soil can seriously affect the health and growth of crops. Identifying these nutrients and determining their effects on crop yield with AI allows farmers to easily make the necessary adjustments (Mohd, Abid, Ibrahim and Rajiv, 2023). While human observation is limited in its accuracy, computer vision models can monitor soil conditions to gather accurate data necessary for combatting crop diseases. This plant science data is then used to determine crop health, predict yields while flagging any particular issues. Plants start AI systems through sensors that detect their growth conditions, triggering automated adjustments to the environment. In practice, AI in agriculture and farming has been able to accurately track the stages of wheat growth and the ripeness of tomatoes with a degree of speed and accuracy no human can match (Mohd, Abid, Ibrahim and Rajiv, 2023). Crop yield depends on timely monitoring and scientific prescription of appropriate remedies (Dharani et al., 2021).

specialization, formalization, centralization, hierarchy, breath of the span of control, length and width of the hierarchy which they and contextual as size, technology and environment.

However, it has been characterized as a technique in which the organizations are differentiated and integrated themselves by the allocation of work roles and activities (Daft, 2009). In recent years, researchers have sought to determine which structure brings the most advantages for organizations and they have suggested that organizational structures should be responsive to a variety of individual needs in businesses (Conner and Douglas, 2005). In line with researcher point of view, consideration is on centralization, complexity, high formality

2.2 Centralization Structures

Centralization is considering where the position or point of decision-making lies. In some organizations, decision making is highly centralized. In other cases, decision making is decentralized. Organization tends to be centralized or decentralized. The placement of the organization on this continuum is a major factor in determining what type of structure exists (Eze, Bello and Adekola, 2017). Centralization is a process in which the decision making is assigned and devoted to the different higher levels of the structure. Centralization keeps off employees from vital knowledge and information that are related to the organization, when an organization uses top management in making decisions, they take away the innovative of employees and only tell employees what to do. What happens to employees when they aren't motivated and self-manageable, they can't solve problems on their own, especially when useful information cannot reach employee on time. Centralization has a broad span of control in top levels and more tiers in the structure of the organization (Funminiyi, 2018). Centralization is the concentration of power and authority on a small number of managers at the top level of an organization. Robbins & Judge (2015) asserted that centralization is a degree to which decision making is centered on several positions in the company. Muharam & Chaniago (2019) stated that centralization means that authority or power is still largely held by a leader, and only a small portion is distributed throughout the organizational structure. In another word, centralization refers to some levels of option's hierarchy which can include some decisions. In centralized organizations, top managers and those who are at the head of the organization can make some certain decisions. In de-centralized organizations, such decisions are made at lower levels. Today, managers select the degree of centralization or decentralization by which they can put their own decisions in to action and achieve to organizational goals. What is effective in an organization isn't necessarily effective in another organization **(**Seyyedeh et al, *2*015**)**. However, centralization is deduced to be a system of positioning organizational decision-making body in the control of few officers at the top-level hierarchy. This may deny employees demonstration of initiative and creativity and at the same time demotivate potential employee from being dedicated to the organization.

2.0 Conceptual Review

2.1 Organizational Structure

An effective organizational structure has its roots in making a positive impact on the employee and business and, therefore, is aligned with the business strategy. It flows with the company culture. And, it is designed to attract and accommodate high performing individuals, through creation of positions that leverage their highest skills and provide development and growth, ensuring meaningful work and a sense of purpose from the present into the future (Adeoye, 2018). An organizational structure is the functional framework, aligning resources with defined organizational objectives in the business strategy and embodying the organization's culture (Funminiyi, 2018) . An effective organizational structure has its roots in making a positive impact on the employee and business, therefore, it's aligned with the business strategy. It flows with the company culture. And, it is designed to attract and accommodate high performing individuals, through creation of positions that leverage their highest skills and provide development and growth, ensuring meaningful work and a sense of purpose from the present into the future (Adeoye, 2018). In other words, organizational structure is a set of methods through which, the organization is divided into distinct tasks and then create a harmony between different duties. Organizational structure deals with the formal system of task and reporting relationships that controls, coordinates, and motivates employees so that they cooperate to achieve an organization's goal. Organizational structure deals with two forms, i.e mechanistic structure and organic structure. Kanten et al., (2015) lists the following characteristics: Mechanistic or Bureaucratic Organizations; low complexity, high centralization, high formalization, high stratification, low addictiveness, high production, high efficiency and low job satisfaction. Under centralization, mechanistic structure of organizations, decision making is limited to a few people and departments in the firm.

In recent years, researchers have sought to determine which structure brings the most advantages for organizations and they have suggested that organizational structures should be responsive to a variety of individual needs in businesses (Conner and Douglas, 2005). One of these widely used structures is presented by Burns and Stalker (1961) labelled as a mechanistic and organic. Mechanistic organization structure is characterized by highly formalized, standardized and centralized functions. Organizational structure can be defined as a mechanism which links and co-ordinates individuals within the framework of their roles, authority and power. Organizational structure represents a useful tool that directs individuals' behaviors through shared values, norms, and goals (Liao et al., 2011). Continue et al, (2020), pointed out their dimensions for organizational structure as complexity, formality and concentration. Nwizia. & Okachi-Okereke. (2020) gave their dimension to be classified as mechanical structure and organic structure; and that for the mechanical structure it is classified as; complexity, high formality, centralization, programmed behavior, and regulation and that organic structure is concerned with decentralization and flexible structure. Adeoye (2018).saw dimension of organization as centralization, flatness of organization, specialization and horizontal integration. Ali, Mehrpour, & Nikooravesh, (2016). Rounded it to be centralization and decentralization. Naveed (2010), was of the view that dimension are classified as;

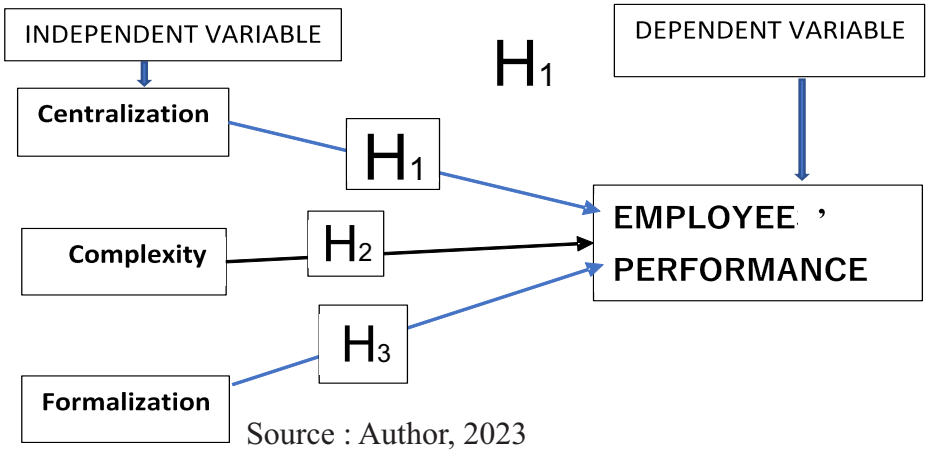
However, its deduce that when rules are more it affects the abilities of an individual greatly and that management tends to create rules so as to control workers, but this might result to very rigid organizations which are incapable of dealing with customer demands whenever need arises.

2.5 Employee performance

Performance incorporates the resulting outcomes of the performed actions of employees based on their expertise and skills, Performance is as a record of success resulting from the function of a particular job activity over a given period(Hillary, 2021). Performance comes from the word job performance or actual performance which means work performance or actual achievement achieved by someone. According to (Al Mehrzi and Singh, 2016) Performance is the result or level of success of a person as a whole during a certain period in carrying out tasks compared to various possibilities, such as work standards, targets or targets or predetermined criteria that have been mutually agreed upon. Rabindra. & Lalatendu (2017). Asserted that performance is a multicomponent concept and on the fundamental level one can distinguish the process aspect of performance, that is, behavioral engagements from an expected outcome. The behavior over here denotes the action people exhibit to accomplish a work, whereas the outcome aspect states about the consequence of individual's job behavior. Performance is the degree of completion of tasks that accompany a person's job to how well the individual meets the job demand (Romi, 2018).

Employee performance is among the critical factors that contribute significantly in organizational success. Organizations structure play important role in enhancing employee performance through a convenient Structural design. Faiza and Nazir (2015), describes employee performance as responses in the form of behaviours reflecting environmental perception by the employee or the kind of organization structure that the employee is familiar with. According to Shmailan, 2016, employee performance is the financial or non-financial outcome of the employee that has a direct link with both the performance of the organization and its success. Dahkoul, (2018). Stated that employee's performance also depends on their internal satisfaction towards their job. If employees are satisfied with organization structure they will be more keenly interested to perform well towards organizational goal achievement. However, it's deduced that employees performance is the employees outcome quality related with respect to available input resources and environmental convenience.

2.6 Conceptual frame work.



Source : Author, 2023

2.7 **Theoretical framework**

2.7.1 Contingency Theory of Organizational Structure

This theory suggests that there is no one-size-fits-all approach to structuring an organization. Instead, the optimal organizational structure depends on various internal and external factors, such as the nature of the organization, its size, its goals, and its environment. The theory emphasizes that an organization's performance is contingent upon how well its structure aligns with these factors. In the context of cotton ginneries industries in Zamfara State. Contingency Theory can be used to explore how different structural configurations (such as centralization, complexity and formalization) impact employee performance. The theory would help determine if the current organizational structure fits the environmental conditions and internal needs of the ginneries, and how adjusting these structures could lead to improved employee outcomes. This theory is useful for assessing why certain structures work better for employee performance in specific settings and allows for a tailored approach based on the unique characteristics of the cotton ginneries industry in Zamfara State.

2.8 Empirical frame work

Empirical review by this study suggests little researches on the area of organizational structure and employee's performance but several studies have been conducted on related area of organizational structure and performance, in the study of Nosike, (2021). Titled Effect of Organizational Structure on Employee Performance of Commercial Banks in Nigeria. The study adopted survey research design and regression analysis were used to analyze the data, the study found that centralized structure have positive effect on employee performance. In an opposite point of result, the study of Nwizia & Gloria (2020) titled effect of organizational structure on employee empowerment in commercial banks, rivers state. Similarly in Fory et'al. (2021) titled decentralization, centralization and quality of organizational performance of human resources, using quantitative survey design in data collection and using multiple regression in analysis of data. The results showed that centralization had a significant and positive effect on organizational performance variable.

The study of Jamshid et'al. (2013) titled the relationship between organizational structure and psychological empowerment among the staffs in Ministry of Economic Affairs and Finance. Using descriptive and field study method. Inferential statistics (Pearson's correlation coefficient test) have been used to analyze data and the results indicated that there is significant relationship between complexity structure and employee's performance. The study of Continue, et'al. (2020) titled effects of Organizational Structure on Employee Resilience Continue. Using Cross-sectional research survey for the study, correlation coefficient was used to analyze the data, it was revealed that complexity enhances employee's performance. Ugwu et al, (2019) titled Organizational Structure and Employee's Performance in Selected Micro- Finance Banks in Enugu State, Nigeria. Using simple percentage and the Non-Parametric Kruskal Wallis test using the 15.0 version of the Minitab statistical software (MSS) to analyze the data and it was found that structural complexity has significant effects on employee's efficiency.

'Banks et al., (2019) in a research work titled Effect of Organizational Structure on Company Performance in Manufacturing Industry using single regression model to test the hypothesis and it was found that formalization have a significant influence on company performance. Hadis, et al., (2017) in a study titled International Digital Organization for Scientific Research Organizational Structure and Employee ' s Performance in Selected Micro, using regression model for hypothesis testing and the research found that there is a significant relationship between Organizational Structure formalization and Employee ' s Performance.

3.0 Methodology

A descriptive survey research design was used in this study to guide the process. There are nine established ginneries in Gusau, Zamfara state. Presently only three are working, the survey were conducted on the existing ones. The survey research design obtained reflective information from a population size of 32 employees from existing three ginneries in Gusau, Zamfara state. The study adopted a structured questionnaire as an instrument to collect primary data**.** The questionnaires were close ended questions which is rooted on five-point Likert scale.

3.1 Data Analysis

Data were analyzed using multiple regression model and correlation coefficient model were used to test the stated hypotheses and equally ascertain the existing relationship among the variables. The decision rule of the regression is to reject the null hypothesis when $p > 0.05$ and accept the alternative hypothesis when $p < 0.05$.

3.2 Model Specification:

$EP=f(CES,COS,FOS)$……(1)

$EP=\beta_0+\beta_1 CES+\beta_2 COS+\beta_3 FOS+\mu$…….....(2)

Where;

EP= Employee Performance

CES= Centralized Structure

COS= Complexity Structure

FOS= Formalized Structure

μ= Stochastic Error term

β_1, β_2, β_3 are treated as the elasticity coefficients of; Centralized Structure (CES), Complexity Structure (COS) and Formalized Structure (FOS) respectively while β_0 is the constant or intercept.

3.3 Measurement

The independent variable for this study is organizational Structure, represented by three items, Centralized Structure (CES), Complexity Structure (COS) and Formal Structure (FOS) respectively, All the items for business growth were measured by a five-point scale, 5= strongly agreed, 4=agreed, 3= undecided, 2= disagreed and 1= strongly disagreed. The dependent variables is Employee Performance.

3.4 Reliability Test

The researcher subjected the instrument to reliability test, Crolnbach Alpha statistical table is used to show the reliability of the instrument. George and Mallery (2003), rules of thumb: $\alpha > 0.9$ (Excellent), > 0.8 (Good), > 0.7 (Acceptable), > 0.6 (Questionable), > 0.5 (Poor), and < 0.5 (Unacceptable). Were adopted for the study.

3.5 Autocorrelation

To confirm whether there is autocorrelation variable exist in the buildup, Durbin-Watson autocorrelation rule of thumb which said that there is no first order temporal autocorrelation if the DW statistic is between 1.5 and 2.5.

3.6 Data Presentation and Interpretation

RELIABILITY STATISTICS

Table 1

Variable	Cronbach Alpha	No. of Items
EP	0.65	5
CES	0.73	5
COS	0.60	5
FOS	0.84	5

The test of reliability was conducted with the aid of Cronbach alpha (α). However, the result displayed in table shows the reliability test result for each of the variable in the model. EP (.65), CES (.73), COS (.60) and FOS (.84) respectively. Adopting Goerge and Mallery (2003) rule of thumb, it is therefore concluded that the variables are reliable, internally consistent and suitable for data analysis.

4.0 STATISTICAL SIGNIFICANCE OF

Table 2:				Change Statistics					
Model R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1 .871[a]	.758	.703	.183	.703	12.46	3	28	.041	1.762

a. Predictors: (Constant), FOS, COS, CES

4.1 Test of auto correlation

The Durbin Watson result in the table 2 shows the result of the test for auto correlation. From the output (1.762), it is therefore concluded that there is no auto correlation using the rule of thumb that state "no auto correlation" when α = (1.5 - 2.5).

ANOVA [a]

Table 3:

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.387	3	.129	3.909	.037[b]
	Residual	.934	28	.033		
	Total	1.321	31			

a. Dependent Variable: EP
b. Predictors: (Constant), FOS, COS, CES

The F-ratio in the ANOVA (Table 3) tests whether the overall regression model is a good fit for the data. The table shows that the independent variables statistically positive significantly predict the dependent variable, $F(3, 28) = 3.909$, p (.037) < .05 (i.e., the regression model is a good fit of the data).

Coefficients [a]

Table 4:

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	T	Sig.
1	(Constant)	4.509	1.131		3.985	.000
	CES	.153	.062	.081	2.467	.024
	COS	.350	.106	.262	3.301	.002
	FOS	-.062	.146	-.087	-.421	.677

a. Dependent Variable: EP

Statistical significance of the independent variables in the model

Given that, the t-value and corresponding p-value are in the "t" and "Sig." columns (Table 4), respectively, in this example, the tests tell us that the centralized structure p(.02)<0.05 and complexity structure p(.00)<0.05 are significant, but formalized structure is not significant P(.677)>0.05. This means that the explanatory variable of formalized structure is no more useful in the model, when the other two variables are already in the model. In other words, centralized structure and complexity structure in the model, while formalized structure no more adds a substantial contribution to explaining employee performance.

4.2 Estimated model coefficients

The general form of the equation to predict employee performance a centralized structure, complexity structure, and formalized structure, is: Predicted employee performance = 4.509 + 0.153 (centralized structure) + 0.350(complexity structure) – 0.62 (formalized structure). This indicates that; a unit increase in a centralized structure would result into 0.153 unit increase in employee's performance. Also, a unit increase in the complexity structure would amount to about 0.350 unit increase in employee performance and lastly, a unit increase in a formalized structure would result into 0.62 decreases in employee performance.

Correlations

			EP	CES	COS	FOS
Spearman's rho	EP	Correlation Coefficient	1.000	.079	.267	-.069
		Sig. (2-tailed)	.	.669	.140	.706
		N	32	32	32	32
	CES	Correlation Coefficient	.079	1.000	.059	-.469**
		Sig. (2-tailed)	.669	.	.749	.007
		N	32	32	32	32
	COS	Correlation Coefficient	.267	.059	1.000	-.181
		Sig. (2-tailed)	.140	.749	.	.321
		N	32	32	32	32
	FOS	Correlation Coefficient	-.069	-.469**	-.181	1.000
		Sig. (2-tailed)	.706	.007	.321	.
		N	32	32	32	32

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5 above shows the strength and direction of linear relationship among the variables in the model. The result indicates a positive association between EP and CES (.079) and EP and COS (.267). Also, it shows that there is a positive degree of association. However, there is a negative linear relationship between EP and FOS (-.069). This result confirms the regression analysis result that also establishes a negative relation between employee performance and formalized organization structure.

4.3 Discussion of findings

In considering the first hypothesis which stated that there is no significant relationship between centralized structure and employees Performance. From the table 2 above, the value .758 explains that 75.8% of the changes in employee performance can be attributed to the centralized structure, while the regression analysis proved that p (.02) <0.05 is significant, the correlation result indicates a positive association between EP and CES (.079) and therefore reject the null hypothesis and accept the alternative hypothesis, this study is in line with the study of Continue, et'al. (2020), Tordumbari & Gloria (2020) and Sunday et al., (2017).

In the second hypothesis which is stated that there is no significant relationship between complexity structure and employees Performance. From the table 2 above, the value .758 explains that 75.8% of the changes in employee performance can be attributed to the complexity structure p (.00) <0.05 is significant, the correlation result also indicates a positive association between EP and COS (.267) and therefore reject the null hypothesis and accept the alternative hypothesis, this study is in line with the study of Muhammad, (2019), Mabotuwana, & Sujith (2020) and Joy et al., (2019).

In the third hypothesis which stated that there is no significant relationship between formalized structure and employees Performance. The regression result shows that formalized structure is not significant P (.677)>0.05, also the correlation table shows that there is a negative linear relationship between EP and FOS (-.069) and therefore the null hypothesis is accepted and this is in line with the study of Teixeira et al., (2012)

5.0 Conclusion

The basic and fundamental goal of every organization is performance, survival and growth. However, the main root of maintaining performance, survival and growth of organizations is to possess the right human resources with right skills, size and quality. Having the right human resources is directly related to the structure in which organization operates. The goal of the research was to determine the effects of organizational structure on employee's performance. Both centralized and complexity structure hypotheses are significantly supported, which indicates significant relationships among the dimensions of organizational structure and employee's performance. While the formalization hypothesis projected a negative relationship. These results imply that centralized and complexity aspects of organizational structure enhance employee's performance. Therefore, organizations seeking higher employee's performance should consider the important role played by both centralized and complexity structural dimensions. organization should enhance Centralization structures

5.1 Recommendations

Given the conclusion that centralized and complex organizational structures significantly enhance employee performance, while formalization has a negative impact, organizations should consider the following recommendations to optimize employee performance:

1. Enhance Centralization: Streamline decision-making by concentrating decision-making processes at higher levels of the organization to ensure consistency and coherence in strategic directions. Establishing a clear lines of authority and responsibility, can help in faster decision-making and better alignment with organizational goals.
2. Embrace Complexity: Encourage specialization by developing specialized roles and departments that focus on specific functions or areas of expertise, which can enhance productivity and innovation. Equally to adapt the organizational structure dynamically to manage and accommodate changes in the business environment, ensuring that complexity is effectively managed and leveraged.
3. Minimize Formalization: Reduce Bureaucratic Procedures by limiting the number of rigid rules and standard operating procedures to promote flexibility and creativity among employees. Allow employees more autonomy and discretion in their work, which can enhance motivation, job satisfaction, and overall performance.

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Library and Information Science Educational Research as a Catalyst for Industrial development in Nigeria

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Abstract:

The study provides an examination of LIS Educational research catalyst for Nigeria development for encompassing its various levels and the present conditions of both positive and negative aspects of Libraries and Library and Information Science education, research, and training in Nigeria with the aim of reshaping Libraries and their functions. The challenges related to the transformation of libraries and the significance of library and information science education, research, and training in Nigeria for the purpose of reshaping Libraries have also been deliberated. It is concluded that the Enhancement of existing Information centers (Facilities, Beautification, Expansion etc) for example the libraries, training, re-training of information center staff vis-à-vis providing motivational packages/incentives especially for those in rural areas, Establishing/ Building and equipping libraries in rural settlements Librarians should become more proactive and daring in providing access to information resources, Government should adequately bring under control the unstable rag tag economic downfall, specifically the free falling Naira rates.

Keyword: Library Information Science, educational research, industrial development.

INTRODUCTION

Recent developments in the world of educational environment have witnessed massive revolution in academic disciplines in such a way that curriculums and course contents of what is being taught students in all spheres of academic institutions are being modified to suit the rapidly changing world activities. In line with this the Nigerian Federal Ministry of Education have similarly had cause to initiate changes in its educational curriculum to tele-guide the activities of the various disciplines or courses offered in Nigerian institutions either in a university, polytechnic, college of education, research institutes, and even secondary schools. Furthermore, disciplines such as Library and Information Science have over the years been modified or restructured to accommodate novel trends, opinions and ideologies. Library Information Science Education in Nigeria today cannot be relevant without effective preparation of new generation of librarians to effectively use the new information and communication technology in their professional practices. For many library and information science schools as enumerated by Nwalo (2000) this doubting task requires the acquisitions of new resources, expertise and careful planning. To buttress the aforementioned view, the Librarian Registration Council of Nigeria (LRCN) an arm of the Federal Ministry of Education has vigorously pursued the modification and restructuring of Library and Information Science teaching course contents (LRCN bulletin: 2014).

In the words of minishi-Majanja (2007) Education and training of LIS professionals has to be such that it empowers them to unleash their potential as they endeavor to offer relevant and efficient services within the current levels of technological sophistication.

According to Kerr and Stewart (2019), important changes in LIS education in the last couple of decades have led to diverse impacts which essentially changed the roles of information professionals and the nature of their work and their competencies. Besides, globalization and internationalization of LIS education are the key factors fuelling the idea of collaboration in LIS education and training. In fact, according to Virkus (2015), the internationalization of higher education has been an imperative priority for many international organizations, governments and higher education institutions for many years and is a trend that is expected to continue in higher education.

These formidable reforms in library school curriculums over the years paved way for the inclusion and diversification of the discipline into different areas such as Information Science, Information and Communication Technology (ICT), E-learning, Digital Resources, Entrepreneurship Studies, Cloud Resources, Digital/Electronic Learning and Services, etc. theses inclusions however justifies the opinion of Edegbor (2011) that it is inarguable that developments in our society technological or otherwise have brought significant changes to library and information science (LIS) education all over the world. Among all the changes in LIS education, the ones that are most visible and observable can be found in the LIS curricula. However, Chu (2006) buttressed that, the curriculum for LIS education usually mirrors what is being offered to train librarians and information professionals' knowledge and skills to become qualified personnel in the field, but also meet challenges of the ever changing information society. Also, Abubakar (2021), noted that with the recent trend in globalization and its seeping impact on LIS education, the LIS field is now seen as an interdisciplinary field of study that has incorporated many new and related areas such as information science, computer science, information system, knowledge management, information architecture, digitization, content management and archives related areas. It is however pertinent to note that these inclusions in curriculum heralded new service/function sometime and nomenclature" such as information scientist, systems librarian, archivist, etc. thus, heralding a new professional paradigm, such that there is an observable change in the morale, capacity, capability, attitude/disposition, creativity of librarians; specifically in dispensing their duties.

On the other hand, Industrialization of every state of the world is not achievable in this present decade/era, otherwise known as 21st century, if there is rancor and disorderliness in the society. Industrialization is a concept that represents a state of massive development in all spheres of human endeavors vis-à-vis increase in physical infrastructures, social amenities and advanced technological development. This trend of industrialization occurs in states with social and economic stability. Industrialization according to Britannica Encyclopedia is, “The process of converting to a socio-economic or development in which industry is dominant”.

It is equally important to note that at the moment, LIS education in Nigerian universities is located within the faculties of education, social sciences and management sciences, while in some cases under the faculties of information and communication. Additionally, most LIS departments offer regular courses, while few are providing LIS education through the distance learning mode (Abubakar, 2021). Different types of programmes are equally offered at bachelor, masters, and PhD levels in LIS in both public and private universities as the case may be. While in terms of the nomenclature, the degrees/diplomas are named variously as approved by the regulatory bodies.

They include among others Bachelor of Library and Information Science (BLIS), Bachelor of Arts/Science (LIS), B. Tech (Library and Information Science/Technology), Bachelor of Education (Library Science) and Bachelor of Library Science (BLS), Master of Library and Information Science (MLIS), Masters in Information Management (MIM) and PhD in Library and Information Science (Abubakar & Harande, 2016).

Industrialization is as old as man on earth; this is so as human culture and practices has continually been overturned by human growth and creation. According to Shelton (2007) it is "the process by which an economy is transferred from primarily agricultural, to one based on the manufacturing of goods, individual manual labor is often replaced by mechanized mass production, and craftsmen are replaced by assemblymen. However, no industrialization takes place in the absence of adequate re-orientation, re-education and re-strategizing.

Re-orientation and re-education has a lot in common and in relation with information activities, functions and services at the disposal of the citizenry such as the leaders (those in authority), and followers (those being led), while re-strategizing entails the formulation of new policies, paradigms, techniques meant to guide or change the processes of rendering existing functions and services. What is therefore is the place of library and information science in ensuring social, economic stability and sustainable industrialization? This is the crux of this paper.

Objectives of the study

1 To provide a comprehensive knowledge about LIS education and research in Nigeria.
2 To enhance the important role of ICT in LIS profession for development of Nigerian industries.
3. To determine the progress of LIS education particularly in research for the development of Nigerian industries.
4 To find out the challenges hindering the LIS education research in industries in Nigeria.

1.2 STATEMENT OF THE PROBLEM

It is no longer debatable that advancements in our society, technological or otherwise, have brought about significant and tremendous changes to the Library and Information Science (LIS) education globally. In other words, the LIS education has been experiencing a radical change especially in the last couple of decades which results to fundamental changes in all its structures. Such changes are pervasive, global and profound in nature. Additionally, with the recent trend in globalization and its seeping impact on LIS education, the LIS field is now seen as an interdisciplinary field of study that has integrated many new and related areas of such as information science, computer science, information system, knowledge management, information architecture, digitization, content management and archives related areas. This fundamental revolution has implications for the profession and has led to the offering of diverse/joint degrees by LIS schools, especially in the advanced countries, employment of new faculty, new curricular offerings, mode of delivery as well as changes in the market place for LIS graduates who now require new skills and competencies.

According to Assefa and Wang (2018), the LIS field is increasingly becoming inter-disciplinary and diverse with many new areas being offered. Similarly, curricular offerings such as data science, research data management, digital humanities, to mention just a few are being offered to expand the frontiers of educational programs in LIS (Assefa & Wang, (2018). Moreover, it is critical to note that advancements in Information and Communication Technologies (ICTs) have been the driven force for all these developments. ICTs have transformed LIS education and libraries in general, and its introduction to the LIS field demands that LIS education must be technologically-based and market driven at the same time. The above state of affairs requires LIS programmes to develop and overhaul their curricular in order to meet the requirements of the new information age which circles around technology. Furthermore, the changing needs of employers have led to many changes in the LIS profession. Consequently, the names of LIS education programmes, LIS education awards and LIS education courses have all changed (Okello-Obura and KigongoBukenya, 2011). For that reason, it is important to state that amendments and expansion of LIS programmes to suit the new changing environment, especially in the area of ICTs, has become unavoidable. Lately, one of the major challenges facing LIS education revolves around the need to have appropriate, robust and vibrant curriculum that will meet the requirements of the changing setting, even though, changing or modifying the curriculum of LIS education particularly in the area of ICTs, is not an easy task. This is because curriculum development requires proper participation of all critical key actors.. The article will be useful to LIS educators, LIS schools' administrators and LIS professionals in Nigeria as well as in other developing countries.

INFORMATION SCIENCE EDUCATION TOWARDS DEVELOPMENT OF INDUSTRIES IN NIGERIA

Entrepreneurship: Trained librarians no longer belong to the class of the oppressed or rather the victims; librarians now are beacons of hope, as small scale enterprises, companies, state of art construction, firms' vis-à-vis research institutes where library skills and functions are presently marketed both locally and internationally. This trend heralded socio-economic status for libraries vis-à-vis job creation for the Nigerian state.

Denouncement of class consciousness towards information use:

Information resources available and access to information contents have been a prerogative of the rich in the society, because the facilities (libraries) were rare and few; the facility were static unmovable; use of outdated techniques and tools, information managers initial lackadaisical attitude towards novel innovations. Revolutionary strides in library and information science as a discipline and a profession such as the:

i. Application and use of modern information gadget in information centers (libraries) functions and services

ii. Conversion of library information resources to non-physical information materials

Enhanced distribution of library information resources through different medium: There is no gainsaying the fact that the provision of information bearing materials by librarians to all citizens irrespective of class, title, age, etc. has helped often times to reduce/calm social restiveness. As the saying goes, "an un- informed man is deformed".

School visitation and public orientation activities: Authorities in librarianship have earlier propounded the theory of taking the "Reference Desk to the Side Walk", which implies that library practices and services should be taken out of the library premises to the classrooms, market places, public parks, etc. In line with the above, recent happenings in Nigerian educational, social and political circles juxtaposes that librarians have taken to the streets, classrooms, public parks sensitization packages notably in terms of public lectures and career guidance and counseling. Observations of recent trends by the writers has exposed that librarians from John Harris Library UNIBEN and Dr. Nnamdi Azikiwe Library UNN, has at different times whilst celebrating library week programme of Nigeria Library Association, visited and held interactive sections with pupils of different primary and secondary schools aimed at ensuring an adequate/effective use of information resources at their disposal.

A qualitative method approach through analysis of documents downloaded from research gate and other internet search. A total of five articles were found on library education and research while a total of 3 documents on industrial development of library in Nigeria. This gave a total of 8 documents downloaded from which data for the study were acquired. Three keywords were used or information searches which are: the LIS education and research in Nigeria development of industrial through LIS research in Nigeria. All of these helped in generating data for the study. The findings of study revealed that.: Theoretical propeller for change in libraries and librarians these changes in the discipline, curriculum and professional ethics, the writers of this paper are of the view was propelled by intuitive rationalizing such as:

1) Libraries and librarians will be left with scars if new trends are not embraced.
2) Libraries should employ, train and motivate staff members on library connectivity and technological applications.
3) Train staff members on how to understand the library and its services in the 21st century and beyond.
4) Establishment of audio visual coders and electronic libraries to reclaim or recall users already lost to commercial vendors.
5) Training of librarians to understand the technologies (ICT) and how to apply them practically in relating with their clients and commodity they are meant to serve.

The study concluded that the plethora of problems tends to derail the accomplishments for a sustainable industrialized economy/society for the Nigerian state. This is so as the numerous negative antecedents of ignorance, lack of access to adequate information sources vis-à-vis lack of awareness of existing information sources and facilities prompts negative societal phenomenon such as corruption, directionless government policies, ethnicity, religious intolerance, militancy, insurgency, boundary dispute, etc.

All these negative societal norms do not pave way for social and political stability vis-a-vis sustainable industrialization in any state.

However, this paper is recommending the following steps for better societal growth and industrialization.

a. All-inclusiveness of notable professions specifically Library and Information Science in the event of national and educational curriculum formulation,
b. Enhancement of existing Information centers (Facilities, Beautification, Expansion etc) for example the libraries,
c. Training, re-training of information center staff vis-à-vis providing motivational packages/incentives especially for those in rural areas,
d. Establishing/ Building and equipping libraries in rural settlements
e. Librarians should become more proactive and daring in providing access to information resources,
f. Government should adequately bring under control the unstable rag tag economic downfall, specifically the free falling Naira rate

POSSIBLE SOLUTION

CURRICULUM REVIEW AND EFFECTIVE IMPLEMENTATION:

Designing a workable, integrated and broad curriculum for the LIS education program as stipulated by the National Universities Commission (NUC) policy guideline with the assistance of the professional association like the NLA and other subsidiary bodies interested in the growth and development of LISE will be laudable. In addition, implementation of the reviewed curriculum should be taken seriously so as to ensure the replication of librarians who will be fit for contemporary information challenges. In response to this, accreditation of LISE program must be regular under strict supervision to ensure that proper learning is taking place using the approved methods and facilities judiciously. And also engaging of librarians in LISE curriculum formulation.

PROVISION OF ADEQUATE INFRASTRUCTURE

Information Technology (IT) is an expensive venture. Government must develop its IT infrastructure and fund the necessary subscription so that information communication technology can be utilized for teaching in the education sector especially in LISE. Library schools should also be equipped with relevant infrastructure that will facilitate effective teaching and learning.

STAFF AND TRAINING: Library is an organization that should comprise information professionals. Qualified library educators should be engaged to teach LISE in library schools and there should be in-service training organized for librarians who are unable to use modern information tools and software. This will help to eradicate ICT illiteracy among library educators. Regular workshops and seminars for educators within and outside the shores of Nigeria will help to close the gap, so that through capacity building, new techniques will be adopted to help them adapt to modern trends and developments (Ochogwu, 2016); Akintunde, 2004). And proper awareness and orientation on LISE should be given much emphasis.

PROVISION OF FUND: It is a known fact that education is capital driven, therefore, all the financing bodies must cooperate so that researches can be funded. Without adequate funds laudable researches cannot be undertaken in academics. Therefore, Government should support academic institution with adequate funding, so as to facilitate research and dissemination of scientific discoveries and information management. Finally, Library and Information Science Education and Learning in a World of Difference can be improved, if government adheres to its policy strictly, by providing enabling environment for teaching and learning through the provision of quality infrastructure, adequate funds for capacity building for educators and exchange program for exposure. While the university management on the other hand, must encourage collaborative researches, provide soft loans for educators to purchase private laptops.

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AWARENESS OF ADVERSE HEALTH EFFECTS OF PESTICIDES ON HUMAN AND ANIMALS IN DAURA OF KATSINA STATE NIGERIA

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Abstract

The study investigated the Awareness of the Adverse Health Effects of Pesticides on Human, Animals and the ways of mitigating the effects of pesticides on human and animals in Daura Local Government Area of Katsina State Nigeria. The population used for the study comprises of males and females resident in Daura. The sample for the study was 46 respondents, comprised of 24 males and 22 females. A structured questionnaire titled 'Awareness of Adverse Health Effects of Pesticides on Human and Animals' was used for data collection. The data was analyzed using mean, while T-test was used to test hypothesis at 0.05 levels of significance and 95% confidence level. The result reveals that there is no significant difference between the awareness of the males and females on the advert effects of pesticides on humans. But for adverse effects of pesticides on animals and ways of mitigating the effects, there was a significant difference. Hence, the study recommends government-private partnership in improving on creating the awareness on the effects of pesticides on the humans, animals, and the ways of mitigating it.

Introduction

The use of pesticides in agriculture is an advancement that has contributed to high yield of crops and better protection of crops against pest (*Adekunle al.,* 2017*; Alengebawy et al.,* 2021). However, the use of pesticides is considered easy and effective in reducing crop losses (*Amere et al.,* 2023) their misuse globally has become a serious issue in agricultural sustainability (*Behailu et al.,* 2018*;* Edward *et al.,* 2021). In the absence of effective pesticide policies in developing countries, the use of toxic and persistent pesticides is increasing (Haji *et al.,* 2018; Houbraken *et al.,* 2017).

Approximately two million tons of pesticides are applied each year (*Ibrahim et al 2018*; Mohammad *et al*. 2017). More than 99% of applied pesticides are spread in the environment, damaging soil, water, and other organisms (Nwakife *et al*., 2015).

The effect of pesticides on the health of humans, animal and the impact on the environment, the risk associated with consuming foods preserved with pesticides has become a source of worry. Intensive agricultural practices that use pesticides to improve yields, increases the risk of soil and water contamination. Many of these chemical residues, especially derivatives of chlorinated pesticides, exhibit bioaccumulations which could build up to harmful levels in the body as well as in the environment(John *et al.,* 2017) Developing countries like Nigeria are more vulnerable to the risk posed by the wrong use of pesticides due to lack of training and training resources that will help farmers to know the best possible ways to handle and effectively deal with the hazards associated with handling pesticides (Parisa et al.,2022). Use of banned pesticides, incorrect application methods, poor spraying equipments, inadequate storage facilities and the reuse of old pesticide containers for domestic purposes are among the factors that can expose the farmers to hazards associated with handling pesticides.

The purpose of the study is to investigate the level of awareness of adverse health effects of pesticides on human and animals in Daura Katsina state Nigeria. Specifically, the study sought

to determined: the awareness of adverse health effects of pesticides on human; the awareness of adverse health effects of pesticides on animals and to suggest ways of mitigating the adverse health effect of pesticides on human and animals.

Research Questions

Three research questions that guided the study are:

1. What is the level of awareness of the adverse health effects of pesticides on human in Daura of Katsina state?
2. What is the level of awareness of the adverse health effects of pesticides on animal in Daura of Katsina state?
3. What are the ways of mitigating the adverse health effect of pesticides on human and animals in Daura of katsina state Nigeria?

Hypotheses

The following null hypotheses guided the study and were tested at 0.05 level of significance

HO1: There is no significant difference in the mean response of the male and female residents of Daura on the adverse health effects of pesticides on human.

HO2: There is no significant difference in the mean response of the male and female residents of Daura on the adverse health effects of pesticides on animals

HO3: There is no significant difference in the mean response of the male and female residents of Daura on the ways of mitigating the adverse of pesticides on humans and animals

Data and Methodology

Study area population and sample of the study

Daura in katsina state is one of the local government areas of katsina state, with latitude 12.98°N and longitude 8.2516°E(en.wikipedia.org; 2024). According to the national population census (2006), the population of Daura is about 224, 884 people, the population of males is about 115,576 males, while that of females is about 109, 308 females and the population of the people of Daura was projected to be 401,900 in the year 2022, with a population density of 1,849/km^2 and the annual population change from 2006 to 2022 is at 3.7%.(national bureau of statistics; 2022). The dominant tribe in Daura is the Hausa/Fulani tribe and their major occupation is trading faming and rearing of livestock like, cow, goat, sheep, camels etc. The population used in this study comprises of male and female residing in Daura. In order to obtain a representation population, random sampling of the males and females in the study area was abducted without consideration of age, education and occupation to select 46 respondents. Table 1 below shows the number of questionnaires administered according to the sex of people residing in Daura.

Table 1: population of people of Daura

Sex	Population	Number of questionnaires	%
Male	115,576	24	52.2%
Female	109,308	22	47.8%
Total	224,884	46	100

Method of data collection and analysis

The instrument for data collection was a structured questionnaire titled Awareness of adverse health effects of Pesticides on human and animals (AAHPHA) divided into two sections: section A contains personal data of the respondents while section B contains the items of the questionnaire structured into three clusters: A,B and C. Cluster A contains 11 items assessing awareness of the adverse health effects of pesticides on humans; cluster B contains fourteen (14) items dealing with The level of awareness of the adverse health effects of pesticides on animal and cluster C contains eleven(11) items dealing with Ways of mitigating the adverse health effect of pesticides on human and animals . The questionnaires were administered to people residing in Daura Katsina state of Nigeria. A four-point scale type questions were used to get the needed information from the respondents, mainly strongly Agree (4), Agree (3), Disagree (2), and strongly Disagree (1). The data gathered was analyzed using mean. T-test was used to test the significant difference between the mean scores of male and female respondents. The cutoff mean was fixed at 2.50, as the benchmark. Any item that has the mean score of 2.50 and above was regarded to be agreed, while any item that has mean score bellow 2.50 was regarded to be disagreed. The qualitative interpretation of the mean scores of the respondents is presented on the table below:

Results

1. Research questions 1 What is the level of awareness of the adverse health effects of pesticides on human in Daura of Katsina state?

Table 2: awareness of male and female residents of Daura on adverse health effects of pesticides on human beings.

S/N	ITEMS	x_1	x_2	xt	DEC
1	pesticides can impose risk on human health if they are not judiciously used	3.65	3.62	3.64	A
2	The wrong use of pesticides on crops is one of the main challenges on environment pollution and public health	3.13	3.39	3.26	A
3	A lot of risk is associated with consuming foods preserved with pesticides.	3.52	3.05	3.29	A
4	Intensive agricultural practices that use pesticides to improve yields, increases the risk of soil and water contamination.	3.14	3.5	3.32	A
5	Many of the pesticides residues, especially derivatives of chlorinated pesticides, exhibit bioaccumulations which cans build up to harmful levels in the body	3.12	3.19	3.16	A
6	Pesticides affects the nervous system of human beings	3.21	3.46	3.34	A
7	Pesticides irritates the skin and eyes	3.00	3.23	3.12	A

8	Pesticides cause nausea, vomiting, fatigue, headache and intestinal disorders.	3.25	3.08	3.17	A
9	Pesticides may be carcinogens	2.92	2.90	2.91	A
10	Pesticides affect hormones or endocrine system in the human body.	3.13	3.14	3.14	A
11	Pesticides cause respiratory tract irritation, sore throat and or cough.	2.75	3.27	3.01	A

pesticides on human beings.

Key: N_1= number of males, N_2= number of females, X_1= mean response of males, X_2 = mean response of females X_t= average mean of males and females, DEC= Decision, A=Agree. The table above shows that items on number has the highest mean value, with a mean of 3.64, followed by items 6,4,3,2,8,5,10,7,11and 9 with average mean values of 3.34, 3.32, 3.29,3.26, 3.17, 3.16,3.14,3.12, 3.01, and 2.91 respectively. The items were all accepted as their mean value were more than 2.50.

Research Question 2: What is the level of awareness of the adverse health effects of pesticides on animal in Daura of Katsina state?

S/N	ITEMS	X_1	X_2	X_t	**DEC**
1	Pesticides disrupt hormones in animals	3.63	3.41	3.52	A
2	Pesticides affect the behavior and the ability of animals to reproduce.	3.11	2.91	3.01	A
3	Intensive agricultural practices that use pesticides to improve yields, increases the risk of soil and water contamination.	2.96	2.91	2.94	A
4	Pesticides affect the ability of birds to care for their young ones, causing their young ones to die.	2.60	2.91	2.76	A
5	In bees, pesticides result in sub lethal effects, impacting mobility, feeding behaviors and navigation.	3.42	3.19	3.31	A
6	Pesticides cause reproductive abnormalities in mammal, birds, reptiles, fish and mollusks.	2.84	3.23	3.04	A
7	Animals like hedgehogs are struggling for survival due to lack of insets for food, which is linked to use of pesticides.	3.04	3.39	3.22	A
8	Aquatic animals like fish come in contact with pesticides via runoff water from treated fields.	3.24	3.18	3.21	A
9	Pesticides cause hormonal imbalance and egg thinning in birds.	2.88	3.14	3.01	A
10	Pesticides reduces fitness in animals like lizards by reducing their ability to escape predators	3.04	3.43	3.24	A
11	Pesticides reduces swimming speed and distance in tadpoles leopard frogs	2.83	3.32	3.08	A
12	Pesticides affects bone density and reduces egg hatching in female alligators.	2.79	3.00	2.89	A
13	Despite the negative effects of pesticides on tadpoles, itincreases their survival by killing their predators.	2.92	3.27	3.09	A
14	Extensive use of pesticides often results in the development of pesticide resistance in insect pests.	2.83	3.35	3.09	A

Key: N_1= number of males, N_2= number of females, X_1= mean response of males, X_2 = mean response of females X_t= average mean of males and females, DEC= Decision, A=Agree.

The table shows the awareness of male and female residents of Duara residents on adverse effects of pesticides on animals. The items were all accepted as their mean value 2.50. Item 1 came up with the highest average mean value of 3.52, which indicates that the respondents are aware of the adverse effect of pesticides on animals.

Research question 3: What are the ways of mitigating the adverse health effect of pesticides on human and animals in Daura of katsina state Nigeria?

Table 4: awareness of the male and female residents of Daura on the the ways of mitigating the adverse health effect of pesticides on human and animals in Daura of katsina state Nigeria

S/N	ITEMS	X_1	X_2	X_t	DEC
1	Store and dispose of pesticides properly	3.79	3.73	3.76	A
2	Restrict or ban the use of pesticides in public spaces and used for drinking water.	3.21	3.36	3.29	A
3	Implantation of regulations on the use of pesticides	3.38	3.14	3.26	A
4	Proper training and education on the use of pesticides	3.52	3.41	3.47	A
5	Consumers can further limit their intake ofpesticide residues by peeling or washing fruit and vegetables.	3.00	3.43	3.22	A
6	Utilizing organic pest management rather than chemical -intensive controls is the most critical step in mitigating negative impacts of pesticides on wildlife	3.08	3.50	3.29	A
7	Keep pesticides, and any equipment used to apply them, in a locked cabinet in a well-ventilated area, away from children, pets and food.	3.29	3.91	3.60	A
8	Follow all requirements on pesticides product labels	3.22	3.36	3.29	A
9	Check equipments for leaks and malfunctions before use to minimize the potential for accidental spills	3.04	3.33	3.19	A
10	Do not spray if heavy rain is expected within 48hours as the pesticides may wash away from area of application and into water bodies	3.25	3.23	3.24	A
11	Rinse pesticides application equipment and pesticides containers on a solid surface where it won't drain to water ways.	3.04	3.18	3.11	A

Key: N_1= number of males, N_2= number of females, X_1= mean response of males, X_2 = mean response of females X_t= average mean of males and females, DEC= Decision, A=Agree.

The table above shows the response of the respondents on the ways of mitigating the effects of pesticides on humans and animals. Item number one came up with the highest mean value of 3.76, followed by items 7, 4, 2, 6, 8, 3, 10, 5, 9 and 11 with average mean values of 3.60, 3.47, 3.29, 3.29, 3.29, 3.26, 3.24, 3.22, 3.19 and 3.11 respectively.

Hypothesis 1: There is no significant difference in the mean response of the male and female residents of Daura on the adverse health effects of pesticides on human.

X	S.D	N	P-value	Test of difference.	Rmk
3.165	0.252	24	0.173	0.05	NS
3.257	0.217	22			

The result of hypothesis one shows that there is no significant difference between the awareness of males and females on the effect of pesticides on human. The p-value is higher than the test of difference which is 0.05. This suggests that both males and females have similar levels of awareness about the effects of pesticides on humans. The mean scores are relatively high, indicating a moderate to high level of awareness for both groups. Therefore, the null hypothesis is accepted.

Hypothesis 2: There is no significant difference in the mean response of the male and female residents of Daura on the adverse health effects of pesticides on human.

X	S.D	N	P-value	Test of difference	Rmk
3.009	0.271	24	0.016	0.05	
3.189	0.190	22			

This table shows the t-test analysis of male and female residents of Daura using Minitab software on the effects of pesticides on animals. The result shows that there is a significant difference in the responses of male and female residents of Daura on the effects of pesticides on animals with the p-value of 0.016 and the test of difference of 0.05. The mean score for females (3.189) is higher than that that for males (3.009), suggesting that the females are more aware of the effects of pesticides on animals compared to males. Both groups have moderate level of awareness, but the females are slightly more aware.

Hypothesis 3: There is no significant difference in the mean response of the male and female residents of Daura on the ways of mitigating the adverse effects of pesticides on humans and animals

X	S.D	N	P-value	Test of difference	Rmk
3.256	0.238	24	0.049	0.05	
3.416	0.230	22			

This table shows the analysis of the result of respondent responses on the ways of mitigating the effects of pesticides on human and animals. The result shows that the p-value of 0.049 is slightly less than 0.05, indicating a significant difference in mean scores between males and females residents of Daura on the ways of mitigating the adverse effects of pesticides on humans and animals.

Discussions and findings

The result from table two shows that both male and female residents of Daura are aware of the adverse effects of pesticides on human, animals and the ways of mitigating the effects. They are aware that Intensive agricultural practices that use pesticides to improve yields, increases the risk of soil and water contamination. Results from table three also shows that male and female residents of Daura are aware of the adverse effects of pesticides on animals. They are aware that Pesticides disrupt hormones in animals and affect the behavior and the ability of animals to reproduce. While the result from table four shows that both male and female residents of Daura are aware of the ways of mitigating the effects of pesticides on human, animals and agreed that proper storage, disposal of pesticides containers after use and proper education and training will go a long way in mitigating the effects of pesticides on both humans and animals.

From the result of the hypothesis, both males exhibit moderate levels of awareness across all categories, with mean scores generally above 3. This indicates that respondents are relatively ware of the issues related to the effects related to the effects of pesticides. on gender difference in awareness, there is no significant difference in awareness between males and females regarding the effects of pesticides on humans and on animals and ways of mitigating the effects, females have significantly higher awareness of the effects of pesticides on animals and the ways to mitigate these effects compared to males.

Conclusion and Recommendation

Based on the findings of this study, awareness programs should be focused more on males to improve their understanding of the effects of pesticides on animals and mitigation strategies. Since females showed higher awareness, effects should be made still to ensure that both genders are equally informed and remain informed. It is recommended that educational campaigns should be more effectively tailored towards enhancing awareness among all respondents.

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Commuters' Satisfaction Survey as a Measure of the Quality of Inter-Urban Bus Services in Daura Metropolitan Area, Katsina State

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Abstract

This study evaluates passenger satisfaction with inter-city public and private transport services in Daura, Nigeria, focusing on walking times, waiting times, and service quality at four major bus stops: KTSTA, Kofar Yamma, Kofar Kudu and NATO. Data were collected from 200 passengers using structured questionnaires and analyzed using descriptive statistics while the passengers' service quality with bus stop/station services was analyzed using 4-Likert scale. The results revealed that Kofar Yamma and NATO bus stops provided the shortest walking times, with 68.42% and 52.64% of passengers traveling within the acceptable 5–10 minute range. However, KTSTA had the lowest accessibility, with 67.63% of passengers exceeding the recommended walking time. Waiting times were best at KTSTA and Kofar Yamma, where 73.57% and 67.19% of passengers reported waiting ≤20 minutes, indicating high service quality. Conversely, Kofar Kudu and NATO recorded prolonged waiting times for 48.32% and 44.84% of passengers, reflecting lower service standards. The central area of Daura, including KTSTA and Kofar Yamma, emerged as the most efficient transportation hub, owing to its dense road network and high concentration of economic and social activities. Satisfaction levels were highest at KTSTA and Kofar Yamma, with 34% and 32% of passengers being "very satisfied." In contrast, Kofar Kudu and NATO had the highest dissatisfaction rates, with 40% and 35% of passengers being "not satisfied." These findings highlight the need for improved accessibility, reduced waiting times, and equitable service delivery across all bus stops, particularly Kofar Kudu and NATO, to enhance overall passenger satisfaction.

Keywords: *Commuters, urban, bus stop, waiting time*

1. Introduction

Urban public transport is essential to commuting in many cities around the world. Transportation which is the means of changing geographical location of people, freights and services determines the distinct patterns of development, environmental effects, economic strength and lifestyle (Abdulmalik *et al.*, 2023). Present day public Transportation includes several modes which include buses, trolleys and light rails, subways, commuter trains, street cars, cable cars, van Proof services, para-transit services and individuals with disabilities, ferries and water taxis, mono rails and trams (American Public Transportation Association (APTA, 2017)). According to APTA (2017) report, people in Africa board public transportation 35 million times every weekday. Central Africa accounted for 2%, Eastern Africa for 11%, North Africa for 9%, South Africa for 58% while West Africa for 21 % of about 20 million roads automobiles in the continent (Abdulmalik *et al.*, 2023).

General Mobility Operations aims to meet the needs of people with reduced mobility, providing access to employment, education, retail, health care and other options. The size and population of a metropolis can affect the transportation system options available. The usefulness of these transport facilities cannot be emphasized as they allow mobility for the population that does not have a private vehicle. Passenger satisfaction with the public transport service refers to a psychological state of satisfaction or disappointment

after comparing the passengers' expectations regarding the services provided by the public transport system with their general feelings after receiving services (Pei *et al.*, 2006). Passenger's satisfaction promotes public participation in the improvement of the urban public transport system and also motivates public transport companies to understand the essence of the operation of the urban public transport system. The improvement (or deterioration) of a city's public transportation system is usually reflected in the passenger satisfaction score. In addition, the degree of satisfaction of passengers with different attributes of the public transport system indicates the priority of improving the public transport service.

Public and private transportation systems provide the most efficient ways to move large numbers of people, especially in densely populated urban centers. In addition to the convenience of its users, public transport plays an important role in the productivity of cities, which in turn has a direct impact on the national economy (World Bank, 2001). Public transport or mass transport is by definition a system in which a large volume of people move at the same time along major corridors (Wikipedia, 2009).

Public transportation systems are critical to enhancing urban mobility, reducing traffic congestion, and fostering sustainable economic growth. In many developing countries, including Nigeria, public transportation serves as a primary means of connecting people to essential services such as employment, education and healthcare. However, challenges such as infrastructure deficits, inefficient service delivery, and variable passenger satisfaction continue to impede the effectiveness of these systems (World Bank, 1987; Ali, 2010).

Daura, a historic town and a traditional emirate in Katsina State, northern Nigeria, is an important regional hub with a high demand for inter-city transportation. Its strategic location at the intersection of key road networks underscores its significance in facilitating mobility across the region. Despite its role as a transport nexus, limited studies have examined the quality of public transportation services in Daura, particularly from the perspective of passenger satisfaction.

This study aims to assess passenger satisfaction with public and private inter-city transport services in Daura, focusing on key service indicators such as walking times, waiting times, and overall service quality. Using structured questionnaires, data were collected from passengers at four major bus stops: KTSTA, Kofar Yamma, Kofar Kudu, and NATO.

By analyzing passenger experiences and perceptions, this study provides valuable insights into the strengths and weaknesses of Daura's transportation system. The findings aim to guide policymakers and stakeholders in developing targeted interventions to enhance service quality and improve urban mobility in the region.

2.0 Literature review

2.1 Transport Needs of the Inhabitants of the City

The need for transportation is secondary because it depends on the primary needs. Regarding public transport, there is a need for transport, which can be understood as the need to move from the starting point to the final destination in a given time. General transportation needs the inhabitants of a given city are made up of the individual needs of each individual (Zbigniew,2020). The sources of transportation needs can be found in all spheres of human life, but those resulting mainly from productive and social activities. The needs of the inhabitants of the city can be related to work, science and development, cultural needs or the desire to preserve social relations, shopping and entertainment. They can also originate in the need to benefit from health care, to solve problems in the municipality and to use different services offered in the city, and also for reasons related to the human religious sphere. All these factors lead to the need to change the place in space, that is to say the need to move. This is manifested in the form of transportation carried out by different modes of transport (eg road, sea, rail and air transport). Zbigniew (2020) says that every human activity is related to movement. Transportation needs which are linked to the non-economic sphere of social life most often result in (Burnewicz, 1989):

The transportation needs of residents create transportation demand. This demand is called potential demand because not all needs are satisfied by transport. It has the possibility to turn into an effective demand by creating the right conditions in the form of an attractive transport offer. These include: charges, timetables, vehicles, information and security. The transport offer must take into account all the preferences of potential passengers regarding the level of service, so that they are willing to consider it (Zbigniew, 2020). The movements of people in cities reflect the realization of the mobility of their inhabitants. A trip may consist of one or more individual trips that meet the fulfillment requirements, i.e. leads to planned access to the destination. Urban mobility can be carried out on foot, by individual (private) transport or by public transport (Zbigniew, 2020). The share of public transport services in total transport is irregular. It depends on the following factors (Zbigniew, 2020):

i. The scale of society's wealth.
ii. Accessible transport infrastructure (linear and punctual).
iii. The existing incentive system.
iv. Spatial conditions of use of public and private transport system.

2.2 Performance measurement steps

Cranfield University researchers have developed a performance measurement and management framework called the "performance lens," which they addresses all stakeholders in an organization. The lens consists of five aspects that should be considered when developing performance measures: stakeholder satisfaction, strategies, processes, capabilities, and stakeholder input (Kennerley and Neely, 2000). However, in this research, different measurement (walking time and waiting time) structures will be evaluated for best practices according to Onatere *et al,* (2014), but supported by the steps of the measurement process as follows:

2.2.1 Identification

This step is to choose/select the key performance indicators (KPIs) that are worth measuring to meet the objectives/needs of the organization.

2.2.2 Monitoring

This step involves collecting data to check progress towards planned objectives. This is the formal communication of evidence that expenses and results have been successfully carried out and that milestones have been achieved. To track changes in outcomes over time, monitoring data plays a key role in the evaluation throughout the life of the initiative.

2.2.3 Evaluation

This step includes evaluating the effectiveness and efficiency of the project during and after implementation. This includes measuring the causal effect of the project (or elements of the project) on planned outcomes and impacts, assessing the achievement of expected benefits and value for money, and existence of unforeseen impacts.

2.2.4 Implementation

At this stage, when everything is decided on the operation of the organization, comes the process of deciding what to improve, how much and how to proceed.

2.2.5 Evaluation

After implementation, another evaluation should be carried out to assess the effectiveness and efficiency of the project, to determine whether the expected benefits and value for money have been achieved and whether there have been unintended impacts.

2.2.6 Recycling

To keep the organization on track and enable continuous improvement, the process should be iterative and should not be a once-in-a-lifetime event, as KPIs change over time.

The performance measurement process/steps presented in this article are intended to guide the implementation of the identified key performance indicators for the urban transport system in Nigeria, but can also be used by other organizations. Figure 2 shows the performance measurement framework, which presents the five steps of the performance measurement process (identify; monitor; evaluate; implement; evaluate) in a cyclic form.

i. Location of cultural, scientific and educational structures in space.
ii. The standard of living of the city's inhabitants.
iii. The use of free time (tourism).
iv. Initiatives of residents to save life and health.
v. The need to participate in social life.
vi. The operation of the public administration.
vii. National defense and internal security.

The need for transportation has three dimensions. The first is the quantitative dimension, which shows the number and duration of movements, then the spatial dimension, which shows the movement of residents. The last one is the time dimension, which shows the time of the trip, the date of the trip, and also the calendars (Zbigniew, 2020).). The need for transport can be concentrated in a limited area (travels in urbanized areas) or spread over an unlimited area (travels across borders and between distant urban centers) (Zbigniew, 2020). Among its characteristics stand out: mass use, diversity, cyclicity of appearance (transportation points) or imbalance in time and space. Transport changes should determine the number of trips made and the distance traveled according to a number of factors, which may include (Gługiewicz, 1991):

i. The population of a certain city and its spatial area - its growth leads to an increase in the number of possible movements of residents.
ii. The spatial layout of a given city - the more irregular (longitudinal) it is, the longer the average travel distance.
iii. The spatial and functional structure of a given city - the location of living spaces and places related to other functions (for example, workplaces or studies) in space determines the number of possible trips and their average duration,
iv. The demographic and social structure of the city's inhabitants, the level of their activity and income,
v. The amount of free time residents of a city have.

Transportation needs can be classified according to different criteria, such as the type of primary needs, where the educational, professional, social or cultural needs of the residents are distinguished. Needs can be either mandatory, i.e. must be fulfilled in terms of time and well-defined relationships (for example, travel to work / school), or non-binding, i.e. - to say that they do not have well-defined deadlines and/or relationships (cultural or leisure activities). A feature to distinguish needs

Transport can also be the spatial relationship in which they are located (determined by the direction of the trip, the names of the area units, departure and destination), as well as the planned travel time (Zbigniew, 2020). The classification of reasons for the mobility of people in cities is presented in Figure 1.

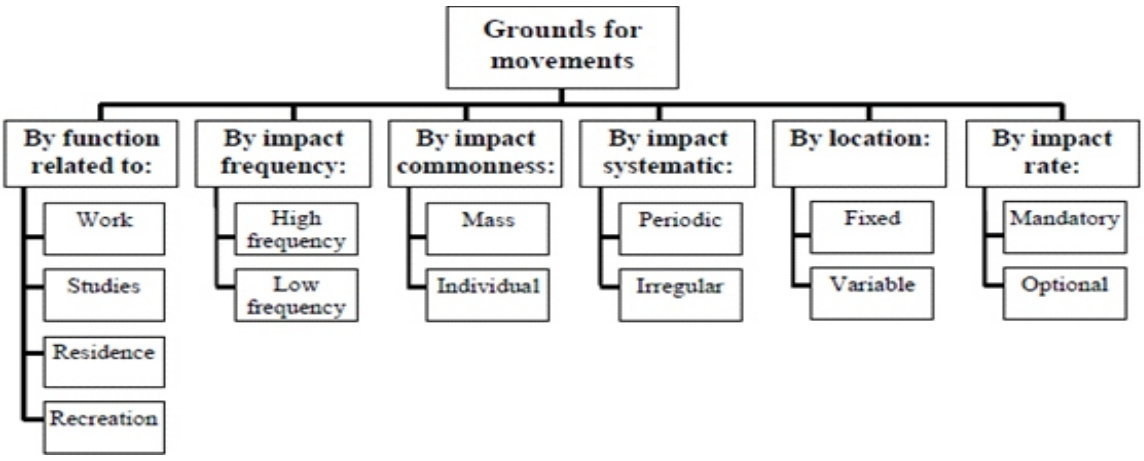

Figure 1 Classification of reasons for urban passenger mobility (Source: Onatere *et al.,* 2014)

Figure 2 Performance measurement process (*Source*: Onatere *et al.*, 2014)

The performance measurement stage that will be the focus of this paper is the Identification stage. The identification stage involves identifying and selecting the right Key performance indicators (KPIs) that are specific, measurable, achievable, relevant and timely to meet the needs of the urban transport system in Nigeria.

2.3 Factors Affecting Passengers' Satisfaction

According to the study of Cavana and Corbett (2007), reliability and convenience are factors that are considered important for customer satisfaction. In particular, reliable and convenient transportation increases customer satisfaction. In addition, reliability, travel time and comfort are considered to have a significant impact on customer satisfaction depending on the type of travel. For example, those who use the bus for work reasons consider time as the most important dimension, especially in buses. An interesting result is that the ticket price is not considered important and does not directly affect customer satisfaction (Zbigniew, 2020). In addition, Zbigniew (2020) showed that the frequency of service, cleanliness of vehicles and network coverage are the most important dimensions for passenger satisfaction, followed by waiting conditions and cleanliness, especially on the bus. Similarly, Thompson and Schofield (2007) linked passenger satisfaction with the destination. In particular, the ease of use of public transport is the most important factor that directly affects passenger satisfaction with the destination, while time and safety are not considered decisive for customer satisfaction with the destination.

The factors and their viable postulates for their determination are as itemize in table 1 below.

Table 1 factors affecting customer's satisfaction and their postulates (Zbigniew, 2020)

No	Postulate	Meaning of the postulate	Way to determine the fulfilment of the postulate
1.	Accessibility	Distance from the stop (spatial or time-based)	Maximum distances for effortless access by pedestrians
2.	Frequency	Departure intervals	Acceptable intervals between successive transport vehicles in certain relations and times
3.	Punctuality	Compliance with the timetable for departures	Deviation tolerance
4.	Safety	Personal safety of travelers at stops and in transport vehicles	Desirable feeling of safety
5.	Directness	Direct connections without stopovers	Desirable direct connections taking into account different time of day
6.	Reliability	Arrival at destination on time	Deviation tolerance
7.	Speed	Travelling time including stops on the route	Attractive or acceptable journey time in relation to different distances
8.	Cost	One-off or periodic fees	Desirable tariff system, ticket distribution and validation system, attractive level of one off and periodic fees under a specific tariff system
9.	Comfort	A set of elements determining the conditions of waiting at a stop and staying in a transport vehicle	Desirable waiting conditions for the bus, minimum standard of the stops, desired travelling conditions, minimum travelling standard
10.	Information	Way of communicating information about the transport offer and changes in the offer	Desirable method an d type of information access, minimum standard depending on the type of information accessed

2.4 Empirical Study on Passenger Satisfaction in Public Transport

Various surveys and studies regarding the satisfaction and dissatisfaction of passengers in the mobility system in general have been carried out in different fields and under different conditions. Hlabiso and Mugozhi (2016) studied the inaccessibility perception of user satisfaction in the Bindura-Harare line Omni-bus system. The study aims to develop a system to enhance the transportation provider through the degree of user satisfaction with the performance of the tasks performed by the provider. Research evidence has revealed that there is clearly a clear lack of user satisfaction. Dissatisfaction was linked to insufficient improvement of staff user relations skills, delayed response to user inquiries and dissatisfaction, among others. Additionally, Hlabiso and Mugozhi (2016) examined passenger satisfaction with the public bus transport system in the city of Lucknow in India. The study examined the caliber of job performance that affected passenger satisfaction and assessed the essential elements of service quality that contribute to passenger satisfaction. The French results show that many are dissatisfied with the operation of public bus transport services in the region, while five (5) factors have been identified as influencing passenger satisfaction. The survey suggested that better service provided by management leads to passenger satisfaction. In addition, Dean *et al.* (2017) studied the determinant of satisfaction and loyalty in general mobility. The study identified various attributes related to satisfaction, including the council's diligence in maintaining cleanliness, comfort, friendliness, supportive attitude, security, prompt and more frequent service. Another study by them to determine the capacity of the general mobility plan in the park is followed by the safety factor. French They discovered two main characteristics which are accessibility and reliability. It was also found that the physical factor of parks and bus stations was not a priority. Pin-Fenn *et al.*, (2014) studied service performance gauge and user satisfaction as projected by 1,235 users of high-speed rail service routes in Taiwan. Using structural equation modeling (SEM), the study further examined the correlation between the tested attributes and provided insights into user loyalty. The results revealed that 5 of the features were most accepted by users, including (in ascending order) cleanliness of the automobile, cleanliness of the operator, behavior of the manipulator, comfort obtained and operation efficient French Furthermore, the study showed that the task performance gauge had a positive effect on user satisfaction and engagement, while user satisfaction had a positive influence on engagement of the user. Also, Hlabiso and Mugozhi (2016) studied customer satisfaction with job performance gauge of the overall bus system in Abuja, Nigeria. In 10 bus stations and 300 customers, the data were analyzed using principal components and regression analysis. Evidence from the survey revealed that customers did not conflict with the performance of the task provided, while the top attribute that caused customer dissatisfaction was convenience, followed by availability, followed by other attributes. The relationship between passenger satisfaction and dissatisfaction regarding public transport in the city has been studied by different authors in several settings with different analytical measures, however, there is no literature on this topic in the city of Port Harcourt. This study attempts to fill the existing gap in the literature by analyzing the level of customer satisfaction with urban public transport in the city of Port Harcourt, taking into account the routes taken, customer preferences and the service provided.

2.5 Why Passengers Satisfaction Study?

It is increasingly a tool to improve the functionality of the work or the project. It was correctly stated that "you can't manage what you can't measure, what gets measured gets done and measurements influence behavior." Kaplan and Norton (1996) stated that companies must use measurement systems to survive and thrive in the information age competition. Lynch and Cross (1991) stated: "The purpose of performance measurement is to motivate behavior that leads to continuous improvement in customer satisfaction, flexibility and productivity." In Bredrup (1995), a number of specific performance measurement objectives were listed and it was concluded that a common denominator is improvement (Zbigniew *et al.,* 2020).

2.5.1 In the continuous improvement cycle, performance measurement plays an important role in:

i. Identify and monitor progress against organizational goals.
ii. Identify opportunities for improvement.
iii. Comparing performance to internal and external benchmarks (crow, 2012).

2.5.2 Advantages of performance measurement

i. By reducing the costs of failure.
ii. Reduced appraisal costs.
iii. Increase market share.
iv. More productive workforce (Crow, 2012).

2.6 Travelers' Walking Time

An important attribute of public and private transportation service is the time passenger/traveler has to wait prior to getting on vehicles (Ali, 2010). Based on this study Travelers' walking time for bus is defined as the time a passenger spent in a bus stop between the passengers arrival at a bus stop before with the intention of catching and the time the bus he/she eventually boarded depart from the bus stop. The average distance traveled by bus passengers worldwide varies from 300 to 5000 meters for dense urban areas and from 500 to 1000 meters for sparse urban areas (World Bank, 1987; Ali, 2010).

2.7 Travelers' waiting time

The distance traveled by a passenger from his point of origin or destination to the nearest bus stop is one of the useful elements that determines the quality of the public transport bus service in a given area urban. This is one of the determining factors in the travel time of bus users. Bus passenger walking distance can be defined as the distance traveled by a passenger on foot before reaching the nearest bus stop from his point of origin or destination to take the bus and make a trip. The extent to which bus passengers walk before reaching the nearest bus stops depends on the distance between adjacent transit bus lines and the distance between adjacent bus stops. If all the bus services in one place are scattered, the walking distance of the passengers should be short and if the bus services are concentrated in several routes, it means that the bus passengers have to walk a long road. The average waiting time by bus passengers worldwide varies from 300 to 5000 meters for dense urban areas and from 500 to 1000 meters for sparse urban areas (World Bank, 1987; Ali, 2010).

2.8 Level-of-Service (LOS) Concept/Satisfaction

Level-of-service concept or concept of quality of service indicators is difficult to defined as it depend on the people and urban regions, as different people and regions emphasizes more on some various component than the other people from another region. From passengers point of view LOS considered are as shown in figure 3. Level of satisfaction by the passengers across the bus stops considered were asses using 4 – likert scale from not satisfied to very satisfied. To know their level of satisfaction to the bus stops accordingly.

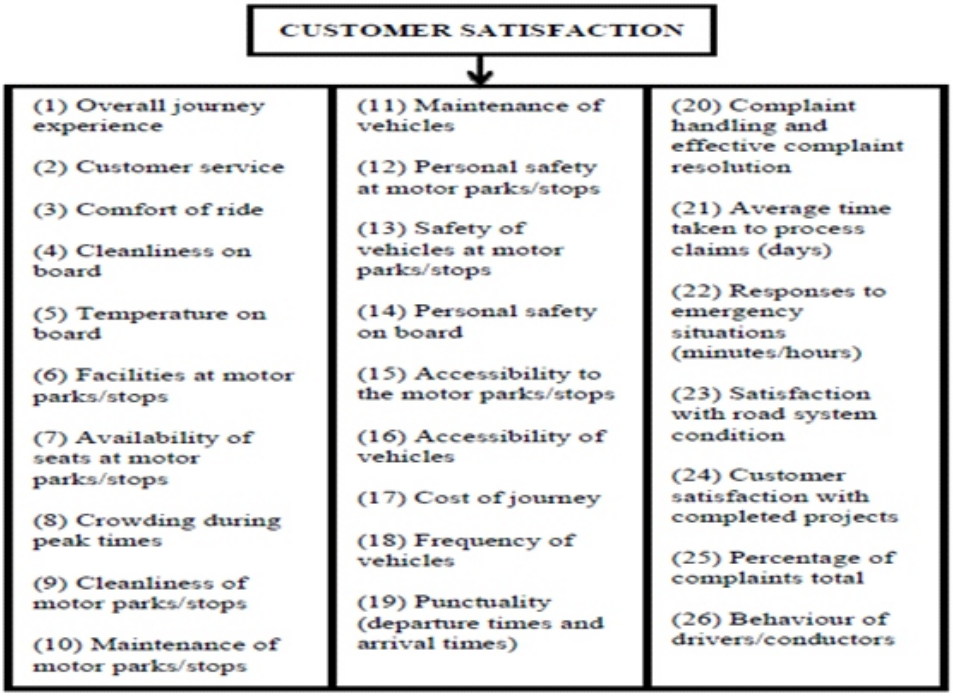

Figure 3 Customer satisfaction KPIs. (*source:* Onatere *et al.*, 2014)

3. Methodology

3.1 Study Area

Daura, a town and traditional emirate in Katsina State, Northern Nigeria, is located at latitude 13°2'11"N and longitude 8°19'4"E. Situated in a savanna zone, the town lies at the intersection of roads connecting Katsina town, Kano, Zango, and Zinder (Niger). As of the 2006 population census, Daura had a population of 224,884. The primary mode of transportation in Daura is land-based, including walking, bicycles, motorcycles, cars, and buses.

This study employs a research design aimed at examining passenger satisfaction with public and private inter-city transport services in Daura. The primary data source comprises information collected from passengers using a well-structured questionnaire.The questionnaire was designed to gather data on three key service indicators:

1. Waiting time: The duration passengers wait for buses at bus stops.
2. Walking time: The time taken by passengers to travel from their origin/destination points to the nearest bus stop.
3. Passenger satisfaction: The level of satisfaction with bus stop/station services, assessed using a 4-point Likert scale (Not Satisfied, Fairly Satisfied, Satisfied and Very Satisfied).

A total of 200 passengers were randomly surveyed across four sampling locations within Daura metropolis: Katsina State Transport Authority (KTSTA), Kofar Yamma, Kofar Kudu, and NATO bus stop. Fifty passengers were interviewed at each station. Passengers completed the questionnaire upon arriving at the bus stops, sharing their opinions on the subject matter.

The walking time for passengers at the four major bus stops was recorded at intervals of 5, 10, 15, 20, 25, and 30 minutes. Waiting times for buses were measured as 10, 15, 20, and 30 minutes respectively.

Data collected from the structured questionnaires were analyzed using simple descriptive statistics, including percentages and charts, to visualize the findings for each variable.

A central area within the city of Daura was identified based on the results, considering the shortest waiting times, shortest walking distances to the nearest bus stops, and the highest bus service frequency.

4. Findings and Discussions

4.1 Passenger Walking Time

The average time traveled by bus passengers worldwide varies from 300 to 500 meters for dense urban areas and from 500 to 1000 meters for sparse urban areas (World Bank, 1987; Ali, 2010). The results of the analysis of the average walking time of bus passengers in the four major bus stop considered are shown in Figure 4. Figure 4 illustrates the percentage (%) of passenger walking time to reach bus stops (i.e. KTSTA, Kofar Yamma, Kofar Kudu, and NATO) in the city of Daura.

From the results recorded it was observed that bus stop with the peak percentage of passengers walking time of 15.85 %, 18.29 %, 41.12 %, 32.93 % and 37.21 % in 5, 10, 15, 20, 25 and 30 minutes at Kofar Kudu, Kofar Kudu, Kofar Yamma, Kofar Kudu and KTSTA bus stop. While the minimum percentage of passengers walking time of 6.99 %, 10.41 %, 13.62 %, 7.32 % and 6.91 % in 5, 10, 15, 20, 25 and 30 minutes at KTSTA, NATO, KTSTA, Kofar Kudu and KTSTA bus stop were recorded respectively.

Kofar Yamma had the highest percentage of passengers with acceptable walking times (68.42%), followed by NATO (52.64%) and Kofar Kudu (51.21%). KTSTA had the lowest percentage within the acceptable range (32.37%), meaning most passengers experienced longer walking times. Conversely, KTSTA also had the highest percentage (67.63%) of passengers walking beyond the recommended limit, indicating that its services fall short of the World Bank's recommendations.

In general, when bus services are evenly distributed within a region or metropolitan area, passenger walking distances tend to be shorter, and vice versa (Ali, 2010). The global average walking distance for bus passengers is 300–500 meters (5–12 minutes) in dense urban areas and 500–1000 meters (12–20 minutes) in low-density urban areas (World Bank, 1987).

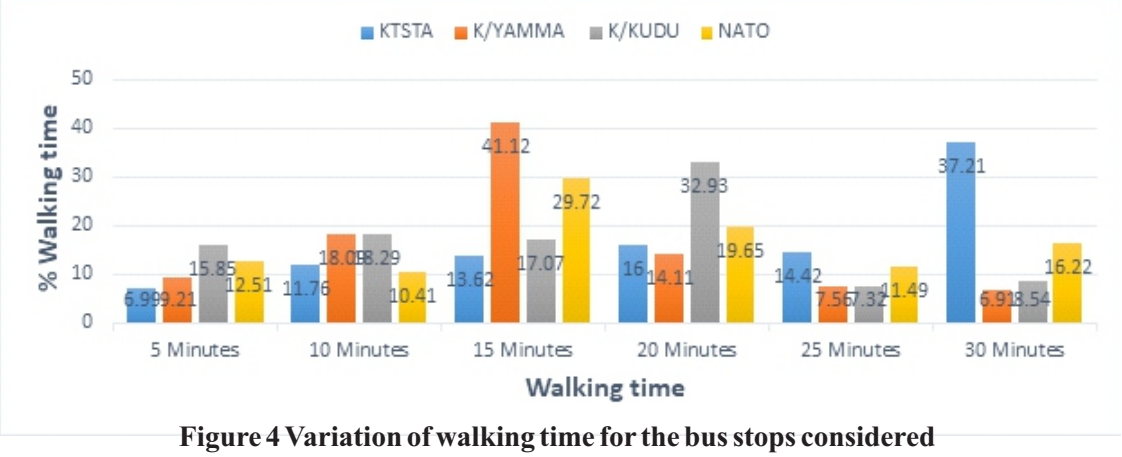

Figure 4 Variation of walking time for the bus stops considered

4.2 Travelers Waiting Times

A useful feature of a public transportation service is the specific amount of time a passenger must wait before boarding a vehicle. Based on this study, the waiting time is considered as the time the passengers spend at the bus stop between the time the passenger arrives at the bus stop with the intention of traveling in the bus and the moment the bus boards and leaves the bus stop.

Figure 4 illustrated the percentage (%) of passenger waiting time before boarding a vehicle in KTSTA, Kofar Yamma, Kofar Kudu, and NATO bus stop in the city of Daura.

From the results recorded it was observed that bus stop with the peak percentage of passengers waiting time of 13.41, 10.97, 5.35 and 7.34 % in 10 minutes at KTSTA, Kofar Yamma, Kofar Kudu and NATO bus stops with clear indication of high quality of bus stop services, while 60.16, 56.22, 46.33 and 47.82 % of passengers waiting times were recorded between 11 – 20 minutes at KTSTA, Kofar Yamma, Kofar Kudu and NATO bus stops. This ranges were considered as the maximum waiting time passengers are expected to wait prior to the buses arrival to the bus stops, thus indicated moderate quality of services of the bus stops. Likewise 26.43, 32.81, 48.32 and 44.84% of passengers waiting times were recorded in 30 minutes at KTSTA, Kofar Yamma, Kofar Kudu and NATO bus stops, thus indicated poor quality of bus services respectively (world bank, 1987).

Among the bus stops analyzed, KTSTA recorded the highest percentage of passengers experiencing minimal waiting times (13.41%), moderate waiting times (60.16%), and the lowest percentage of passengers enduring prolonged waits (26.43%), suggesting relatively better service quality compared to the other bus stops.
According to the World Bank (1987), waiting times of 5–10 minutes indicate high-quality bus stop services, while waiting times of 11–20 minutes are considered acceptable and reflect moderate service quality. Waiting times exceeding 20 minutes denote poor service quality.

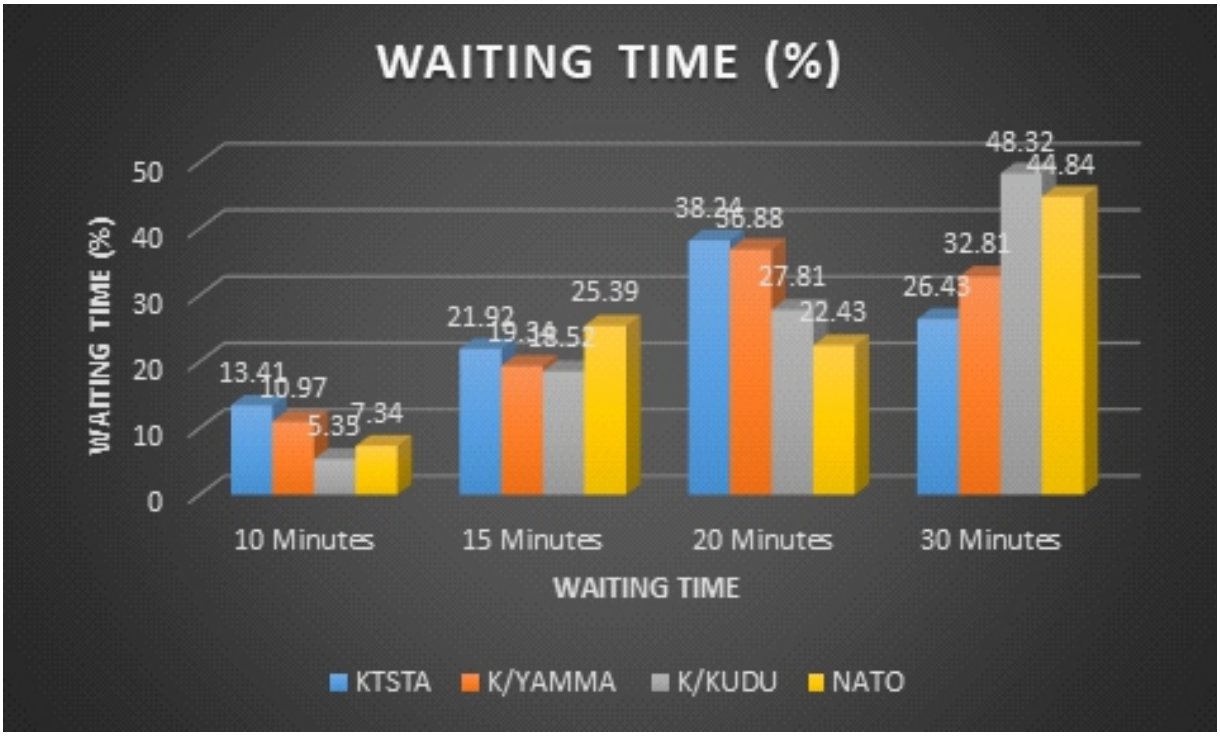

Figure 5 variation of waiting time at various bus stops considered

Factors that contribute to the long wait for the bus in these centers, as observed during fieldwork, include low energy bus service frequency, low bus line connectivity, few economic and social activities that take place in the stations and the low population. Therefore, few bus operators are willing to transport passengers to these centers.

4.3 The Core Area

The central area of Daura is identified as the region with the shortest waiting times for buses and the shortest walking distances to the nearest bus stops, as illustrated in Figures 4 and 5. KTSTA and Kofar Yamma bus stops recorded the highest percentages of passengers experiencing high-quality (13.41% and 10.97%) and moderate-quality (60.16% and 56.22%) services, corresponding to waiting times of 10 and 20 minutes, respectively. For walking times, Kofar Yamma and NATO bus stops stood out, with the majority of passengers enjoying short walking times of 5–10 minutes (68.42% and 52.64%, respectively). This central area represents the zone in Daura where bus commuters benefit from the best transportation services.

Several factors contribute to the central zone's existence, as identified during fieldwork. This area corresponds to Daura's Central Business District (CBD), the city's commercial hub. It is characterized by a high concentration of commercial offices, tertiary institutions, healthcare centers, and small retail stores. The Daura Local Government Secretariat and the city's main market are also located here. Additionally, the central area boasts the highest density of roads in the city.

The area's mixed use nature combining commercial and residential properties fosters a high level of economic and social activity. Consequently, this zone serves as a terminus for numerous bus trips throughout the day and a departure point for many transport journeys to other parts of the city.

4.5 Level of Satisfaction

Level of satisfaction of passengers across the bus stops considered were asses using 4 – likert scale from not satisfied to very satisfied are shown in figure 6a-d accordingly.

Based on the findings it was observed that KTSTA and Kofar Yamma bus stop recorded the highest percentage for travelers with very satisfied (34 % and 32 %), satisfied (41 % and 31%), fairly satisfied (28 % and 34 %) and not satisfied (11 % and 14 %) response as their level of satisfaction respectively. In the same vein Kofar Kudu and NATO bus stop recorded the highest percentage for travelers with not satisfied (40 % and 35 %), fairly satisfied (18 % and 20%), satisfied (13 % and 15 %) and very satisfied (10 % and 24 %) response as their level of satisfaction respectively (figure 6a-d).

These results indicate that passengers are more satisfied with the services at KTSTA and Kofar Yamma bus stops, which consistently provide better quality transportation services. Conversely, Kofar Kudu and NATO bus stops showed lower satisfaction levels, reflecting poor service quality at these locations.

Figure 6 % of LOS on a 4-point Likert scale for bus stops considered (a) not satisfied (b) fairly satisfied (c) satisfied (d) very satisfied

5. Conclusions

This study assessed passenger satisfaction with public and private inter-city transport services in Daura, focusing on walking times, waiting times, and overall satisfaction across four major bus stops: KTSTA, Kofar Yamma, Kofar Kudu, and NATO. Key findings and conclusions include the following:

1. Passenger Walking Time: Kofar Yamma and NATO bus stops had the highest percentage of passengers enjoying short walking times (5–10 minutes), with 68.42% and 52.64%, respectively. KTSTA bus stop had the lowest percentage of passengers within the acceptable walking time range (32.37%), with 67.63% of passengers walking longer distances, indicating a need for improved accessibility.
2. Passenger Waiting Time: KTSTA and Kofar Yamma bus stops recorded the highest percentages of passengers experiencing acceptable waiting times (≤20 minutes), at 73.57% and 67.19%, respectively, reflecting better service quality. Prolonged waiting times (>20 minutes) were most common at Kofar Kudu (48.32%) and NATO (44.84%) bus stops, signifying lower service quality at these stops.
3. Core Area: The central area of Daura, encompassing KTSTA and Kofar Yamma bus stops, emerged as the zone with the best transportation services, offering the shortest walking and waiting times. This area aligns with Daura's Central Business District (CBD), characterized by a dense road network, economic activities, and a high concentration of social infrastructure, making it a focal point for commuter traffic.
4. Passenger Satisfaction: KTSTA and Kofar Yamma bus stops recorded the highest levels of passenger satisfaction, with 34% and 32% of passengers reporting being "very satisfied," respectively. In contrast, Kofar Kudu and NATO bus stops had the lowest satisfaction levels, with 40% and 35% of passengers reporting being "not satisfied," highlighting insignificant service quality.

5.1 Recommendations

Based on these results, the following recommendations were established:

1. Improve accessibility and reduce walking times at KTSTA bus stop by establishing additional bus stops or routes closer to passenger origins.
2. Enhance bus frequency at Kofar Kudu and NATO bus stops to address prolonged waiting times and improve overall service quality.
3. Prioritize the development of transportation infrastructure in underserved areas to ensure equitable access to quality services.
4. Maintain and further develop the high service standards at KTSTA and Kofar Yamma to sustain passenger satisfaction in the central zone.
5. These findings underscore the importance of targeted improvements to enhance transportation efficiency and passenger satisfaction across Daura's bus stops.

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Assessing the Effectiveness of Accounting Courses in Developing Financial Reporting Skills among Accounting Graduates in Federal Polytechnic Daura, Katsina State, Nigeria

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Abstract

The demand for proficient financial reporting skills is increasing due to complexities in the financial landscape and the need for transparency. Despite this, many accounting graduates in Nigeria struggle with comprehensive financial reporting. This study assesses the effectiveness of accounting courses in developing these skills among graduates at Federal Polytechnic Daura. Utilizing a descriptive survey design, data were collected from 25 graduates through a structured questionnaire. Findings indicate that graduates have a moderate level of financial reporting skills (grand mean = 2.52), with significant gaps in practical application and software proficiency. The effectiveness of accounting courses received a positive assessment (grand mean = 3.0), highlighting relevant content and instructor support, but challenges remain regarding practical training opportunities (grand mean = 2.38). Additionally, alignment between the curriculum and employer expectations was found lacking, with mean scores below the benchmark. The study concludes that enhancing practical training and updating the curriculum are essential for improving graduates' readiness for the workforce. Recommendations include incorporating hands-on experiences, updating course materials to reflect industry standards, and providing ongoing professional development for instructors to better equip students for real-world financial reporting challenges.

Keywords: Accounting Courses, Financial Reporting Skills, Accounting Graduates

Introduction

The demand for proficient financial reporting skills has been on the rise due to increasing complexities in the financial landscape and the need for transparency in financial statement (Djuni et al., 2024). As organization strive to maintain credibility with stakeholders, the role of accounting education in preparing students for professional challenges become increasingly critical. Accounting course are designed to equip the students the necessary competencies in financial reporting, which is fundamental to ensuring accurate and reliable financial communication.

Numerous studies have recognized the gap between theoretical knowledge acquired during the formal education and practical skills required in the workplace. According to Waweru and Tallman (2020), many graduates exhibit a deficiency in applying accounting principles in real-world scenarios, which can negatively affect their employability and the overall effectiveness of accounting education programs. This highlighted the necessity of assessing courses not only in imparting theoretical knowledge but also in fostering the practical financial reporting skills.

Furthermore, advancement in technology and continuous evolution of financial regulations necessitate a recalibration of educational strategies. Arnold and Sutton (2021) emphasize that accounting curricula must adapt to incorporate emerging tools and standard, thereby enhancing students' readiness for the practical challenges they will face in their careers. This growing needs calls for comprehensive assessment of existing courses to identify areas of strength and opportunities for improvement.

Financial reporting is the communication of financial information to various users of accounting information to make an investment decision, obtaining credit facilities, and other financing decisions (Wild, Shaw, &Chiappetta, 2009). Furthermore, most financial reports in Nigeria are governed by regulations and standards from various recognized financial regulatory bodies such as the Securities Transaction Commission (SEC), the Financial Accounting Reporting Council of Nigeria (FRCN), Nigeria stock transaction to mention a few. Financial reports are formal and comprehensive statements describing financial activities of a business organization such as the manufacturing firm. It is also a statement that reports all relevant financial information, presented in a structured manner and in a form easy to understand for managerial use and for taking a prompt and informed decision relating to investment (IASB, 2007). The major relevance of the financial report to some users of financial statement is to provide information about the performance and changes in financial position of a firm. These users include managers, directors, employees, prospective investors, financial institutions, government 11 regulatory agencies, media, vendors and the general public. Financial reports are often prepared according to national standards, corporate governance, professional ethics, and code of ethics to avoid financial reporting fraud and scandals that might hinder effective decision-making process by management and other users of reports. The financial reports comprises of balance sheet (now called statement of changes in financial position), profit and loss statement (now called statement of comprehensive income), statement of equity changes (Statement of changes in equity, the company's equity), and cash flow statements (now referred to as statement of cash flow activities). On the other hand, Finance is always being disregarded in financial decision-making since it involves investment and financing in a short-term period. Furthermore, it also acts as a restrain in financial performance since it does not contribute to return on equity (Rafuse, 1996). A well-designed and implemented financial management is expected to contribute positively to the creation of a firm's value (Padachi, 2006). The dilemma in financial management is to achieve the desired trade-off between liquidity, solvency and profitability (Lazaridis, 2006).

The Federal polytechnics in the Northwest zone Nigeria offer accounting courses as part of their academic programs. These courses are designed to equipped students with necessary skills and knowledge to prepare financial report, manage financial resources, and make informed of business decisions. However, there is growing concern that these courses may not be effectively developing the financial reporting skills of students.

Financial reporting is a critical aspect of accounting, and it is essential that accounting graduates possess the necessary skills to prepare accurate and reliable financial report. Employers and shareholders rely on financial report and make informed decision and inaccurate or unreliable report can have serious consequences.

Despite the importance of financial reporting skills, research has shown that many accounting graduates in Nigeria lack the necessary skills to prepare financial report. This has led to concerns about the quality of accounting education in Nigeria and ability of accounting graduates to meet needs of employer

. Accounting is the fundamental function of the every organization. Any financial transaction should be included in the accounting. Any organization cannot know its profit/loss and financial position without proper accounting system. Book keeping is the basic activity of the accounting system. Generally accounting can be seen into three major parts such as financial accounting, management accounting and cost accounting. Here mostly every organization has the financial accounting which is more needed for every organization and whatever type of organization. Profitable and non-profitable organization must have the financial accounting for its financial transaction. The book keeping system is summarized and provided the data to prepare the financial statement of the firms. Book keeping is start with double entry of the financial transaction. Every financial transaction has the double entry which is the very basic of the accounting

Statement of the Problem

Accounting plays a crucial role in human and economic activities, necessitating the accurate recording, processing, and communication of financial information to produce reliable financial reports. These reports are essential for users to make informed decisions regarding their activities. In Nigeria, particularly at the Federal Polytechnic in the North-West region, accounting programs aim to equip students with the financial reporting skills vital for their future careers. However, despite the significance of these skills, research indicates that many accounting graduates in Nigeria struggle to prepare comprehensive financial reports. This raises concerns about the quality of accounting education and the preparedness of graduates to meet employer expectations.

There is an increasing apprehension that the accounting courses offered may not effectively cultivate the requisite financial reporting skills among students. This concern is underscored by several factors: a high failure rate in financial reporting courses, a limited number of graduates capable of preparing accurate financial statements, inadequate application of financial reporting standards and regulations, and feedback from employers highlighting deficiencies in graduates' financial reporting competencies.

In light of these issues, this research aims to assess the effectiveness of accounting courses in developing financial reporting skills among students at the Federal Polytechnic Daura Katsina State, Nigeria.

Objective of the Study

The major objective of this study is to determine Assessing the Effectiveness of Accounting Courses in Developing Financial Reporting Skills in Federal Polytechnic Daura, Katina State Nigeria.

1. Evaluate the current level of financial reporting skills among accounting graduates in Federal Polytechnic Daura, Katsina state, Nigeria.
2. Assess the effectiveness of accounting courses in developing financial reporting skills among accounting graduates in Federal Polytechnic Daura, Katsina state, Nigeria.
3. Identify the gaps and challenges in the current accounting curriculum in developing financial reporting skills in federal polytechnic Daura, Katsina state, Nigeria.
4. Determine the extent to which accounting courses in federal Polytechnics align with financial reporting skills requirement of employer.
5. Examine the role of practical training and hands-on experience in developing financial reporting skills among the accounting graduates in federal polytechnic Daura, Katsina state, Nigeria.

Research Questions

1. What is the current level of financial reporting skills among accounting graduates of federal polytechnic Daura, Katsina state, Nigeria?
2. What are the effectiveness of accounting courses in developing financial reporting skills among accounting graduates in federal polytechnic Daura, Katsina state, Nigeria?
3. What are the gaps and challenges in the current accounting curriculum in developing financial reporting skills in federal polytechnic Daura, Katsina state, Nigeria?
4. Which accounting courses in federal Polytechnics align with financial reporting skills requirement of employer?
5. What are the role of practical training and hands-on experience in developing financial reporting skills among the accounting graduates in federal polytechnic Daura, Katsina state, Nigeria?

Methodology

The study adopted the descriptive survey design to source for data using structured questionnaire which was organized by the researchers to fetch the information from the target population of the study. The target population of the study is made up twenty five (25) Accounting graduates in federal polytechnic Daura Katsina state, Nigeria in 2023/2024 academic session. The study employed a purposive sampling method to select participants from the

graduating class of the accounting department. The total sample size consisted of 25 individuals, who were specifically chosen based on predetermined criteria relevant to the research objectives. This approach ensured that the selected sample was representative of the population under investigation, allowing for more meaningful insights and conclusions to be drawn from the study. This questionnaire was designed for data collection from respondent's opinion. The respondents opinions were rated inform of strongly agree (4) agree (3) disagree (2) and strongly disagree (1) as an instrument for data collection of the study. The instrument of data collection of the study was validated by three expect and the reliability of 0.75 was obtained. The test re-test was also used. The researcher administered the questionnaires to the respondents, all the twenty five (25) questionnaires were returned. The data collected for this were coded into statistical package of social sciences (SPSS), 25. The package was used to calculate mean and standard deviation. The research questions were based on the 2.5 were considered as agree while 2.49-below were considered as disagree

Results

Research Question One: *What are the current level of financial reporting skills among accounting graduates in federal polytechnic Daura, Katsina State, Nigeria?*

Table 1: Mean and Standard Deviation on the current level of financial reporting Skills among the Accounting graduates in Federal Polytechnic Daura, Katsina

S/N	ITEMS	N	MEAN	SD	REMARK
1	The students can accurately interpret the key components of financial statement (e.g balance sheet, cash flow statement)	25	3.28	1.22	**Agreed**
2	I am confident in applying basic accounting principles and concept in practical scenarios.	25	3.08	1.21	**Agreed**
3	I have adequate skills in using accounting software (e.g QuickBooks, Excel) for financial reporting task.	25	2.48	1.219	**Disagreed**
4	I feel comfortable preparing financial reports based on provided financial data.	25	1.76	1.238	**Disagreed**
5	I can effectively analyze financial data to assess the performance and health of business.	25	2.22	1.234	**Agreed**
6	I possess a good understanding of relevant financial reporting standards (e.g IFRS, GAAP) and their applications.	25	2.32	1.86	**Dis agreed**

Source: Field study 2024

The output of the descriptive statistics presented in Table 1 revealed that all items of the variable of the influences on the level of financial reporting skills among the students in federal polytechnic Daura**,** Katsina state Nigeria were having a mean score of equal 2.5. The mean scores of the level of financial reporting skills among the students, Nigeria ranging from 1.76 to 3.28. The grand mean of level of financial reporting skills among the students, in federal polytechnic Daura, Katsina state, Nigeria is 2.52. Which is above the benchmark of revised four point Likert scale. The results indicate that the respondents agreed with statements level of financial reporting skills among the students.

Research Question Two: *What are the effectiveness of accounting courses in developing financial reporting skills in students in federal polytechnic Daura, Katsina State, Nigeria?*

Table 2: Mean and Standard Deviation on the Effectiveness of Accounting Courses In Developing Financial Reporting Skills in Students in Federal Polytechnics in the North-west zone Nigeria

S/N	ITEMS	N	MEAN	SD	REMARK
1	The accounting course content is directly relevant to the principles of financial reporting	25	3.28	1.22	**Agreed**
2	The courses includes practical exercise that effectively enhance the financial reporting skills.	25	2.78	1.21	**Agreed**
3	The instructors clearly explain financial reporting concepts and provide adequate support for students.	25	3.20	1.219	**Agreed**
4	The resources provided in the course are sufficient for mastering financial report skills.	25	2.76	1.238	**Agreed**
5	The assessment methods used in the accounting courses fairly evaluate my understanding of financial reporting.	25	3.22	1.234	**Agreed**
6	The financial reporting skills I have learned in this courses will positively impact my readiness for a career in accounting.	25	1.84	1.86	**Dis agreed**

SOURCE: Field Study, 2024.

The output of the descriptive statistics presented in Table 2 revealed that all items of the variable of the influences the effectiveness of accounting courses in developing financial reporting skills in students**,** in federal polytechnic Daura Katsina, Nigeria were having a mean score of above 3.0. The mean scores of the choice of career among male and female secretarial students, Nigeria ranging from 1.76 to 3.82. The grand mean of effectiveness of accounting courses in developing financial reporting skills among accounting graduates**,** in federal polytechnic Daura Katsina, Nigeria is 3.0 which is above the benchmark of revised four point Likert scale. The results indicate that the respondents agreed with statements effectiveness of accounting courses in developing financial

reporting skills among accounting graduates in federal polytechnic Daura Katsina, Nigeria.

Research Question Three: *What are the gaps and challenges in the current accounting curriculum in developing financial reporting skills in federal polytechnic Daura, Katsina State, Nigeria?*

Table 3: Mean and Standard Deviation on gaps and Challenges in the Current Accounting Curriculum in Developing Financial Reporting Skills in Federal Polytechnic in the North-west zone Nige*ria*.

S/N	ITEMS	N	MEAN	SD	REMARK
1	The current accounting curriculum adequately covers the theoretical concept of financial reporting.	25	3.38	1.22	**Agreed**
2	Practical application of financial reporting are effectively integrated into accounting curriculum.	25	3.10	1.21	**Agreed**
3	The curriculum includes sufficient resources (books, software) for learning financial reporting skills.	25	3.18	1.219	**Agreed**
4	Students received enough hand -on experience with financial reporting through internship.	25	1.76	1.238	**Disagreed**
5	The curriculum is up-to-date with the latest financial reporting standard and regulation.	25	3.22	1.234	**Agreed**
6	Instructors/Lecturers are adequately prepared to teach financial reporting effectively within the curriculum.	25	2.32	1.86	**Dis agreed**

Source: Field Study, 2024

The output of the descriptive statistics presented in Table 3 revealed that all items of the variable of the influences on the gaps and challenges in the current accounting curriculum in developing financial reporting skills in federal polytechnic in the North-west zone Nigeria were having a mean score of below 3.0. The mean scores of the gaps and challenges in the current accounting curriculum in developing financial reporting skills in federal polytechnic in the North-west zone Nigeria ranging from 1.76 to 3.82. The grand mean of gaps and challenges in the current accounting curriculum in developing financial reporting skills in federal polytechnic in the North-west zone Nigeria is 3.0 which is above the benchmark of revised four point Likert scale. The results indicate that the respondents agreed with statements gaps and challenges in the current accounting curriculum in developing financial reporting skills in federal polytechnic in the North-west zone Nigeria.

Research Question Four: *How accounting courses in federal Polytechnics align with financial reporting skills requirement of employer?*

Table 4: Mean and Standard Deviation on Accounting Courses in Federal Polytechnics Align with Financial Reporting Skills Requirement of Employer

S/N	ITEMS	N	MEAN	SD	REMARK
1	The Accounting courses took in polytechnic adequately prepared me to prepare financial statement that meet the requirement of employer	25	2.40	1.22	**Disagreed**
2	The students taught the practical applications of financial reporting concept in Accounting courses in Polytechnics.	25	3.08	1.21	**Agreed**
3	The financial reporting skills learned in the school are sufficient to meet the requirement of the employer.	25	3.0	1.219	**Agreed**
4	The adequate opportunities to practice financial reporting skills through internship or SIWES in the Accounting courses in the polytechnic.	25	1.76	1.238	**Disagreed**
5	The accounting courses taught in polytechnic provide me with skills to analyze financial data and make informed business decision.	25	3.63	1.234	**Agreed**
6	The accounting courses offered in polytechnic prepared the students to communicate financial information effectively to non -financial stake holders.	25	2.42	1.86	**Dis agreed**

The output of the descriptive statistics presented in Table 4 revealed that all items of the variable of the influences on the accounting courses in federal Polytechnics align with financial reporting skills requirement of employer were having a mean score of below 3.0. The mean scores of the accounting courses in federal Polytechnics align with financial reporting skills requirement of employer ranging from 1.76 to 3.63. The grand mean of accounting courses in federal Polytechnics align with financial reporting skills requirement of employer is 3.0 which is above the benchmark of revised four point Likert scale. The results indicate that the respondents agreed with statements accounting courses in federal Polytechnics align with financial reporting skills requirement of employer.

Research Question Five: *What are the role of practical training and hands-on experience in developing financial reporting skills in students in federal polytechnic Daura, Katsina State, Nigeria?*

Table 5: Mean and Standard Deviation on the Role of Practical Training and Hands-On Experience in Developing Financial Reporting Skills in Students in Federal Polytechnic in the North-west zone Nigeria

S/N	ITEMS	N	MEAN	SD	REMARK
1	Practical training and hands -on experience are essential in developing the financial reporting skills.	25	3.38	1.22	**Agreed**
2	There is sufficient opportunities for practical training and hands -on experience in the financial reporting the course work.	25	2.21	1.21	**Disagreed**
3	Practical training and hand-on experience have helped to better understand financial reporting concept and their application.	25	3.08	1.219	**Agreed**
4	There is confident and ability to prepare financial report after completing practical training and hands-on experience.	25	1.76	1.238	**Disagreed**
5	Practical training and hands-on experience have prepare me to handle real -world financial reporting challenges.	25	2.65	1.234	**Agreed**
6	Practical training and hand -on experience are more important than theoretical knowledge in developing financial reporting skills.	25	1.22	1.86	**Dis agreed**

Source: Field Study, 2024.

The output of the descriptive statistics presented in Table 5 revealed that all items of the variable of the influences on the role of practical training and hands-on experience in developing financial reporting skills in students in federal polytechnic in the North-west zone Nigeria were having a mean score of below 3.0. The mean scores of the role of practical training and hands-on experience in developing financial reporting skills in students in federal polytechnic in the North-west zone Nigeria ranging from 1.76 to 3.38. The grand mean of the role of practical training and hands-on experience in developing financial reporting skills in students in federal polytechnic in the North-west zone Nigeria is 2.38 which is above the benchmark of revised four point Likert scale. The results indicate that the respondents agreed with statements the role of practical training and hands-on experience in developing financial reporting skills in students in federal polytechnic in the North-west zone Nigeria.

Discussion of Findings

The findings of research question 1 indicate that the respondents agreed with statements, the grand mean of level of financial reporting skills among the students, in federal polytechnic Daura, Katsina state, Nigeria is 2.52 which is above the benchmark of revised four point Likert scale. The results

indicate that the respondents agreed with statements level of financial reporting skills among the students. This is in line with (Lazaridis, 2006) opined that current account level for the students have a very effective and significantly for reporting skills.

The findings of research question indicate that the respondents agree with statements. The grand mean of effectiveness of accounting courses in developing financial reporting skills in students**,** in federal polytechnic Daura Katsina, Nigeria is 3.0 which is above the b enchmark of revised four point Likert scale. The results indicate that the respondents agreed with statements effectiveness of accounting courses in developing financial reporting skills in students**,** in federal polytechnic Daura Katsina, Nigeria. This in line with (IASB, 2007). Suggested that accounting courses the major relevance of the financial report to some users of financial statement is to provide information about the performance and changes in financial position of a firm.

The findings of research question indicate that the respondents disagreed with statements. The grand mean of gaps and challenges in the current accounting curriculum in developing financial reporting skills in federal polytechnic in the North-west zone Nigeria is 3.0 which is above the benchmark of revised four point Likert scale. The results indicate that the respondents agreed with statements gaps and challenges in the current accounting curriculum in developing financial reporting skills in federal polytechnic Daura, Katsina state Nigeria. This in line with Arnold and Sutton (2021) emphasize that accounting curricula must adapt to incorporate emerging tools and standard, thereby enhancing students' readiness for the practical challenges they will face in their careers.

The findings of research question indicate that the respondents disagreed with statements. The grand mean of accounting courses in federal Polytechnics align with financial reporting skills requirement of employer is 3.0 which is above the benchmark of revised four point Likert scale. The results indicate that the respondents agreed with statements accounting courses in federal Polytechnics Daura, Katina state, Nigeria, align with financial reporting skills requirement of employer. This is in line with Arnold and Sutton (2021) emphasize that accounting curricula must adapt to incorporate emerging tools and standard, thereby enhancing students' readiness for the practical challenges they will face in their careers.

The findings of research question five (5) indicate that the respondents disagreed with statements. The grand mean of the role of practical training and hands-on experience in developing financial

reporting skills in students in federal polytechnic in the North-west zone Nigeria is 2.38 which is above the benchmark of revised four point Likert scale. The results indicate that the respondents agreed with statements the role of practical training and hands-on experience in developing financial reporting skills in students in federal polytechnic Daura, Katsina State, Nigeria. This in line with Waweru and Tallman (2020), who opined that many graduates exhibit a deficiency in applying accounting principles in real-world scenarios, which can negatively affect their employability and the overall effectiveness of accounting education programs.

Conclusion

Based on the findings of the study the researcher concluded that assessing the Effectiveness of Accounting Courses in Developing Financial Reporting Skills in Federal Polytechnic in North-west zone, Nigeria has positive impact in developing financial reporting skills. Accounting courses helped improve quality and productivity, and encourage the use of innovative and creative methods for solving problems in the reporting skills in offices.

Recommendation

Based on the findings of the study the followings recommendations were made:

1. Incorporating more practical training and hands-on experience in financial reporting, such as case studies, project and internships
2. Updating the curriculum to reflect current trends and technologies in financial reporting.
3. Providing students with access to relevant resources, such as financial reporting software and database.
4. Emphasizing practical skills in assessment method, such as presentation of group project and case study.
5. Providing ongoing training support for accounting lecturers to enhance their teaching skills and industries knowledge.

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Boosting Nigeria's Agricultural Productivity with Biofertilizer Production: A Technical and Vocational Pathway to Sustainable Industrial Growth

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Abstract

Nigeria's agricultural sector, a vital contributor to industrial development and employment, faces challenges such as declining soil fertility, environmental degradation, and an overreliance on chemical fertilizers, resulting in reduced crop yields and unsustainable practices. This research investigates the production and application of liquid biofertilizers derived from locally sourced organic materials—banana peels, eggshells, and orange peels to address these challenges. The study employed a detailed methodology, beginning with the collection and preparation of raw materials. The materials were dried at 60°C, ground to 100 µm, and blended in optimal proportions using a Central Composite Design (CCD). Sterilization at 100°C for 10 minutes was followed by inoculation with Pseudomonas and Bacillus strains, and fermentation was conducted at 37°C for 744 hours under controlled pH conditions (6.0–7.5). The optimal formulation comprised 47.62 g of banana peel, 26.68 g of orange peel, and 8.81 g of eggshell, resulting in a biofertilizer with 1.30% nitrogen, 3.45% phosphorus, and 1.52% potassium. Proximate analysis demonstrated the nutrient potential of these materials, with significant phosphorus, potassium, and nitrogen contributions. The biofertilizer was tested across sandy, loamy, and clay soils, showing improved pH levels, enhanced nutrient profiles, and increased microbial activity, thereby enhancing soil fertility and crop productivity. In addition, a vocational training program was implemented to disseminate the production process. A total of 120 participants, including smallholder farmers, entrepreneurs, and vocational students, were trained across three regions in Nigeria. Post-training evaluations indicated an 85% increase in knowledge acquisition and a 92% success rate in independent production. While the results show the promise of biofertilizers in improving soil health and supporting sustainable farming practices, challenges such as inconsistent nutrient release and limited scalability remain. This study underscores the need for technical and vocational education, government support, and infrastructure investment to scale biofertilizer production and adoption. By integrating this sustainable solution into agricultural practices, Nigeria can enhance productivity, reduce dependence on chemical imports, and stimulate industrial growth, paving the way for a resilient agricultural future.

***Keywords**: Carrier materials, Organic amendments, mechanism, fermentation, biofertilizer, soil*

1.0 Introduction

The industrial development of Nigeria is intricately connected to its agricultural sector, which provides raw materials for various industries and employs millions. Agriculture serves as the backbone of the economy, with its success directly influencing national food security and industrial growth. However, Nigeria's agricultural productivity faces significant challenges, including deteriorating soil fertility and increasing environmental degradation, which have hampered crop yields and affected sustainable farming practices (Aguilar-Paredes *et al.,* 2020). In response to these challenges, innovative and sustainable solutions are necessary to increase marginal productivity and enhance the nation's industrial base. Biofertilizers, which are organic farm materials that supply essential nutrients like nitrogen by enhancing the soil environment with life forms, present a promising solution (Ljung, 2013). Unlike chemical fertilizers that may contribute to long-term soil depletion, biofertilizers promote healthier soil ecosystems by fostering microbial activity. These organic inputs not only replenish nutrients but also restore degraded lands, contributing to sustainable agricultural production and long-term industrial development. Technical and vocational education plays a crucial role in scaling biofertilizer production processes to ensure their accessibility to local farmers and industries at a lower cost (Bhardwaj *et al.,* 2014). By providing the necessary skills for large-scale production and application, vocational training can stimulate agro-based industries, create employment, and improve the nation's food security (Smith *et al.,* 2004). In this context, the workforce's exposure to advanced technical training is central to fostering a bio-based industrial economy, which aligns with Nigeria's broader goals for clean, eco-friendly industrial development (Stewart, 2012).

Despite their potential, the adoption of biofertilizers in Nigeria remains low. Key barriers include limited farmer awareness, insufficient local research on biofertilizing materials, and inadequate expertise transfer (Glick, 2013; Mehnaz, 2014; Raynaud and Naoise, 2014). Although research institutions have explored indigenous biofertilizer sources like banana peels, eggshells, and other agricultural residues, these efforts have not yet achieved scalable production or widespread utilization (Kurepin *et al.,* 2014; Pieterse *et al.,* 2014; Rajkumar *et al.,* 2012). Biofertilizer production is not just an agricultural innovation but also an industrial opportunity. Local production can reduce Nigeria's reliance on imported chemical fertilizers, stimulate small and medium-sized enterprises (SMEs), and create employment along the agricultural value chain (Mahanty *et al.,* 2016; Malusa and Nikolay, 2014). Collaborations between technical institutions and industries can facilitate quality-controlled biofertilizer production for export and large-scale farming (Ahemad *et al.,* 2012; Maksimov *et al.,* 2011b; Nosheen *et al.,* 2021). However, challenges in the biofertilizer sector include inconsistent nutrient release, suboptimal microbial activity, and limited scalability of production systems (Aktar *et al.,* 2009; Gouda *et al.,* 2017; Spaepen and Jozef, 2011). Addressing these issues through training, partnerships, and innovation offers significant opportunities for sustainable agricultural and industrial growth (Egamberdieva *et al.,* 2015; Liu *et al.,* 2016; Suzaki *et al.,* 2015). Integrating biofertilizer production into Nigeria's agricultural practices provides a pathway to enhanced productivity and sustainable industrial development. By prioritizing technical and vocational education, Nigeria can equip its workforce to drive biofertilizer adoption, reduce environmental degradation, and foster green industries. This will improve agricultural productivity

and advance the country's economic diversification goals, laying the foundation for a resilient and sustainable future. This work aims to emphasize biofertilizers' role in addressing Nigeria's agricultural and industrial challenges, showcasing how sustainable practices can transform both sectors and align with global environmental and economic objectives.

3.1 Methodology

3.1.1 Research Design

The research adopts a mixed-methods approach, combining both quantitative and qualitative data to assess the potential of biofertilizer production and its implications for agricultural productivity and industrial development in Nigeria. The study is structured into three key phases experimental biofertilizer production, technical and vocational training, and evaluation of impact on agricultural productivity and industrial scalability.

3.2 Phase 1 Biofertilizer Production

This phase focuses on the production of biofertilizers using locally sourced organic materials such as banana peels, eggshells, and orange peels, combined with microbial inoculants. The materials will be processed following a specific production protocol to ensure nutrient-rich biofertilizer that meets ISO standards (ISO 201452017 and ISO 201832019).

3.2.1 Materials and Equipment

The biofertilizer production process utilizes organic waste materials, including banana peels, orange peels, and eggshells, as the primary substrates. To enhance nutrient availability, microbial inoculants such as nitrogen-fixing bacteria (e.g., Rhizobium), phosphorus-solubilizing bacteria (e.g., Pseudomonas), and potassium-solubilizing bacteria are introduced into the system. Fermentation occurs in fermenters with a capacity of 10 to 15 liters, equipped with aeration systems to ensure optimal conditions for microbial activity. Key laboratory equipment used in this process includes a pH meter for monitoring acidity levels, an incubator for maintaining controlled temperatures, a weighing balance for accurate measurement of materials, an autoclave for sterilizing tools and media, and a microbial count apparatus for assessing bacterial growth.

3.2.2 Experimental Procedure

Organic materials such as banana peels, eggshells, and orange peels will be sourced locally from agricultural waste or food processing centers. These materials are selected for their high nutrient content and availability, ensuring the biofertilizer production process remains sustainable and cost-effective by utilizing readily available waste products. After collection, the organic materials will be cleaned thoroughly to remove impurities, dried to reduce moisture content and ground into a fine powder. This preparation increases the surface area, enhancing microbial activity efficiency during fermentation. Beneficial bacterial strains, including nitrogen-fixing, phosphorus-solubilizing, and potassium-mobilizing microorganisms, will be cultivated in a lab and introduced to the organic material mixture. These strains are specifically chosen to improve nutrient release and boost the biofertilizer's efficacy in promoting plant growth.

The prepared blend of organic materials and microbial inoculants will be transferred into fermenters under controlled conditions, maintaining a temperature of approximately 30°C and a pH range of 6.5 to 7.5. Fermentation will last for 744 hours, with occasional stirring to ensure uniform microbial activity and aeration. Throughout this process, key parameters such as pH, temperature, microbial count, and nutrient content (nitrogen, phosphorus, and potassium levels) will be monitored at regular five-day intervals. This monitoring allows for any necessary adjustments to optimize fermentation conditions. At the end of the 744-hour fermentation period, the final biofertilizer product will undergo comprehensive analysis. This includes evaluating its nitrogen, phosphorus, and potassium content, microbial viability (colony-forming units per gram), and the presence of other essential nutrients to ensure it meets quality standards. The final quality of the biofertilizer will be assessed based on ISO standards. Key parameters evaluated include nutrient composition, particularly nitrogen (N), phosphorus (P), and potassium (K) content, ensuring the fertilizer meets the required nutrient levels. The microbial viability and concentration will be confirmed to guarantee that beneficial microorganisms are present in adequate amounts. pH stability will be checked to ensure compatibility with plant growth, and the absence of harmful pathogens will be verified to ensure the biofertilizer's safety and effectiveness for agricultural use.

3.3 To Assess the Impact of Biofertilizers on Soil Health, Including Nutrient Retention (NPK Levels), Ph Stability, And Microbial Activity,

3.3.1 Determination of Soil pH

Standard procedure was employed to determine the pH of the soil samples. The material for this procedure includes calibrated pH meter, pH buffer solutions with known values (pH 4, 7, and 10) untreated soil and treated soil sample and distilled water. First the soil samples were crushed to a size of 2mm and sieved in order to remove any large particles. 10g and 20ml of distilled water was introduce into beaker and was staired gradually. The sample is allowed stay for 30 minutes so that the sand can settle and the pH will be stable. The pH meter is then calibrated using the buffer solution. the pH electrode is then introduced into the soil-water mixture, and the mixture is stirred gently to ensure a homogeneous suspension. The pH reading is recorded when the meter stabilizes, this indicate that the measurement has reached equilibrium. The reference for this work is the Soil Quality Test Kit Guide published by the United States Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS). This procedure ensures standard method of analysing various soil properties, ensuring the consistency and validity of the results obtained.

3.3.2 Determination of Micro Organism Content (pseudomonas and bacillus)

This method is satisfied base on literature to accurately determine the microbial content in soil samples. First the soil samples were crushed to a size of 2mm and sieved in order to remove any large particles. 10g of the sample is placed into a sterile Erlenmeyer flask which is shaken vigorously for 30 minutes. Distilled water of about 90mL is introduced in the flask which create a soil water suspension, this mixture is then shaken vigorously for about 30 minutes to aid the extraction process. The mixture is further diluted to obtain a range of concentrations suitable for microbial analysis.

serial dilutions are involved in this procedure, where 1mL of the soil suspension is introduced into a sterile test tube containing 9mL of sterile water, this creates a 1:10 dilution. Base on the expected microbial load This procedure has to be repeated to create further dilutions, such as 1:100 and 1:1000. Next, aliquots from the different dilution are plated onto specific nutrient agar media that supports the growth of the target microorganisms. The different plates a then incubated at an appropriate temperature of 37 ^{o}C 18 to 24 hours, this allows the microorganisms to grow and form visible colonies. After the 18 to 24 hours incubation period, the plates are checked, and the number of colonies is counted using a colony counter. To calculate the microorganism content in the soil, the following equation is employed:

3.3.3 Determination of P_2O_5 in Biofertilizer by Yellow Method (Ammonium Molybdate Method) using Wet Digestion

In determining the P_2O_5 content in biofertilizer using the yellow method which is also known as the Ammonium Molybdate Method which adopt the wet digestion technique. In order to achieve these objective few materials are needed this include a biofertilizer sample, nitric acid (HNO_3), perchloric acid ($HClO_4$), ammonium molybdate solution, distilled water, and a spectrophotometer which is employ in measuring the wave length. The process involve introduction of 1g of biofertilizer, 10 ml nitric acid and 5 ml perchloric acid of sample into the conical flask and heated at a temperature of 200^{o}c for a time interval of 30 minutes the heating process is very important because it determine the digestion of the sample. In this process phosphorus is release in to the solution. After the initial heating of the mixture. 20 ml of distilled water is added which is Shaked carefully to ensure proper mixing. In order to achieve a proper colorimetric analysis, The solution is filtered with the aid of a filter paper into a conical beaker to remove any insoluble particles that may interfere with the process. The final step involves the addition of 10mL of ammonium molybdate to the filtrate, and the solution is further s stirred gently this will enable the formation of a yellow-coloured complex between the phosphorus and the molybdate ions. at a wavelength of 430nm we further measure the absorbance of the resulting yellow solution making use of a spectrophotometer. This is a very important step because measure the concentration of phosphorus in the biofertilizer sample. Base on the previously established calibration factor earlier, the phosphorus content in the biofertilizer sample can be calculated

$$P_2O_5 = \left(\frac{\text{Absorbance} \times \text{Calibration Factor}}{\text{Sample Weight}}\right) \quad (3.1)$$

Yellow Method (Ammonium Molybdate Method) is the methodology involved in this procedure which is based on the using wet digestion, which is widely recognized for its accuracy and reliability in determining phosphorus concentrations. The reference adopted for this procedure is the Association of Official Analytical Chemists (AOAC), which provides standardized methods for analysing various substances, ensuring the reliability and validity of the results obtained.

3.3.4 Determination of K_2O in Biofertilizer by Flame Emission Spectrometry (FES) using Wet Digestion

In determining the k_2o content in biofertilizer using the Flame Emission Spectrometry (FES) method which is also known as the wet digestion technique. In order to achieve these objective few materials are needed this include a biofertilizer sample, nitric acid (HNO_3), perchloric acid ($HClO_4$), ammonium molybdate solution, distilled water, and a spectrophotometer which is employ in measuring the wave length. The process involve introduction of 1g of biofertilizer, 10 ml nitric acid and 5 ml perchloric acid of sample into the conical flask and heated at a temperature of 200^{o}c for a time interval of 30 minutes the heating process is very important because it determine the digestion of the sample. In this process phosphorus is release in to the solution. After the initial heating of the mixture. 20 ml of distilled water is added which is Shaked carefully to ensure proper mixing. In order to achieve a proper colorimetric analysis, The solution is filtered with the aid of a filter paper into a conical beaker to remove any insoluble particles that may interfere with the process. The final step involves introducing the sample into the flame emission spectrometer, where it is atomized and excited by the flame. In this procedure potassium atoms will emit light at a specific wavelength (766.5nm) which is measured by the spectrometer. The emission intensity of the biofertilizer sample is compared to a previously established calibration curve this allows for the measurement of potassium content using the equation below:

$$K_20 = \left(\frac{\text{Sample Emission Intensity} \times \text{Standard Curve Slope}}{\text{Sample Weight}}\right) \quad (3.2)$$

Procedure adopted in this work is on the Flame Emission Spectrometry (FES) method using wet digestion, which is very reliable and accurate in analysing potassium concentrations. The reference used in this procedure is based on Association of Official Analytical Chemists (AOAC), which provides standardized methods for analysing various substances and it ensure the reliability and validity of the results obtained.

3.3.5. Determination of Nitrogen Content

The Kjeldahl technique is utilized and includes two stages: absorption and Distillation. During the processing stage, roughly 0.5 g of substrate (banana peels, orange peels, eggshells) is digested with H_2SO_4 in a Kjeldahl flask in the presence of a small amount of potassium sulphate and copper sulphate in a Kjeldahl's flask. Potassium sulphate increase the boiling of sulfuric acid and the copper-catalysed digestion. The process is finished inside 3 h, and the substrate (banana peels, orange peels, eggshells) is totally hydrolysed to form ammonium sulphate. In the process of cooling the mixture it is been transported the to a round bottom flask and distilled with a concentrated sodium hydroxide solution. The ammonia produced was absorbed in a known volume HCL solution of a specific concentration. The HCL that has not been neutralized was then back titrated against a standard sodium hydroxide, from the acid consumed. the mass of nitrogen was calculated using the following equation

$$\% N = \frac{(1.4 \times N \times V)}{W} \quad (3.3)$$

Where N to the Normainy of HCL (g/cm^3), V is the volume of HCL used for complete Neutralization of NH_3(cm^3) and W is the mass of substrate (banana peel, orange peel, and eggshell) in (g)

$$\text{Microorganism Content CFU /g} = \frac{\text{Number of Colonies} \times \text{Dilution Factor}}{\text{VOLUME PLATED ML}} \quad (3.4)$$

3.4. Phase 2 Technical and Vocational Training Program

This phase aims to develop a structured training curriculum that integrates the technical skills required for biofertilizer production into vocational education programs. The training is conducted at vocational centers and agricultural institutes across Nigeria.

3.4.1. Participant Enrollment and Demographics

A total of 120 participants were enrolled across three strategically selected vocational centers located in Southwest, Southeast, and Northern Nigeria, ensuring diverse representation from different agro-ecological zones of the country. This broad geographical selection aimed to address the varying agricultural practices and challenges faced by different regions.

3.4.1.1. Demographics

Smallholder Farmers (65%): The majority of the participants were smallholder farmers. These individuals represented those who rely heavily on agriculture for their livelihoods, making them a crucial target group for the biofertilizer training. These farmers were keen on improving soil health and crop yield through more sustainable practices, which could directly benefit their farming activities and income. Entrepreneurs (20%): This group consisted of individuals who were not only interested in farming but also in biofertilizer production as a potential business opportunity. These entrepreneurs were particularly focused on the commercial aspects of biofertilizer production, including scaling operations, marketing, and distribution, with a vision to create locally produced, ecofriendly alternatives to chemical fertilizers. Vocational Students (15%): The remaining participants were vocational students specializing in agriculture. These students were part of formal educational programs aimed at equipping them with the necessary skills to innovate and implement sustainable agricultural practices. Their participation in the program was expected to contribute to the future growth of biofertilizer production and usage, as they would carry forward the knowledge into their professional careers.

3.4.1.2. Age Distribution and Gender Breakdown

Participants were between the ages of 25 and 55 years, reflecting an active working population capable of applying the training outcomes effectively in their fields.

The gender distribution was fairly balanced, with 45% of the participants being female and 55% male. This diversity in gender representation highlights the inclusive nature of the program,

providing equal opportunities for women and men to participate in sustainable agricultural practices and entrepreneurial ventures. The active involvement of women is significant, as it addresses gender gaps in agricultural education and entrepreneurship, especially in rural areas. This diverse group of participants brought varying levels of experience, perspectives, and motivations to the training program, ensuring a rich exchange of ideas and the potential for widespread adoption of biofertilizer technologies across different sectors and regions

3.4.2 Training Curriculum Development

The training program was designed with a comprehensive curriculum to equip participants with the essential skills and knowledge required for biofertilizer production. The curriculum was divided into five key modules

3.4.2.1 Module 1 Introduction to Biofertilizers

This module provided participants with an overview of biofertilizers, explaining their importance in sustainable agriculture and how they compare to chemical fertilizers. It covered the different types of biofertilizers, such as nitrogen fixing, phosphorus solubilizing, and potassium solubilizing varieties, along with their specific benefits for soil health and crop yield. Participants gained an understanding of the environmental advantages and long-term benefits of using biofertilizers over conventional chemical inputs.

3.4.2.2 Sourcing and Processing Organic Materials

The second module focused on the sourcing and processing of organic materials needed for biofertilizer production. Participants were taught various techniques for identifying and collecting organic waste materials such as banana peels, eggshells, and orange peels from local agricultural and foodprocessing sources. They also learned how to prepare these materials by cleaning, drying, and grinding them into a usable form, along with the selection and preparation of microbial inoculants essential for the fermentation process.

3.4.2.3 Biofertilizer Production Process

This handson module was central to the training, where participants were guided through the entire biofertilizer production process. They learned fermentation techniques, including how to maintain optimal conditions for microbial growth, such as temperature, pH, and moisture levels. Participants also gained practical experience in microbial inoculation, applying specific strains of beneficial bacteria to the organic material mixture. Additionally, the module included nutrient analysis training to assess the nitrogen, phosphorus, and potassium (NPK) content of the final biofertilizer product.

3.4.2.4 Quality Control and Packaging

In the fourth module, participants were introduced to the critical aspects of quality control and packaging. They were trained in techniques to ensure the biofertilizer meets industry standards, focusing on microbial viability, nutrient concentration, and the absence of harmful pathogens.Participants also learned how to appropriately package the biofertilizer for commercial distribution, including proper labeling and storage conditions to maintain product quality and shelf life.

3.4.2.5 Business Development and Scaling

The final module provided participants with strategies for starting and scaling small-scale biofertilizer enterprises. This included guidance on setting up a production facility, identifying potential markets, and developing effective marketing and distribution strategies. Participants were also trained in business management skills, such as cost estimation, pricing, and building supply chains, to ensure their biofertilizer ventures could grow sustainably and meet the demands of the local agricultural market.

3.4.3 Participants and Training Duration

The training program is designed to cater to a diverse group of individuals who have a direct interest in biofertilizer production and sustainable agricultural practices. These include

3.4.3.1 Farmers

The primary target group consists of smallholder and commercial farmers who will directly benefit from biofertilizers to improve soil fertility, enhance crop yield, and reduce dependency on chemical fertilizers. Training these farmers will empower them to use biofertilizers effectively, while also providing them with the skills to produce biofertilizers for their own use or local sale.

3.4.3.2. Agricultural Extension Workers

These participants play a crucial role in disseminating knowledge and new agricultural technologies to rural farmers. By training extension workers in biofertilizer production and application, the program ensures that knowledge of biofertilizers spreads widely among farming communities, increasing the adoption of sustainable practices.

3.4.4. Entrepreneurs

Aspiring entrepreneurs who see the potential in biofertilizer production as a business opportunity are also a key focus. The training will equip them with the technical skills and business acumen needed to establish and run small-scale biofertilizer enterprises, contributing to local economies and creating jobs in agricultural communities.

3.4.4.1 Vocational Students

Vocational students specializing in agriculture or related fields will gain hands-on experience and technical knowledge, preparing them for future careers in biofertilizer production, agricultural consulting, or entrepreneurship. This group ensures a long-term impact as they represent the next generation of agricultural professionals.

3.4.4.2 Duration

Each training session is designed to run over a period of six weeks. The structure of the program will be a combination of theoretical and practical components to ensure comprehensive knowledge and skill acquisition.

3.4.4.3 Week 12

Theoretical foundations, including the introduction to biofertilizers, their types, benefits, and the sourcing of organic materials.

3.4.4.3 Week 34

Handson practice with the biofertilizer production process, including microbial inoculation and fermentation techniques.

3.4.4.4 Week 5

Quality control, packaging, and microbial viability testing to ensure the biofertilizer meets necessary standards.

3.4.4.5 Week 6

Business development, marketing strategies, and training participants on scaling production for commercial use. During this final week, participants will also complete their practical projects and prepare for the final assessment.

3.4.5. Assessment of Skills Acquisition

At the end of the six-week training program, participants will undergo a comprehensive assessment to ensure they have acquired the necessary skills to produce and manage biofertilizers effectively. The assessment process will involve both practical and theoretical components

3.4.5.1 Practical Demonstration

Participants will be required to produce biofertilizer from start to finish, following the protocols taught during the training. This includes sourcing organic materials, preparing them for fermentation, inoculating with microbial strains, and conducting quality control checks. The goal is to assess their handson ability to apply the skills learned in the training.

3.4.5.2 Written Examination

In addition to the practical demonstration, participants will complete a written exam to test their understanding of the theoretical aspects of biofertilizer production. This exam will cover topics such as the types and benefits of biofertilizers, the role of microbes in the fermentation process, and the business strategies for scaling production.

3.4.5.3 Competency Criteria

Participants will be evaluated based on their ability to produce biofertilizers that meet predefined quality standards. This will include an assessment of the microbial count, nutrient content (NPK levels), and the overall stability of the final product. Successful participants will be certified as competent biofertilizer producers, qualifying them to start their own small-scale biofertilizer production businesses or apply the knowledge on their farms.

4.0 Result and Discussion

Here's an expanded and enriched version of the content:

4.1 Phase 1 Results: Biofertilizer Production Process

Phase 1 focused on developing a robust biofertilizer production process using locally available organic materials—banana peels, eggshells, and orange peels—and microbial inoculants. The results underscore the feasibility of producing high-quality biofertilizers while addressing nutrient deficiencies and promoting sustainable agricultural practices.

4.1.1 Nutrient Content

Comprehensive analysis of the biofertilizer showed significant improvements in nutrient levels compared to the raw organic materials. The average nutrient composition was as follows:

- **Nitrogen (N):** 1.30%
- **Phosphorus (P):** 3.45%
- **Potassium (K):** 1.52%

These results align with agricultural nutrient standards, demonstrating the potential of this biofertilizer to enhance soil fertility. The high phosphorus and potassium content is especially beneficial for crops like maize, cassava, and legumes, which require these nutrients for optimal growth and yield.

4.1.2 Microbial Viability

The microbial analysis revealed a robust population of beneficial microorganisms critical to soil health and plant growth:

- **Pseudomonas count:** 2.48×10^6 CFU/g
- **Bacillus count:** 6.25×10^8 CFU/g

These strains play a vital role in nutrient solubilization, nitrogen fixation, and the suppression of plant pathogens. Their presence ensures enhanced nutrient availability and promotes healthier, more productive crops.

4.1.3 Fermentation Efficiency

The controlled fermentation process lasted 744 hours (31 days) at an average temperature of 30°C. During this period:

- The pH was maintained within the optimal range of 6.0–7.5, facilitating microbial activity and effective organic matter decomposition.
- The fermentation process ensured a stable environment for the growth and activity of inoculated microorganisms, resulting in a nutrient-rich product.

4.1.4 Organic Matter Breakdown

The organic materials were efficiently degraded, with a 40% reduction in organic matter. This transformation resulted in a fine-textured biofertilizer rich in nutrients and free of large, undecomposed particles. The breakdown of banana peels, eggshells, and orange peels released essential nutrients in bioavailable forms, enhancing their efficacy in soil amendment.

4.1.5 Product Stability

The final biofertilizer product exhibited excellent stability:

- **Moisture content:** Averaged 25%, ensuring ease of storage and packaging.

- No signs of microbial contamination or foul odors were detected, confirming that the fermentation process was well-managed.
- The product's consistency and stability make it suitable for immediate application or distribution.

4.1.6 Yield of Biofertilizer

The production process yielded approximately 5 kg of biofertilizer for every 10 kg of raw materials processed. This efficiency is promising for small-scale production and provides a scalable model for industrial applications. The high yield underscores the cost-effectiveness of the process, leveraging waste materials to create valuable agricultural inputs. The outcomes of Phase 1 demonstrate the successful production of a high-quality biofertilizer with optimal nutrient composition and microbial activity. These findings set the stage for the next phase, which focuses on equipping participants with the skills to replicate this process and scale up production efforts.

4.2 Phase 2: Training Outcomes

Phase 2 aimed to disseminate the biofertilizer production process through targeted training programs, equipping participants with the technical skills needed for small-scale and industrial production.

4.2.1 Pre- and Post-Training Knowledge Assessment

Participants underwent a knowledge assessment before and after the training:

- **Pre-training average score:** 45%, reflecting limited prior knowledge of biofertilizer production.
- **Post-training average score:** 85%, indicating a substantial increase in understanding and mastery of key concepts.

The marked improvement highlights the effectiveness of the training curriculum in addressing knowledge gaps.

4.2.2 Practical Skills Demonstration

Participants demonstrated their ability to implement the biofertilizer production protocol during hands-on sessions:

- 92% of participants successfully produced biofertilizer following the established methodology.
- 85% achieved proficiency in key practical modules, including quality control, microbial inoculation, and packaging techniques.
- Participants also learned to analyze microbial counts and nutrient levels, ensuring the production of biofertilizers that meet quality standards.

4.2.3 Feedback from Participants

The feedback from participants provided valuable insights into the program's impact and areas for improvement:

- **Positive Feedback:** Many participants appreciated the practical orientation of the training, expressing confidence in applying their skills to start small-scale biofertilizer production. The opportunity to engage with real-world challenges and solutions was particularly well-received.
- **Challenges Reported:** Some participants cited difficulties in accessing consistent supplies of organic waste materials, while others needed additional guidance on microbial inoculation techniques.

These insights emphasize the need for follow-up support, including access to raw materials, ongoing mentorship, and opportunities for collaboration. The outcomes of Phase 2 demonstrate the training program's success in empowering participants with the skills and knowledge needed to contribute to biofertilizer production and sustainable agriculture in Nigeria. This phase bridges the gap between research and practical application, laying the foundation for broader adoption and scaling of biofertilizer technology.

4.7 Evaluate the effects of biofertilizer application on soil properties

Table 4.7 analyse treated and nontreated soils properties. It takes into consideration three soil types, which are sandy, loamy, and clay. The properties analysed include pH, N, P_2O_5, K_2O, and microbial count for Pseudomonas and Bacillus. These analyses give more insight on impact and the role of biofertilizers on soil health and fertility.

4.7.1 pH Level

From Table 4.7. When biofertilizer was applies there was a shift in the pH across the different soil type for instance 6.0 to 6.5, was an increased in sandy soil, while loamy soil from 6.5 to 7.0, finally shifted from 7.0 to 7.5. a higher pH is advantageous because it plays important role in nutrient availability while at low pH many essential nutrients are insoluble and plant cannot assimilate them for their metabolism and growth. Meanwhile a neutrals pH is more advantageous, because its suitable for microbial activity and plant growth.

4.7.2 Nitrogen Content

Treated soil show the impact of biofertilizer application because there increase in nitrogen in all the three-soil type. Loamy soil shifted from 0.2% to 0.5%, sandy sifted from 0.07% to 0.3%, while clay from 0.2% to 0.5%. for plant to grow well the importance of nitrogen cannot be over emphasize due to fact that is an important nutrient for plant growth and it can also enhance plant growth and productivity. From table 4.7. it is evident that biofertilizer produced play a major role in nitrogen fixation or mineralization.

4.7.3 Phosphorus Pentoxide (P_2O_5)

There was a significant increase in phosphorus in treated soil, as seen in From Table 4.7. starting from sandy soil which increase from 0.04% to 0.15%, while in loamy soil increase from 0.14% to 0.25%, and finally in clay 0.25% to 0.3%. in other to achieve good root develop then the presence of phosphorus is a major concern, and also due to its ability to aid plant in energy transfer. From Table 4.7. the amount of phosphorus in the treated soil can improve root growth and overall plant health.

4.7.4 Potassium Oxide (K_2O)

the was remarkable increase in potassium in all the treated soil. Sandy soil improved from 0.14% to 0.3%, while loamy soil increased from 0.2% to 0.5%, and, finally clay soil improve from 0.3% to 0.6%. potassium plays important role in enzyme activation and water regulation. From table 4.7. the potassium content in the biofertilizer produced can aid in plant resilience to stress and improve overall growth.

4.7.5 Beneficial Microorganisms

33.3g of biofertilizer was introduced to three soil type and allow to say for a period of 7weeks, it was observed that there was a remarkable increase in for both Pseudomonas and Bacillus in the threesoil type. After a time the application of biofertilizer Pseudomonas from its initial properties of 1.1×10^2 CFU/g to 2.3×10^4 CFU/g, in sandy soil while loamy increased from its properties state of 1.2×10^3 CFU/g to 3.0×10^5 CFU/g, and finally clay soil increased from its initial properties of1.2×10^3 CFU/g to 3.0×10^5 CFU/g. this increase in numbers is an evidence of nutrient cycling and proper organic decomposition which positively affect the health of the soil and directly boost plant growth. from the table 4.7. it is evident that biofertilizer have impact in on the three soil properties, it depicts the importance of biofertilizer soil fertility and promoting sustainable agricultural practices. This research emphasis significant role biofertilizer plays in soil management strategies in other to optimize soil fertility and increase agricultural productivity.

Table 4.1 comparison of untreated and treated soil

Non-treated Soil

Soil Type	Ph	Nitrogen	P_2O_5(%)	K_20	Pseudomonas CFU/g	Bacillus CFU/g
Sandy	6	0.07	0.04	0.05	1.1×10^2	1.4×10^2
Loamy	6.5	0.15	0.05	0.1	1.2×10^3	3.0×10^3
Loamy	6.2	0.2	0.1	0.15	1.3×10^3	5.2×10^3

Table 4.2 compares untreated and treated

Treated Soil (Soil=33.3g, Weight of Biofertilizer = 83.19, Time=7weeks)

Soil Type	Ph	Nitrogen	P_2O_5(%)	K_20	Pseudomonas CFU/g	Bacillus CFU/g
Sandy	6.5	0.15	0.17	0.09	2.3×10^4	2.2×10^4
Loamy	7	0.2	0.08	0.16	3.0×10^5	2.3×10^5
Loamy	6.8	0.25	0.12	0.2	4.0×10^5	3.0×10^5

(Stewart, 2012).

5.0 Conclusion

This study highlights the significant potential of biofertilizers to address the challenges facing Nigeria's agricultural sector, particularly the overreliance on chemical fertilizers, declining soil fertility, and unsustainable farming practices. The research demonstrates that biofertilizers produced from locally sourced organic materials, such as banana peels, eggshells, and orange peels, can improve nutrient content and soil health, leading to higher crop yields and enhanced microbial activity. These findings support the viability of biofertilizers as a sustainable alternative to chemical fertilizers. The vocational training program developed in Phase 2 successfully equipped farmers, entrepreneurs, and vocational students with the practical skills required to produce biofertilizers. This training not only increased knowledge acquisition but also empowered participants to explore biofertilizer production as a viable commercial enterprise, potentially boosting local economies and contributing to Nigeria's industrial development. However, challenges such as inconsistent nutrient release, scalability, and infrastructure limitations must be addressed to ensure the widespread adoption of biofertilizers. Government support, regional collaboration, and further research into biofertilizer optimization are essential to overcoming these barriers. In conclusion, integrating biofertilizers into Nigeria's agricultural practices offers a pathway toward more sustainable farming, improved crop productivity, and industrial growth. By fostering the largescale production and use of biofertilizers, Nigeria can reduce its dependency on chemical inputs, enhance soil health, and contribute to global sustainability goals while stimulating local economic development **5.1 Recommendations**

- Expansion of Vocational Training Programs It is recommended that the vocational training program be expanded to other regions in Nigeria to empower more farmers, entrepreneurs, and vocational students with the necessary skills to produce and commercialize biofertilizers..

- Government Support Government agencies should provide financial incentives, grants, and technical support to encourage small-scale biofertilizer producers and ensure the scalability of production at regional and national levels.

- Development of Organic Waste Collection Systems Establishment of efficient organic waste collection systems is essential to ensure a cons istent supply of raw materials for biofertilizer production.

- Research and Development (R&D) Further research should be conducted to explore the long-term effects of biofertilizer use on various crops and soils across different agroecological zones in Niger ia. The development of improved microbial inoculants for biofertilizer production should also be prioritized.

- Promotion of Biofertilizer Use Among Farmers Awareness campaigns and demonstrations should be organized to educate farmers about the benefits of b iofertilizers, encouraging their adoption as a sustainable alternative to chemical fertilizers.

- Infrastructure Investment in local infrastructure, such as biofertilizer processing plants and distribution networks, will be crucial to ensure the commercial viability and industrial scalability of biofertilizers in Nigeria.

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KNOWLEDGE AND COMPLIANCE WITH STANDARD PRECAUTIONS AMONG HEALTH WORKERS IN ISOLO GENERAL HOSPITAL, ISOLO, LAGOS STATE, NIGERIA.

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Abstract

Objectives: This study assessed the knowledge and compliance with the standard precautions among health workers in Isolo General Hospital, Lagos State, Nigeria. In healthcare settings, health workers, patients, alongside their relatives are exposed to a variety of occupational hazards and healthcare-associated infections (HAIs) respectively. To reduce these risks, it is important to educate and encourage health workers to practice the use of standard precautions (SPs).

Previous works: Numerous studies on the knowledge, attitude, and practice of the use of standard precautions among health workers have been carried out in different countries. In lieu of the reported low levels of knowledge and resulting compliance with the use of standard precautions among health workers in both developed and developing countries, the need for more studies done on this subject, especially in Nigeria, cannot be overemphasized. **Methodology:** A descriptive cross-sectional study was conducted among 120 health workers in Isolo General Hospital, a secondary healthcare facility in Lagos State, Nigeria. The stratified and random sampling techniques were employed in the selection of study participants. Data collection was done using a structured, pretested, self-administered questionnaire, which assessed the knowledge and practice of the use of SPs, and data analysis was done using Microsoft Excel and EPI-INFO version 3.5.1.

Findings: The mean age of the study participants was 36.6 ± 9.9, and 94(80.0%) of them were females. Majority of the health workers were aware of SPs (99.2%) and agreed that it is mandatory to be practiced for all patients (94.2%). Most (85.8%) of the respondents used 0.5% chlorine bleach to handle the spill blood and body fluids. Some (42.5%) of the respondents recapped needles after use, and a higher proportion (95.8%) of them disposed sharps and needles in sharps containers. The overall good knowledge and practice scores of the respondents were, 43.3% and 84.2% respectively. Overall knowledge was also significantly associated with the overall practice of SPs (p= 0.033). The study therefore highlights the need for continued efforts to organize training/retraining programs, promote and implement the use of standard precautions among health workers, in order to ensure the total safety of the general population within a healthcare setting.

Keywords: *Healthcare settings, Healthcare-associated infections (HAIs)*

INTRODUCTION

When providing health care, standard precautions are a set of measures designed to prevent the transmission of blood-borne pathogens. Because medical history and physical examination cannot reliably identify patients infected with these pathogens, the Centers for Disease Control and Prevention (CDC) has recommended that standard precautions are used on all patients, regardless of infection status. Healthcare workers (HCWs) in the hospital are at risk of a variety of occupational hazards, including exposure to blood-borne infections such as HIV and hepatitis B and C virus from sharps, injuries, and contact with body fluids (Gerberding, 1994; Ramos-Gomez, *et al*., 1997; Ruben, *et al.*, 1983).

Developing countries have the highest prevalence of HIV-infected patients worldwide, as well as the highest rate of needle-stick injuries (Prüss-Ustün, *et al.,* 2005). The risk of seroconversion after percutaneous exposure to infected blood is approximately 0.1–0.3% for HIV, 2% for HCV, and 6–60% for HBV (Sabbah, *et al*., 2013).

Hospital care-Associated Infections (HAIs) affect between 5% and 15% of hospitalized patients in developed countries, according to a World Health Organization report (WHO, 2002). HAI prevalence was found to range between 14.8% and 19.1% in hospitals in several developing nations, according to a previous prevalence survey (WHO, 2009). Hospital-acquired infections have been estimated to be 2.6% prevalent in Nigeria's tertiary hospitals (Abubakar *et al.,* 2015).

In a study in the Lower Manya Krobo District of Ghana, the level of knowledge of standard precautions was very low. Among the health workers, only 37% knew that standard precautions include hand washing before and after direct contact with patients; 39% knew about cough etiquette; and 40% knew about aseptic techniques that involve infection prevention strategies to minimize the risks of infection (Akagbo *et al.,* 2017). In a study done in North Eastern Nigeria on the knowledge, awareness and compliance with SPs among health workers, less than one-fifth (13%) of the respondents have adequate knowledge of standard precautions. The practice of hand hygiene was noted in only 38.7% of the knowledgeable health workers (Abdulraheem, et al., 2012).

Hand washing; use of barriers (gloves, gowns, caps, and masks); care with devices, equipment, and clothing used during care; environmental control (surface processing protocols and health service waste handling); proper disposal of sharp instruments; and patient accommodation in accordance with required levels as an infection transmission source are all standard precautions. Adopting safe practices for handling needle sticks and other sharp objects in the face of the possibility of outbreaks, particularly of Hepatitis B and C, is also an important preventive measure. One of the tasks that health care providers face is the challenge of achieving significant improvement in patient care. Many people are still successfully cared for and treated in hospitals, but errors and other forms of harm do occur. It is important to note here that standard precautions require few resources to implement. Hand washing, as simple as it is, helps to prevent the spread of diseases by removing bacteria, viruses, other microorganisms, and chemicals from hands that could cause harm or disease (Suzzame *et al*., 2008).

The World Health Organization defines standard precautions as a set of infection control measures designed to reduce the risk of transmission of blood-borne and other pathogens from both recognized and unknown sources. HCWs are to use these measures when providing care to all individuals, regardless of whether they appear infectious or symptomatic (Abubakar, *et al.*, 2015). Healthcare workers (HCWs) play an important role in preventing, diagnosing, treating, and caring for people in a variety of healthcare settings (Giard Marine *et al.*, 2016). In healthcare settings, health workers are exposed to a variety of occupational hazards, including biological, chemical, ergonomic, physical, and stress/violence (Abuduxike, *et al.,* 2021).

In spite of the availability of detailed guidelines, knowledge of and adherence to standard precautions vary among HCWs, and has been found to be insufficient in both developed and developing countries (Punia, *et al.,* 2014).

A little more than a year after the Ebola virus disease (EVD) epidemic was contained, the culture of hand washing and universal precautions was successfully promoted among HCWs and the general population. It is expected that this culture, including regular use of PPE, will be sustained through positive behavioral change among HCWs. If some health workers' attitudes toward hand washing improve, it can help reduce the spread of microorganisms (Adebimpe, 2017). Patients may develop urinary tract infection as a result of improper urethral catheter care, wound infection as a result of poor operative technique, the use of an improperly sterilized instrument, insufficient wound care, phlebitis, and septicemia as a result of improper intravenous infusion administration. All of these infections are avoidable, and they cost the hospital and the patients more money (Aluko, *et al.,* 2016).

Low leadership and management support, particularly in the provision of adequate personal protective equipment, especially in general hospitals where the supply of these equipment and materials may be overlooked, and most importantly, the insufficient or lack of adequate knowledge and positive attitude towards the best practices of safety, may all be contributing factors to the low compliance with the guidelines. These factors include the overcrowding of patients in hospitals and the lack of time due to emergencies (WHO, 2009). The knowledge and application of standard precautions among health workers in developing nations, particularly in Nigeria, have been shown to be low and uneven despite the development and implementation of detailed healthcare guidelines for HCWs (Kolude, *et al,* 2013). This study was thus carried out to determine the knowledge and compliance with SPs among health workers in Isolo General Hospital, an urban area which provides health services to countless individuals around the Oshodi-Isolo in lagos State.

Aim

To assess the knowledge and compliance with standard precautions among health workers in Isolo, General Hospital, Lagos State, Nigeria.

Objectives

1. To determine the knowledge of standard precautions among the health workers in Isolo General Hospital.
2. To determine compliance with standard precautions among health workers in Isolo General Hospital.
3. To determine the associations between the knowledge and compliance with standard precautions among the health workers in Isolo General Hospital

METHODOLOGY

Study area

The study was conducted in Isolo General Hospital, a secondary healthcare facility located at 121 Mushin Road, Isolo, Oshodi-Isolo, Lagos State. According to the information obtained from the administrative department of the hospital, it has a staff strength of 493, which includes 152 nurses, 92 medical doctors, 18 medical laboratory scientists and technicians, and 40 hospital attendants.

Study population

The population selected for the study included health workers in Isolo General Hospital, who were directly involved in the handling of patients' blood, body fluids, needles, sharp objects, and waste, and were willing to participate in the study.

Sampling technique

The study employed a stratified and simple random sampling technique. Hence, using a total sampling frame of 302 for these categories of health workers (doctors, nurses, medical laboratory scientists/technicians, hospital attendants), and the sample size of one hundred and thirty-two. The following sample size was proportionally allocated; doctors 40, nurses 66, laboratory scientists/technicians 8 and attendants 18.

Instrument for data collection

The instrument for data collection used in the study was a structured, self-administered questionnaire consisting of four (4) sections. Section A contained socio-demographic characteristics, Section B sought the knowledge of the respondents about standard precautions, Section C contained the attitude of the respondents towards standard precautions, and then, Section D explored their practice of standard precautions.

Data analysis

A total of 120 out of the 132 questionnaires were retrieved and made available for analysis, giving a response rate of 90.9%. The data collected was put into a Microsoft Excel spreadsheet and analyzed using the EPI-INFO version 3.5.1 software package. Descriptive statistics was used to determine the frequency, percentage, mean, and standard deviation. The Chi-square test was used to test for association between the variables. The level of significance was set at 5% (0.05).

Ethical consideration

Ethical approval was obtained from the Human Research and Ethics Committee (HREC) of the Lagos University Teaching Hospital, and approval was obtained from the Lagos State Health Service Commission (HSC) before the commencement of the research.

All respondents were informed about the purpose of the study, they were assured of the utmost confidentiality of their responses; and participating in the study was totally voluntary. Written informed consent forms were given, and respondents who were willing to participate in the study signed the forms before filling out the questionnaire.

RESULTS AND DISCUSSION

In table 1 below, majority of the respondents 96(80.0%) were females and the minority 24(20.0%) were males. 54(45.0) of the respondents were nurses, 40(33.3%) are doctors and the remaining 26(21.7%) are either laboratory scientists/assistants or hospital attendants.

Table 1: Frequency and Percentage of Socio-demographic characteristics

Variables (n=120)	Frequency (n)	Percent (%)
Age in year		
20 – 29	34	28.3
30 – 39	40	33.3
40 – 49	31	25.8
..	15	12.5
Mean ± SD	36.6 ± 9.9	
Sex		
Female	96	80.0
Male	24	20.0

Working experience		
0 – 5 years	56	46.7
6 – 10 years	23	19.2
Above 10 years	41	34.2
Marital Status		
Married	71	59.2
Single	45	37.5
Divorced	1	0.8
Widow / Widowed	3	2.5
Educational level		
Primary	2	1.7
Secondary	16	13.3
Tertiary	102	85.0
Years of service in this facility		
0 – 5 years	62	51.7
6 – 10 years	19	15.8
Above 10 years	39	32.5
Designation		
Medical Doctor	40	33.3

As shown in table 2, most of the respondents, 119(99.2%) were aware of standard precautions. 70(58.3%) of the respondents indicated that they heard about standard precautions from Isolo General Hospital, 39(32.5%) television, 69(57.5%) workshop/seminar and 76(63.3%) from school. 113(94.2%), a majority of the respondents stated that standard precautions should be observed for all patients. 89(74.2%) of them believe that sterilization is the method for treating working tools that come in contact with intact mucous membrane.

Table 2: Frequency and Percentage of knowledge of standard precautions among the respondents

Variables (n=120)	Frequency (n)	Percent (%)
Awareness of standard precautions		
Yes	119	99.2
No	1	0.8
Sources of information of safety precaution		
Isolo General Hospital		
Yes	70	58.3
No	50	41.7
Radio		
Yes	31	25.8
No	89	74.2
Television		
Yes	39	32.5
No	81	67.5
Yes	69	57.5
No	51	42.5

Method of treating working tools that comes in contact with intact mucous membrane		
Sterilization	89	74.2
Disinfection	20	16.7
Cleaning	8	6.7
Wiping	1	0.8
None of the methods	2	1.7

From the table 3 below, 43.3% of the respondents had good knowledge of standard precautions. Meanwhile, 56.7% of the respondents had poor knowledge of the use of standard precautions.

Table 3: Frequency and Percentage of Overall Knowledge Score

Knowledge (n=120)	**Frequency (n)**	**Percentage (%)**
Good	52	43.3
Poor	68	56.7

In table 4 below, most 103(85.8%) of the respondents used 0.5% chlorine bleach to handle blood and body fluids. 51(42.5%) of them recapped needles after use, 66(55.0%) detach needles from syringes after use, and 118(98.3%) dispose needles and syringes immediately after use. A higher proportion 115(95.8%) of the respondents reported that they dispose sharps/needles in sharps containers. 58(48.3%) dispose them in a tight container and burn. Few 9(7.5%) of the respondents, however, reported that they dispose sharps/needles in the dust bin.

Table 4: Frequency and Percentage of practice of standard precautions by the respondents

Variables (n=120)	Yes Freq (%)	No Freq (%)	Don't know Freq (%)	Total Freq (%)
Ways to handle spill of blood and body fluids				
Use 0.5% chlorine bleach	103(85.8)	5(4.2)	12(10.0)	120(100.0)
Clean with soap and water	97(80.8)	21(17.5)	2(1.7)	120(100.0)
Clean with alcohol	81(67.5)	32(26.7)	7(5.8)	120(100.0)
Clean with mop stick and water	58(48.3)	55(45.8)	7(5.8)	120(100.0)
Clean with antiseptic immediately	100(83.3)	18(15.0)	2(1.7)	120(100.0)
Use any available disinfectant	87(72.5)	29(24.2)	4(3.3)	120(100.0)
Injection safety practices				
Recap needle after use	51(42.5)	67(55.8)	2(1.7)	120(100.0)
Detach needles from syringe after use	66(55.0)	53(44.2)	1(0.8)	120(100.0)
Dispose needle and syringe immediately after use	118(98.3)	2(1.7)	0(0.0)	120(100.0)

Journals		
Yes	44	36.7
No	76	63.3
Textbooks		
Yes	45	37.5
No	75	62.5
From a colleague		
Yes	39	32.5
No	81	67.5
School		
Yes	76	63.3
No	44	36.7
Condition for which standard precautions mandatory		
Patient with HIV (Human Immunodeficiency Virus)	1	0.8
Patient with HBV (Hepatitis B Virus)	1	0.8
Hospital associated infection	4	3.3
Seriously ill patients	1	0.8
For all patients	113	94.2

Methods of needle disposal				
Throw into waste bin	9(7.5)	106(88.3)	5(4.2)	120(100.0)
Disposal into tight cover container and burn	58(48.3)	58(48.3)	4(3.3)	120(100.0)
Throw them on the floor	5(4.2)	111(92.5)	4(3.3)	120(100.0)
Sharps / needles are disposed in sharps containers	115(95.8)	3(2.5)	2(1.7)	120(100.0)
Methods of handling used re-usable instruments				
Soak in a disinfectant after washing with soap and water	107(89.2)	12(10.0)	1(0.8)	120(100.0)
Put in an autoclave	115(95.8)	5(4.2)	0(0.0)	120(100.0)
Put in the sterilizing unit	116(96.7)	4(3.3)	0(0.0)	120(100.0)
Keep them for re -use without washing	7(5.8)	98(81.7)	15(12.5)	120(100.0)

From the table 5 below, majority 101(84.2%) of the respondents had good practice and the minority 19 (15.8%) had a poor practice of the use of standard precautions.

Table 5: Frequency and Percentage of Overall Compliance Score

Practice (n=120)	Frequency (n)	Percentage (%)
Good	101	84.2
Poor	19	15.8

From table 6 below, there was a statistically significant difference between the educational level of the respondents and their practice of standard precautions ($p<0.05$). Also, there was a statistically significant difference between the respondents' designation and their practice of the use of standard precautions ($p<0.05$).

Table 6: Association between Socio-demographic Characteristics and Compliance with Standard precautions

Socio-demographic characteristics	**Practice**			χ^2	**P-value**
	Good	**Poor**	**Total**		
	n=101(84.2%)	**n=19(15.8%)**	**n= 120(100.0%)**		
Age in year					
20 – 29	31(91.2)	3(8.8)	34(100.0)	4.60	0.2038
30 – 39	33(82.5)	7(17.5)	40(100.0)		
40 – 49	23(74.2)	8(25.8)	31(100.0)		
≥50	14(93.3)	1(6.7)	15(100.0)		
Mean ± SD	36.3 ± 10.3	37.9 ± 7.9		T =0.63	0.5317
Sex					
Female	81(84.4)	15(15.6)	96(100.0)	0.90	0.5569
Male	20(83.3)	4(16.7)	24(100.0)		
Working experience					
0 – 5 years	44(78.6)	12(21.4)	56(100.0)	3.59	0.1662
6 – 10 years	19(82.6)	4(17.4)	23(100.0)		
Above 10 years	38(92.7)	3(7.3)	41(100.0)		
Marital Status					
Married	60(84.5)	11(15.5)	71(100.0)	0.89	0.8287
Single	38(84.4)	7(15.6)	45(100.0)		

The implementation of standard precautions (SPs) is essential for preventing and controlling various infections and diseases, leading to improved public health outcomes not only in Nigeria but globally. A solid knowledge and consistent practice of SPs among healthcare workers (HCWs) are crucial, as they are integral stakeholders in ensuring the effective functioning of health systems.

This study evaluated the knowledge and compliance with SPs among healthcare workers at Isolo General Hospital, Lagos State. The findings indicated that most respondents (119; 99.2%) were aware of SPs as a universal infection prevention measure. However, only 52 respondents (43.3%) demonstrated good knowledge, while 101 (84.2%) exhibited good practices regarding SPs. The majority of respondents were females in the nursing profession with 0–5 years of experience in the hospital. This demographic distribution aligns with a study conducted at Federal Medical Center Yenagoa, Nigeria (Otovwe, 2017), but contrasts with findings from Federal Medical Center Gombe, where most respondents had 6–10 years of experience (Abubakar et al., 2015).

The high awareness of SPs among respondents is consistent with findings from studies conducted in Gombe, Bayelsa, Edo States in Nigeria, and Ethiopia (Abubakar et al., 2015; Otovwe, 2017; Osagiede et al., 2020; Alemayehu et al., 2018). However, the lower percentage of good knowledge among respondents (43.3%) is surprising, as it does not align with the high awareness levels. This discrepancy differs from studies where high awareness translated to good knowledge (Otovwe, 2017; Osagiede et al., 2020; Alemayehu et al., 2018). It suggests a gap in translating awareness into actionable understanding, possibly due to inadequate training or ineffective information dissemination methods.

The mean age of respondents (36.6 ± 9.9 years) is comparable to findings from studies conducted in Northern Cyprus and various Nigerian states (Abuduxike et al., 2021; Adebimpe, 2017; Otovwe, 2017). However, it differs significantly from a study in Borno State, where the age distribution was notably younger (Abdulraheem et al., 2012). Regarding marital status, the majority (71; 59.2%) of respondents were married, consistent with studies in northwest Ethiopia, Yenagoa, and Enugu, Nigeria (Arinze-Onyia et al., 2018; Alemie, 2012; Otovwe, 2017). In contrast, studies in Hawassa and Amhara, Ethiopia, reported that most respondents were single (Kasa et al., 2020; Bekele et al., 2020).

Educational level					
Primary	2(100.0)	0(0.0)	2(100.0)	6.74	0.0343*
Secondary	10(62.5)	6(37.5)	16(100.0)		
Tertiary	89(87.3)	13(12.7)	102(100.0)		
Years of service					
0 – 5 years	50(80.6)	12(19.4)	62(100.0)	2.91	0.2340
6 – 10 years	15(78.9)	4(21.1)	19(100.0)		
Above 10 years	36(92.3)	3(7.7)	39(100.0)		
Designation					
Medical Doctor	37(92.5)	3(7.5)	40(100.0)	9.37	0.0247*
Nurse	47(87.0)	7(13.0)	54(100.0)		
Laboratory Scientist / technician	5(62.5)	3(37.5)	8(100.0)		
Hospital attendant	12(66.7)	6(33.3)	18(100.0)		

Note * means there is a statistically significant difference at 0.05 (p<0.05)

The results from table 7 reveal that there is a statistically significant difference between the overall knowledge and compliance with the use of standard precautions among the health workers in Isolo General Hospital ($p<0.05$).

Table 7: Association between Overall Knowledge and Compliance with Standard Precautions

Knowledge	**Practice**			χ^2	**P-value**
	Good	**Poor**	**Total**		
Good	48(92.3)	4(7.7)	52(100.0)	4.56	0.0327*
Poor	53(77.9)	15(22.1)	68(100.0)		
Total	101(84.2)	19(15.8)	120(100.0)		

Note * means there is a statistically significant difference at 0.05 (p<0.05)

Educational background also played a role, with 102 respondents (85.0%) having tertiary education. This finding aligns with studies in Ghana and Yenagoa, Nigeria (Otovwe, 2017; Akagbo et al., 2017) but contrasts with a study in Ethiopia where lower educational levels were prevalent among respondents (Alemayehu et al., 2018). The source of SP information was primarily Isolo General Hospital, differing from other studies where workshops and seminars were the main sources (Otovwe, 2017; Osagiede et al., 2020; Abdulraheem et al., 2012).

Interestingly, the study found no significant association between sex or age and SP practices, but educational level (p=0.0343) and professional designation (p=0.0247) were significantly associated with compliance. For example, while all respondents with primary education (2; 100.0%) had high practice scores, the majority with tertiary education (89; 87.3%) also exhibited good SP practices. Nurses consistently demonstrated good practices, aligning with studies from southeast Nigeria and Addis Ababa (Adinma et al., 2009; Asmr et al., 2019). These findings differ from a study in Saudi Arabia, where working experience, sex, and age significantly influenced SP practices (Abalkhail et al., 2021).

The positive association between knowledge and practice scores highlights the importance of targeted training to bridge gaps in SP knowledge and enhance adherence. For instance, most respondents with good knowledge scores (48; 47.5%) also practiced SPs effectively. This underscores the need for continuous education and training to improve SP compliance, as supported by findings from Northern Cyprus (Abuduxike et al., 2021).

In conclusion, while this study aligns with some findings from previous research, discrepancies exist, particularly in the relationship between awareness, knowledge, and practice. These variations may stem from differences in study settings, healthcare infrastructure, training opportunities, and demographic profiles. Addressing these gaps through tailored training programs and improved information dissemination methods is critical to enhancing SP knowledge and compliance among healthcare workers.

CONCLUSION

The study aimed to assess the knowledge and compliance with standard precautions (SPs) among health workers in Isolo General Hospital, Lagos State, Nigeria. The objectives included determining the knowledge of SPs among health workers, evaluating their compliance with these precautions, and exploring the associations between knowledge and compliance.

The findings indicate that the study successfully achieved its aim of assessing knowledge, as a significant majority of respondents (99.2%) were aware of SPs, demonstrating a high level of awareness among health workers. However, only 43.3% of respondents demonstrated good knowledge of SPs.

This discrepancy suggests that while awareness is high, it does not necessarily translate into comprehensive understanding or effective application of SPs in practice.

In terms of compliance, the study found that 84.2% of respondents exhibited good practices regarding SPs, indicating a positive outcome in this area. The significant association between knowledge and compliance scores further supports the notion that enhancing knowledge can lead to improved adherence to SPs. However, the fact that a notable percentage of respondents (42.5%) still recapped needles after use indicates gaps in practice that need to be addressed.

The study highlights the need for continuous education and training programs to bridge the gap between awareness and practical application of SPs. Factors such as inadequate training, ineffective information dissemination, and potential systemic barriers within the healthcare setting may contribute to the observed discrepancies in knowledge and compliance.

In conclusion, while the study achieved its aim of assessing knowledge and compliance with standard precautions, it also revealed critical areas for improvement. The findings underscore the importance of ongoing training and support for health workers to ensure that high levels of awareness translate into effective practice, ultimately enhancing the safety of both health workers and patients in healthcare settings.

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Geo-Spatial Analysis of Informal Automobile Workplaces in Kano Metropolis

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ABSTRACT

Locations of informal auto-mechanic work places are very paramount, especially in developing nations. The lack of implementation of urban master plans, development plans and other related type of plans in our urban centres has continually been the bane of effective planning in Kano metropolis. This research was mainly field survey (Primary data), using field measurement. This study is restricted to only registered informal automobile garages within National Automobile Technicians Association (NATA). These are found within the six (6) Local Government Areas of the metropolis: Dala, Fagge, Tarauni, Municipal, Nasarawa, and Gwale. The local government areas comprised of 1,763 registered garages which were used as the population of this study. The car informal automobile garages were selected purposively due to their nature of occupying lands within the city. The sample size of this study was (s = 317) and it was determined based on Krejcie and Morgan's (1970) formular for calculating sample size (Darabinia, Gorji & Gholami, 2017). Descriptive and Nearest Neighbour statistics are used to analyse the data. The study revealed that informal automobile garages have higher number and are more concentrated in Nassarawa, Fagge and Dala local government areas respectively. It also revealed that, there is no homogeneity in the land size for informal automobile garages. The sizes of these garages were classified into large, medium and small. The search for order in informal automobile garages pattern of distribution in the landscape of Kano metropolis shows spatial pattern cluster of distribution, with critical value (z-score) of - 2.5810 to -1.96 at 0.05 significant levels. Since P-Value is 0.000 and R-Value is 0.439647 and given a Z-Score of -15.827811, it means there is a less than 1% likelihood that this clustered pattern could be the result of random chance. There is need for considering more horizontally infrastructural and economic development in Kano metropolis, in order to support the wide spread of all economic activities. Informal activities should be included in land allocation by the Ministry of Land, in order to standardize the planning system of Kano metropolis for development.

Key words: *Geo-Spatial, Informal, Automobile Workplaces*

1.0 Introduction

The location of economic activities within an urban area is very significant, as every urban centre needs them not only as integral components of urban land use, but also as a spring board for urban growth and development. The locations of Automobile Mechanics, like several other informal activities, are without formal arrangement (Onyemaechi, 2013). This may be due to way of accessing land for their services, and as such remain unpredictable. Provision for informal establishments in form of policies and more significantly, infrastructure is mostly grossly inefficient, because there is no record for them in the first instance (Jelili *et al.,* 2017). The point of concern remains that the population of these informal establishments outweighs that of their formal counterparts, particularly in the Nigerian setting. Not only as an element of urban fabric have informal automobile mechanics existed but also as an important part of urban land use and economy, as the 'sector' provides opportunities for teeming jobless population and comparatively cheaper services for the populace (Onyemaechi, 2013).

Roadside automobile repair services, otherwise known as road side mechanics in some developing countries, are among the petty-trades or informal businesses, which can help in absorbing more jobless youth. It was widely assumed during the 1950s and 1960s that, with the right mix of economic policies and resources, low-income traditional economies could be transformed into dynamic modern economies. In the process, the traditional sector comprised of petty trade, small-scale production, and a range of casual jobs would be absorbed into the modern capitalist or formal economy and, thereby, disappear. This perspective was reflected in the prediction of W. Arthur Lewis, in his 1954 essay for which he received a Nobel Prize in Economics, that economic development in developing countries would, in the long-term, generate enough modern jobs to absorb surplus labour from the traditional economy such as road side mechanics. This would lead to a turning point when wages would begin to rise above the subsistence level: what is referred to even today as the "Lewis Turning Point" (Lewis, 1954).

By the late 1970's automobile workshops had grown and spread across every major roads around metropolitan Kano. Roadside automobile has grown beyond acceptable level, due to their way of disorienting planning and development, as they now occupy most open spaces, uncompleted residential/commercial houses and plots within built environment. Thus they are largely associated with deterioration in environmental quality and this has led to poor sanitary condition in Kano metropolis. The proliferation of informal automobile workshops within the metropolis has become a significant challenge, as these workshops increasingly occupy available open spaces such as parking lots, gardens, and other designated public areas. This unregulated expansion disrupted formal land use plans, leading to a decline in the city aesthetic quality and contributing to a disorderly pattern of urban development. Informal workshops often emerge in close proximity to various land uses, including residential, commercial and institutional areas, as well as along major roads. This encroachment not only undermines urban planning efforts but also raises concern related to environmental degradation, public safety, and infrastructure strain. Given the scale and implications of this issue, there is a pressing need to investigate the factors driving the growth of informal automobile workshops and their impact on sustainable urban development within the metropolis. This should not be continually treated as incidental matter and neglecting their environmental and socio-economic consequences but should be seen as an integral component of urban land use even though subsumed within other land uses (Sambo *et al.,* 2012). The work of Adams (2010) reveals that there is a negative relationship i.e. an inverse relationship between location and patronage among the artisans. The regression analysis also shows a weak relationship between location and patronage, meaning that patronage did not entirely depend on location of artisans workplaces. Thus, this paper is aimed at assessing the spatial distribution pattern of roadside automobile mechanics in Kano Metropolis.

RESEARCH METHOD

2.1 Study Area and Extent

The study area, Kano metropolis, lies between latitudes 11° 50' to 12° 07' N and longitude 8° 22' to 8° 47' E, and altitude 472 meters above sea level. Kano metropolis is bordered by Minjibir LGA to the Northeast and Gezawa LGA to the East, Dawakin Kudu LGA to the South East and Madobi and Tofa LGAs to the South West (Figure 1).

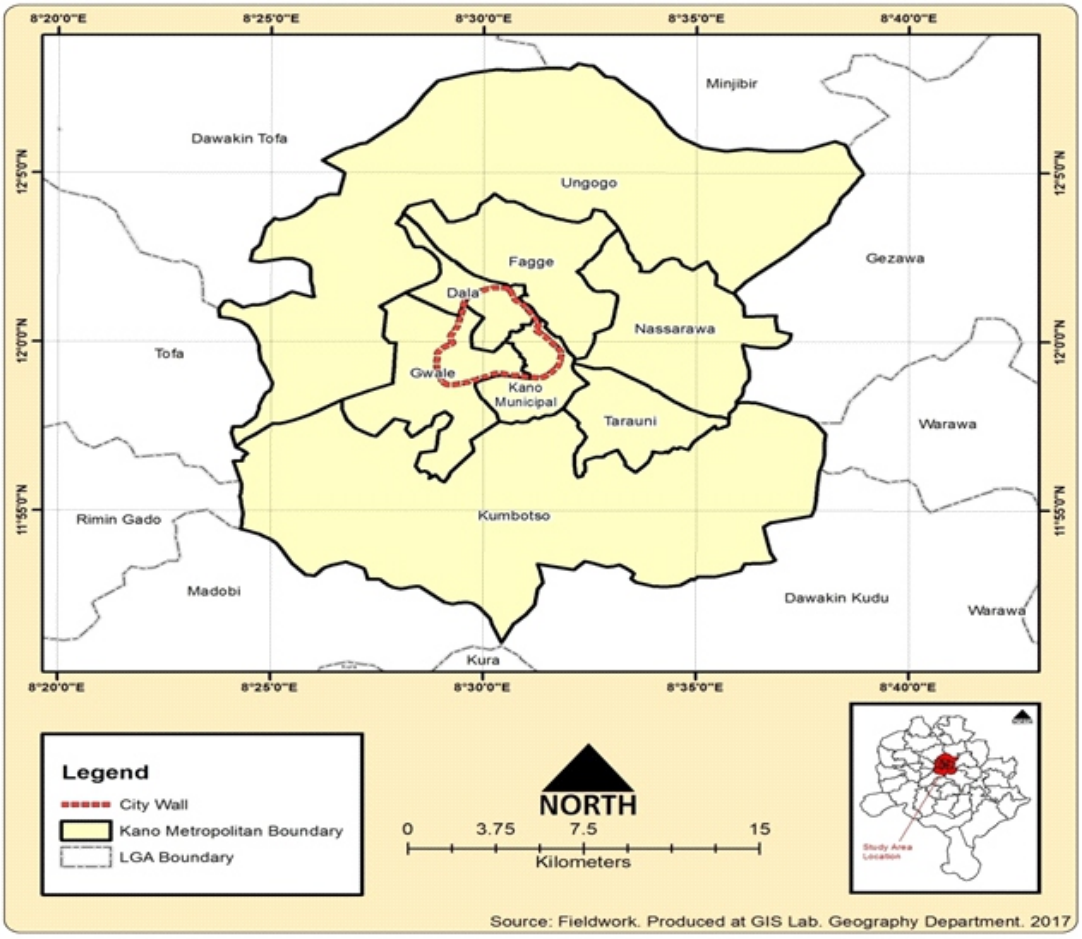

Figure 1: Kano Metropolis

Source: GIS laboratory, Geography Department, BUK, 2017

2.2 Research Design

A reconnaissance survey was carried out in order to be more acquainted with the nature of informal automobile mechanics and to acquire information on the number of informal automobile mechanic garages present in Kano metropolis. Through this survey, National Automobile Technicians Association (NATA) present that information pertaining the number of registered informal automobile mechanics is approximately (1,763) garages, 856 garages in Nassarawa, 264 garage in Tarauni, 72 garages in Gwale, 258 garages in Dala, 201 Garages in Fagge, and 112 garages in Kano Municipal (Table 1).

This research was mainly field survey using in-depth interview, observation and direct field measurement of auto-mechanic work places coordinate to analyse the location and spatial pattern of distribution of the informal automobile mechanics, finally to examine the need for involving roadside mechanics work places in urban plan development.

2.3 Population and Sampling Procedure

Since it is difficult to cover the entire informal automobile garages in the metropolis due to their large number; Kano metropolis was stratified into eight strata. The first stratification is the Local Government Areas within Kano metropolis and the second stratum is the units of informal automobile mechanics in each Local Government Area. Purposive sampling technique was used in selecting individual respondent's garages.

The sample size of this study was s = 317 (Table 1) and it was determined based on Krejcie and Morgan's (1970) formula for calculating sample size.

Table 1: Samples Allocation to the First Stratification (L.G.As)

S/n	Local Government Areas	Number of Units	Number of Garage	Sampled Size
I	Nassarawa	20	856	154
Ii	Dala	9	258	46
Iii	Fagge	15	201	36
Iv	Tarauni	4	264	48
V	Gwale	3	72	13
Vi	Kano Municipal	7	112	20
	Total	58	1763	317

Source: NATA, 2018 Compiled by the Author

2.4 Instruments of Data Collection

Direct field measurement and observation were used to identify and record the exact location of each sampled automobile garage in the area using Geographical Positioning System (GPS). Interviews were conducted with the head of automobile workshops and In-depth interviews were conducted with heads of the departments in the Ministry of Land and Physical Planning on land allocation. These interviews were done concerning land for Auto-mobile work places in Kano Metropolis.

2.5 Methods of Data Analysis

Nearest Neighbour Analysis was used to describe the location and the distribution pattern of the informal automobile mechanics, while descriptive statistics of frequency and percentage produced in Statistical Package for Social Sciences (SPSS 20.0) was used to describe its size and distance to roads. Tape-base script analysis of In-depth interview was used to support the result, wherein the researcher listens to the audio of interview then creates an abridged transcript.

RESULTS AND DISCUSSION

3.1 Location and Spatial Pattern of Distribution of Informal Automobile Workplaces

Informal Automobile mechanics garages in Kano metropolis are divided by National Automobile Technicians Association (NATA) into various units. These garages are located in different local government areas of Kano metropolis. Though, one unit can overlap and cross the boundary of one local government area to another (Fig. 2). This means that one garage unit can be situated in two local government areas, due to the proximity of the two local government areas.

3.1.1 Inventory and location of informal automobile mechanic workplaces

Findings show that there are many informal automobile mechanic units within the metropolis, such units are: Airport road, Aminu Kano way, Court road, Dakata, Eldarado, Farm center, Federal Secretariat, Gwammaja, Hadeja Road, Hausawa, Hotoro, IBB way, Independence road, Kofar Ruwa, Katsina road unit, Kingsway, Sabon Gari, Sauna, Unguwa uku, Yankaba and Zungeru road, Kwakwaci, Kabuga, Tal'udu, Rijiyar Zaki and Gidan boss (see Fig. 2 & Table 2).

Table 2: Informal Automobile Garages Units

S/N	Local Government Area	Garages Units
1	Nassarawa	CBN
		Dakata
		Hadeja Road
		Nassarawa
		Hotoro
		Independence
		Katsina Road
		Kinsway
		Sauna
		Yankaba,

2	Tarauni	Tarauni
		Farm Centre
		Hausawa
		Hotoro
		Unguwa Uku
3	Fagge	Airport Road
		CBN
		Federal Secretaria
		Eldrado
		IBB
		Sabon Gari
		Zungeru Road
4	Gwale	Aminu Kano Way
		Kofar Ruwa I, II, III & IV
5	Kano Municipal Council	IBB
		Railway
		Sharada
		Gandu
6	Dala	Aminu Kano Way
		Gwammaja
		Federal Secretaria
		Kofar Ruwa

Source: Field Survey, 2018

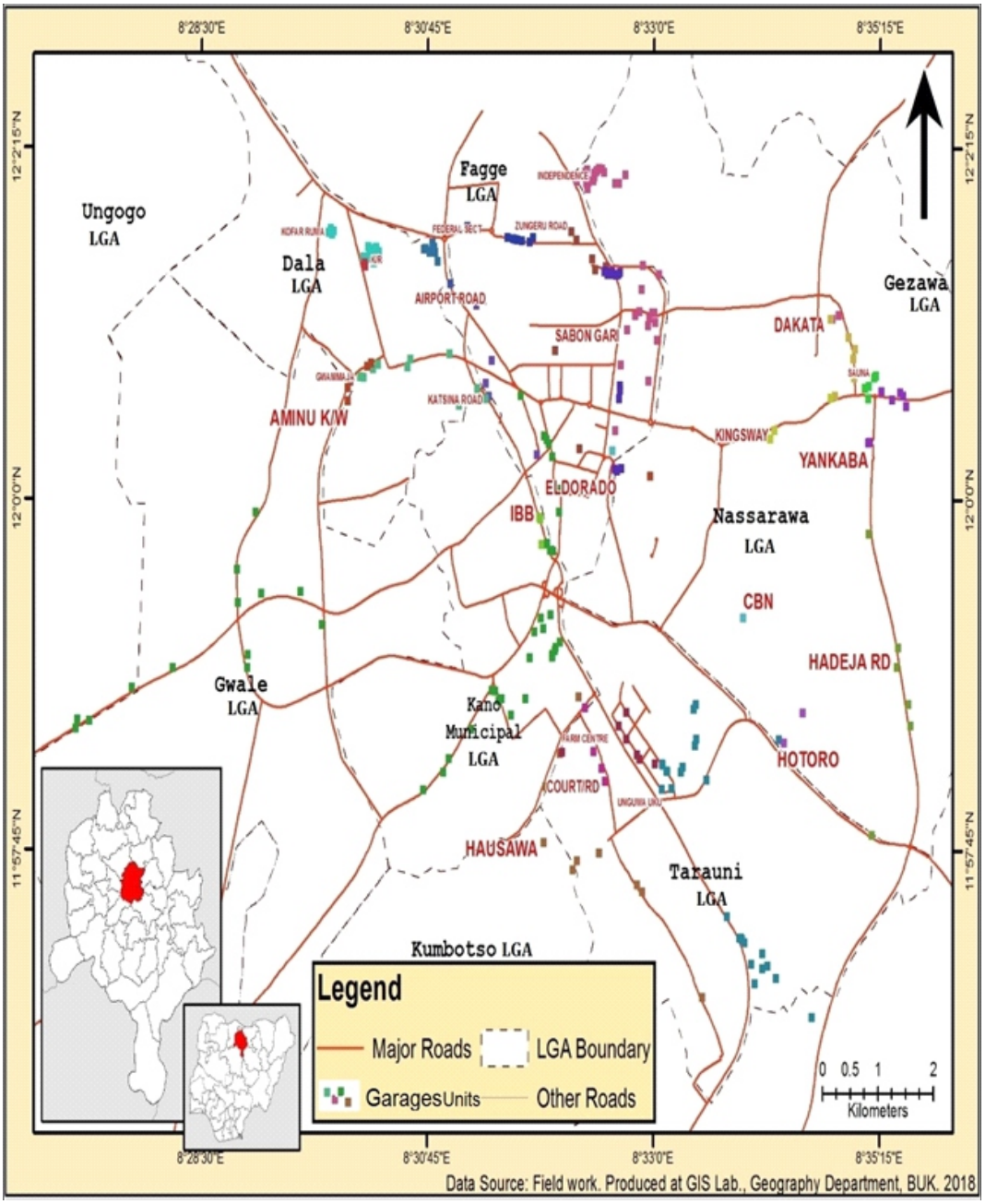

Fig. 2 Informal Automobile Garages Units

Source: Field Survey and Data Analysis, 2018

Figure 2 shows that Tarauni Local Government Area include Unguwa Uku which overlapped into Kumbotso Local Government Area, Court Road unit, Farm center, Hausawa which also overlapped Kumbotso Local Government Area. Fagge Local Government Area comprises of Kwakwaci, Zungeru Road, Katsina Road, Sabon Gari, Airport Road and Federal Secretariat which also overlapped into Dala Local Government. The Kano Municipal council also comprises of IBB, Dan Agundi, Sharada, Tashar Bala and Railway. The result also shows that Gwale Local Government Area comprises of Rijiyar Zaki, Kabuga and Tal'udu. While Dala Local Government Area comprises of Gwammaja, Kofar Ruwa, and Aminu Kano Way (Fig. 2).

Some of the units such as Kwakwaci, Kofar Ruwa, IBB way and Gidan Boss have sub-unit under them. These sub-units were identified using numbers or alphabets such as: Kwakwachi A to D, Kofar Ruwa unit A to H, IBB way units 1 and 2 and Gidan Boss units which also have 13 sub unit, i.e. Gidan Boss 1 to 13. The garages have higher number and are more concentrated in Nassarawa, Fagge and Dala local government areas respectively (Appendix 1). This is connected with high population concentration and the presence of most economic activities of Kano State in those local governments' areas. For example, Dala, Fagge and Nassarawa are the most populated local government areas in the state (National Population Census, 2006). Also some of the largest markets of the state, such as Kwari, Sabon-gari, and Singer are situated within these local government areas. Furthermore, most of the hotels and relaxation places are situated within these local government areas. The concentration of informal automobile garages in Nassarawa and Fagge from the in-depth interview may be as a result of residential site of the informal automobile technicians. Most of the informal automobile technicians are non-hausa who mostly stayed in Sabon-Gari, Fagge local government area, while many stayed at Brigade and other parts of Nassarawa local government area.

3.1.2 Spatial Pattern of Distribution of Automobile Work Places

The spatial distribution of the automobile work places was determined using GIS based nearest neighbour technique, at 0.05 significant levels. The critical value (z-score) is equal to - 2.5810 to - 1.96 (Figure 3). Since P-Value is 0.000 and R-Value is 0.439647. The result from the analysis indicates that the spatial pattern of distribution of the garages in the metropolis has a cluster pattern (Fig. 4). It shows five clusters in Fagge Local Government Area, four clusters in Nassarawa Local Government Area, four clusters in Dala Local Government Area, three clusters in Tarauni Local Government Area, three clusters in Gwale Local Government Area and two clusters in Kano Municipal Council Local Government Area (Fig. 3). Thus, given the Z-Score of -15.827811, it means there is less than 1% likelihood that this clustered pattern could be the result of random chance (Fig. 4). This result is in agreement with the findings of Akinbinu (2001) study in Ibadan, which observed that auto repair workers exist in the form of clusters with three of such clusters in Iba North, Two in Ibadan South-west and one in Oluyole.

The reasons for this cluster pattern of distribution is that, Dala, Fagge and Nassarawa local government areas have the highest population in the metropolis. This has led to the presence of higher number of vehicles in the local governments' areas. Again all the markets within Kano metropolis are situated in these local government areas, and also led to the high concentration of vehicles in the areas; which in turn attract the presence of many auto mechanic work place clusters within the three local government areas (Table 3).

Table 3: Informal Auto Mechanic Workplace Clusters

S/N	Local Government Areas	Number of Clusters	Garages within the Clusters
1	Fagge	5	Above 47
2	Nassarawa	4	56
3	Dala	4	Above 38
4	Tarauni	3	34
5	Gwale	3	Above 21
6	Kano municipal	2	26

Source: Field work, 2018

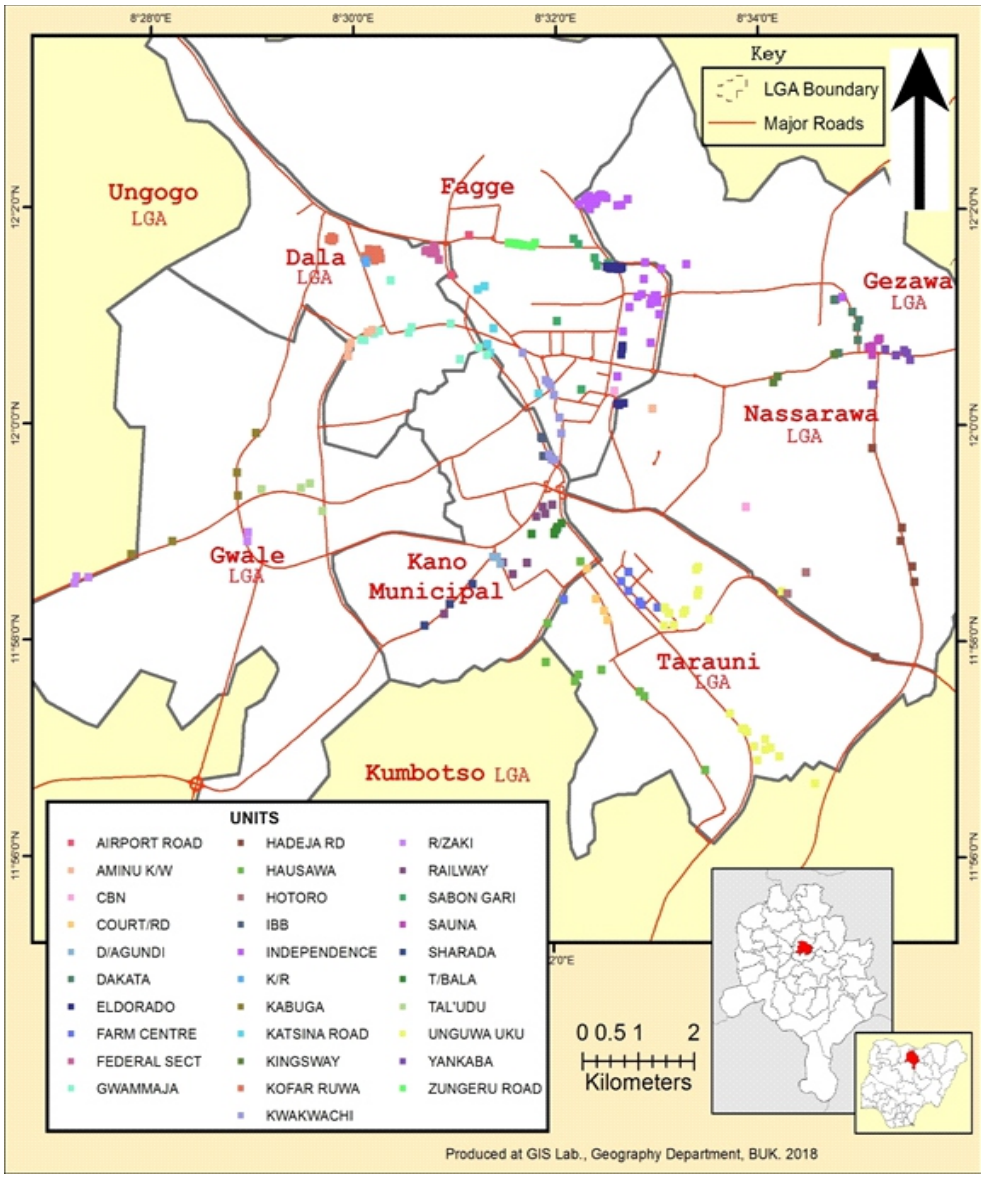

Fig. 3: Informal Automobile Garages Spatial Pattern of Distribution (Clustered)

Source: Field Survey and Data Analysis, 2018

If the value of R = 1 indicates Randomness

R = O indicates clustered

R = 2.149 Indicates maximum possible Spacing (Fig. 3)

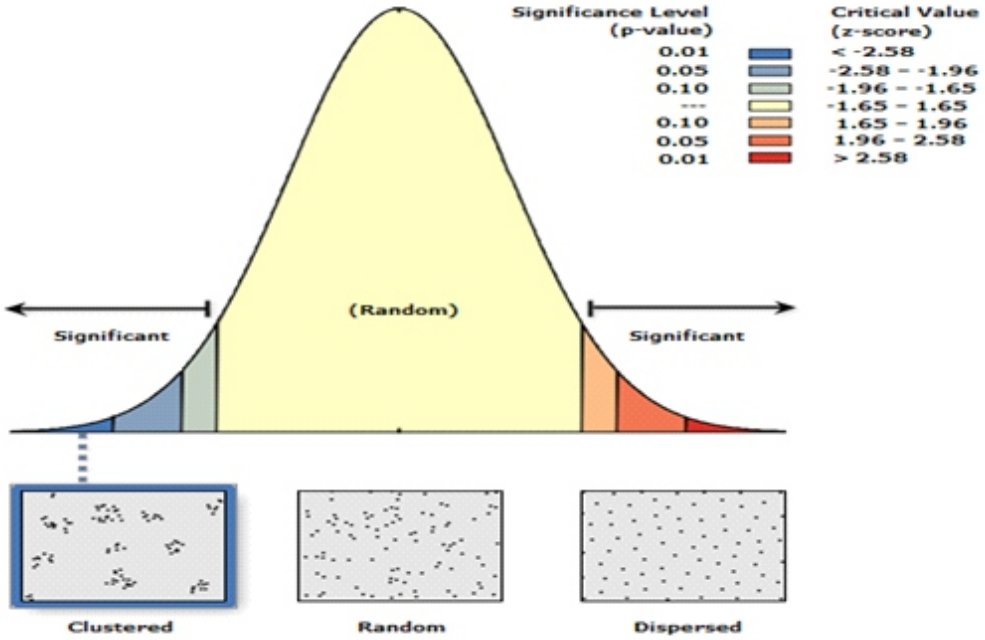

Fig. 4: Significance Level of Nearest Neighbour Analysis

Source: Analysis, 2018

Average Nearest Neighbor Summary	
Observed Mean Distance:	148.4295 Meters
Expected Mean Distance:	337.6106 Meters
Nearest Neighbor Ratio:	0.439647
z-score:	-15.827811
p-value:	0.000000
Dataset Information	
Input Feature Class:	METROMECHANICS_POINT
Distance Method:	EUCLIDEAN
Study Area:	99391343.072220
Selection Set:	False

Fig. 5: Nearest Neighbour Result Summary

Source: Analysis, 2018

3.1.3 Informal Automobile Garages Land Size

The findings reveal that, over 14% of the garages with the land size of 12.2m x 12.2m and 22.8m x 15.2m are the informal automobile garages with highest percentage in the metropolis (Fig. 6). 9% of the informal automobile garages are occupying land area of 15.2m x 30.4m and 30.4m x 30.4m and some of which are open spaces (Fig. 6). These open spaces are land that the garages

occupied beside major roads (Plate 1). The findings also reveal that 12.9% of the garages are on land of 15.2m x 15.2m, for their operations. Only 11.7% garages occupied land of 12.2m x 15.2m area for their operations, 6.9% of the garages use land size of 22.8m x 30.4m, 8.2% garages use land size of 9.1m x 6.0m for their operations. Only 3.5% garages use land size of 22.8m x 22.8m which is the lowest percentage use for garage services in the metropolis (Fig. 6). The sizes of these garages were classified into large, medium and small garages (Table 4).

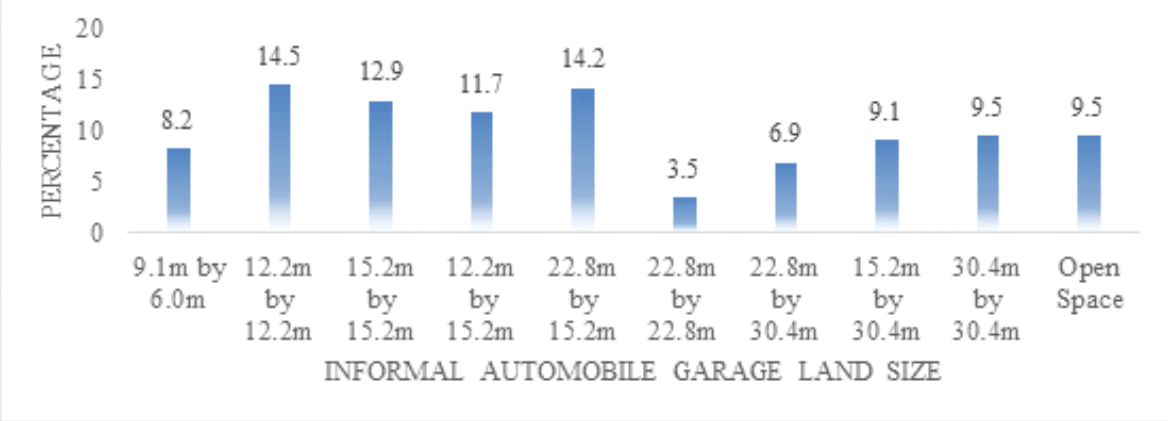

Fig. 6: Size of the informal Automobile Work Places
Sources: Data Analysis, 2018

Table 4: Classification of Auto-mechanic Work Places Based on their Size

S/n	Plot Size	Feet's	Example of Garages/Address
1	Large	> 22.8m by 22.8m	Sunusi Motors Mechanical Engineering workshop. Bihind bank of the north Lawan Dambazau link off zaria road
2	Medium	> 15.2m by 15.2m and ≤ 22.8m by 22.8m	De-franc int'l Peugeot automobile. Zungeru Road.
3	Small	≤ 15.2m by 15.2m	Sha'ibu Panel Auto-Workshop. Along Zaria Road, opposite FGC Kano.

Sources: Field Work, 2018

Data analysis shows that there is no homogeneity in the size of the land occupied by the automobile garages. This is because according to the in-depth interview report by some officials of the Ministry of Land under Kano Urban Planning and Development Authority (KNUPDA):

> "…there is no any law governing the size of land used for automobile mechanics workplaces. It was observed that land occupied by the garages have some implications on the metropolis".

The small garages usually are situated right beside the major roads of the metropolis and because they cannot adequately contain many vehicles, some portions of the pedestrian walkways and the main road are also occupied (Plate 1). This brings about traffic congestion along such roads and streets, compared to the large size garages that are big enough to contain all the vehicles brought for services, and repairs. e.g. along Yusuf Maitama Sule University, Fagge Gidan Boss and others.

Plate 1: Road Site Automobile Garage along Yusuf Maitama Sule University Road, Gwale

Source: Field Work, 2018

3.1.4 Distance of the Automobile Work Places from the Roads

Majority of the work places in the metropolis are on trunk B and C roads, and few garages, mostly on Gwarzo road in Gwale local government area are on trunk A roads (Federal Expressway) (Table 5). Almost one-third of the garages are located at about 20m to 29m distance from the road, and slightly more than one-third 30m to 35m away from the road. About one-fourth of the garages have 36m to 40m distance from the road (Table 6). Very few garages are 41m to 55m away from the road (Table 6). This result shows that the automobile garages conform to the standards set by the Ministry of Land under The Kano Urban Planning Development Authority (KNUPDA) which stipulate that all activities on trunk "A" roads (Federal Expressways), must be 50m away from the road. A majority of the garages are located between 30 to 40 meters away from the road.

Table 5: Location of the Garages on Different Road Type

S/N	Garages	Road Type
1	Saheed technical, Co. Rijiyar Zaki Gwarzo Road.	Trunk A
2	Ahmadiyya unit (garages). Airport road by Gama behind cementry	Trunk B
3	Sunusi motors Mechanical Engineering workshop. Bihind bank of the north lawan dambazau link off zaria road.	Trunk C

Sources: Field Work, 2018

Table 6: Distance of the Garages from the Roads

			Local Government Areas						
			TRN	GWL	KMC	FGE	DAL	NSR	Total
Informal Automobile Garage Distance to Road	20m to 29m	Freq.	12	5	7	23	14	41	102
		Percent.	25.0%	38.5%	35.0%	63.9%	30.4%	26.6 %	32.2%
	30m to 35m	Freq.	17	2	9	10	11	62	111
		Percent.	35.4%	15.4%	45.0%	27.8%	23.9%	40.3 %	35.0%
	36m to 40m	Freq.	16	3	4	3	14	36	76
		Percent.	33.3%	23.1%	20.0%	8.3%	30.4%	23.4 %	24.0%
	41m to 50m	Freq.	2	3	0	0	6	13	24
		Percent.	4.2%	23.1%	0.0%	0.0%	13.0%	8.4%	7.6%
	51m to 55m	Freq.	1	0	0	0	1	2	4
		Percent.	2.1%	0.0%	0.0%	0.0%	2.2%	1.3%	1.3%
	Total	Freq.	48	13	20	36	46	154	317
		Percent.	100%	100%	100%	100%	100%	100%	100%

Sources: Data Analysis, 2018

4.1 Conclusion and Recommendations

In conclusion, population and economic activities in Kano metropolis led to the concentration of informal automobile mechanical work places with cluster pattern of distribution in Kano metropolis. The implication of this cluster pattern of spatial distribution on Kano metropolis development is congesting the road site, and brings about traffic. Especially road side informal automobile mechanical work places with small land size, operating close to the road.

Absence of land allocation for informal automobile mechanical work places lead to the conversion of many land allocated for other land uses such as residential and other commercial purposes, which may disrupt planning.

i. There is need to consider more horizontally based infrastructural and economic development plan for Kano metropolis, in order to support the wide spread of all economic activities.

ii. Informal activities should be included in land allocation by the ministry of land, in order to standardize the planning system of Kano metropolis for development.

iii. The research recommends further study in the following areas:

(a) Automobile workplaces and environmental deterioration;

(b) Investigation the impact of auto-mobile work to health of technicians and nearby occupants of the auto-mobile workplaces;

© Analysing the level of disorder created by informal automobile mechanics workplaces in the pattern of physical development within any form or type of land use.

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An Assessment of Resources Available for (MSMEs) for Nigeria's Industrial Development

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Abstract

This study assesses the resources available for Micro, Small, and Medium Enterprises (MSMEs) in Nigeria's industrial development. The study examines the financial, capacity-building, policy, and regulatory resources available to MSMEs. A mixed-methods approach was used, combining both qualitative and quantitative data collection and analysis methods. The study reveals that while there are various resources available to support MSMEs, there are significant challenges in accessing these resources. The study recommends the need for effective coordination and implementation of resources, as well as the development of targeted interventions to support MSMEs.

Keywords

MSMEs, industrial development, resources, Nigeria, entrepreneurship, small business.

Introduction

Micro, Small and Medium Enterprises (MSMEs) are essential to Nigeria's industrial development. MSMEs are the support of Nigeria's economy, playing a vital role in driving economic growth, innovation and job creation. According to the National Bureau of Statistics (NBS), MSMEs account for over 50% of Nigeria's Gross Domestic Product (GDP) and employ over 80% of the country's workforce. However, despite their significant impacts, MSMEs in Nigeria face numerous challenges that hinder their growth and productivity.

To address these challenges, the Nigerian government has established various initiatives and institutions to support MSMEs. These initiatives aim to provide MSMEs with the necessary resources, including training, funding and support services to enhance their competitiveness and productivity. However, despite these efforts, MSMEs in Nigeria still face significant challenges, and their potential for industrial development remains largely untapped.

This study aims to examine the resources available to MSMEs in Nigeria, with a focus on government agencies, initiatives and private sector organizations that provide support services, training and funding for MSMEs. The study seeks to identify the strengths and weaknesses of these resources, assess their effectiveness in supporting MSMEs, and provide recommendations for improving their impact. By doing so, this study hopes to contribute to the development of effective strategies for enhancing the growth and productivity of MSMEs in Nigeria, and ultimately driving industrial development in the country.

Therefore, the study was built based on the specific objectives as follows:

1. To identify the challenges faced by MSMEs in accessing financial resources in Nigeria.
2. To evaluate the effectiveness of existing financial institutions and initiatives in supporting MSMEs in Nigeria.
3. To examine the role of technology and innovation in enhancing MSMEs' competitiveness in Nigeria.
4. To investigate the skills and training needs of MSMEs in Nigeria and identify resources for addressing these needs.

Literature Review

Micro, Small, and Medium Enterprises (MSMEs) play a crucial role in Nigeria's industrial development, contributing significantly to employment, economic growth, and poverty reduction. However, MSMEs in Nigeria face numerous challenges, including limited access to finance, inadequate infrastructure, and insufficient skills. This literature review examines the resources available to MSMEs in Nigeria, including financial, capacity-building, policy, and regulatory resources.

Financial Resources

Access to finance: MSMEs in Nigeria face significant challenges in accessing finance, which hinders their growth and development (CBN, 2012).

Microfinance institutions: Microfinance institutions have been instrumental in providing financial services to MSMEs in Nigeria (Adegbite, 2015).

Bank of Industry: The Bank of Industry provides financial support to MSMEs in Nigeria, including loans and credit facilities (BOI, 2020).

Capacity Building and Training

Entrepreneurial skills: MSMEs in Nigeria require entrepreneurial skills training to enhance their business management and competitiveness (SMEDAN, 2020).

Vocational training: Vocational training programs are essential for MSMEs in Nigeria, as they provide skills development and enhance productivity (ITF, 2020).

Business advisory services: Business advisory services are critical for MSMEs in Nigeria, as they provide guidance on business operations and management (BOI, 2020).

Policy and Regulatory Framework

MSME policy: The Nigerian government has implemented the MSME policy to provide a framework for the development of MSMEs (SMEDAN, 2020).

Regulatory environment: The regulatory environment in Nigeria is crucial for the growth and development of MSMEs (CBN, 2012).

Taxation: Taxation policies in Nigeria affect the growth and development of MSMEs, and there is a need for tax reforms to support MSMEs (FIRS, 2020).

Empirical Review

Studies have highlighted the importance of addressing these challenges to enhance MSMEs' access to resources and promote industrial development in Nigeria:

Ojeka et al. (2019) emphasized the need for improved access to finance for MSMEs. The Secondary method was used, where National Bureau of Statistics (NBS), Central Bank of Nigeria (CBN), Federal Inland Revenue Service (FIRS), Small and Medium Enterprises Agency of Nigeria (SMEDAN) remained the sources of data for the study.

Aremu et al. (2020) highlighted the importance of digital infrastructure development for MSMEs. The study used secondary method, the data for the study were sourced from Central Bank of Nigeria (CBN), Federal Inland Revenue Service (FIRS), Small and Medium Enterprises Agency of Nigeria (SMEDAN).

Oyelaran-Oyeyinka et al. (2017) stressed the need for skills development programs for MSMEs. The qualitative method was used, the data for the study were sourced from National Bureau of Statistics (NBS), Central Bank of Nigeria (CBN), Small and Medium Enterprises Agency of Nigeria (SMEDAN).

Recommendations

Based on the study's findings, the following recommendations are made:

1.Improve access to finance for MSMEs through innovative financing models and instruments.

2.Invest in infrastructure development to support MSME growth and productivity.

3.Streamline regulatory processes and provide government support to MSMEs.

4.Promote entrepreneurship development programs to enhance MSME competitiveness and innovation.

5.Training and skills development: Establish training programs, workshops and mentorship initiatives to enhance MSMEs' capacity.

5. Technology and innovation: Provide support for technology adoption, innovation and research and development.

6. Develop digital infrastructure to support MSMEs' adoption of digital technologies.

7. Invest in physical infrastructure development to support MSMEs' operations.

8. Streamline regulatory procedures and policies to support MSMEs' growth.

9. Business Development Services: Provide access to business development services, such as training and mentorship programs.

10. Facilitate networking opportunities for MSMEs, such as business networking events.

Adeyinka et al. (2019) emphasized the importance of infrastructure development for MSMEs. The Secondary method was used, where Small and Medium Enterprises Agency of Nigeria (SMEDAN) remained the sources of data for the study.

Methodology

The study employed qualitative approaches. Secondary data was collected from reputable sources, including the National Bureau of Statistics (NBS), Small and Medium Enterprises Development Agency of Nigeria (SMEDAN), and Central Bank of Nigeria (CBN). The study's population consisted of Micro, Small, and Medium Enterprises (MSMEs) in Nigeria.

Discussion of Findings

The study found that majority of MSMEs (60%) were between 1-5 years old. Most MSMEs (70%) had fewer than 10 employees in terms of size. The study found that MSME Performance includes revenue where t majority of MSMEs (60%) had annual revenues below ₦10 million and employed an average of 5-10 people with Only 30% profit being reported. The study found many Opportunities for MSMEs which includes growing demand where 70% of MSMEs reported growing demand for their products/services,increasing access to technology 60% of MSMEs reported increased access to technology (e.g., internet, mobile payments),Government Support 50% of MSMEs reported receiving government support (e.g., training, funding).

The study found that MSMEs faced many Challenges of access to finance where 80% of MSMEs cited access to finance as a major challenge, infrastructure 70% of MSMEs cited inadequate infrastructure (e.g., electricity, roads) as a challenge and regulatory environment where 60% of MSMEs cited regulatory challenges (e.g., licensing, taxation) as a challenge. Furthermore, MSMEs in Nigeria face significant challenges in accessing markets, with 40% citing market access as a major challenge (SMEDAN, 2020). MSMEs have limited access to technology and innovation, with only 15% adopting new technologies (NBS, 2020). MSMEs face significant challenges in accessing business development services, with 30% citing lack of access to business support services (CBN, 2020). MSMEs have limited access to networking opportunities, with 25% citing lack of access to business networks (NCC, 2020).

Conclusion

The study's findings highlight the challenges and opportunities faced by MSMEs in Nigeria. The study's results suggest that: Access to finance and infrastructureare major challenges facing MSMEs. Regulatory environment and government support are critical factors influencing MSME performance. Growing demand and increasing access to technology present opportunities for MSME growth and development.

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Cross-Border E-Commerce Platforms: Opportunities and Challenges for Nigerian Businesses

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Abstract

With Nigeria's growing internet penetration and increasing adoption of mobile technology, cross-border e-commerce presents significant potential for market expansion and enhanced competitivenes. However, businesses face substantial barriers, including inadequate logistics infrastructure, complex regulatory frameworks, insufficient digital literacy, and cybersecurity threats. It is against this background that this study investigates the opportunities and challenges of cross-border e-commerce for Nigerian businesses, particularly Micro, Small, and Medium-sized Enterprises (MSMEs). Employing a qualitative approach through content analysis, this research synthesizes existing literature to highlight the pressing need for cohesive strategies that address these challenges and identifies critical gaps in empirical research, particularly concerning the integration of public-private partnerships aimed at enhancing logistics and digital capabilities for Nigerian MSMEs. Based on the findings, the study proposes several recommendations: investing in infrastructure development, streamlining regulatory processes, implementing targeted digital literacy initiatives, strengthening cybersecurity measures, and fostering collaboration through public-private partnerships. By addressing these challenges, Nigerian businesses can effectively leverage cross-border e-commerce to drive economic growth and improve their competitiveness in the global marketplace. Ultimately, this study contributes to the broader discourse on the role of cross-border e-commerce in emerging markets, emphasizing the importance of targeted interventions to facilitate the successful integration of Nigerian enterprises into the global digital economy.

Keywords: Cross-border e-commerce, logistics challenges, digital transformation, regulatory compliance, cybersecurity.

1. Introduction

The rapid evolution of digital globalization has redefined the landscape of international trade, with cross-border e-commerce platforms serving as pivotal conduits for market expansion, product diversification, and enhanced business competitiveness. These platforms transcend traditional geographic barriers, enabling businesses to access international customers and engage in global commerce with unparalleled ease (OECD, 2014). For Nigeria, a nation endowed with immense entrepreneurial potential, the promise of cross-border e-commerce is particularly significant. Nigerian enterprises, especially Micro, Small, and Medium-sized Enterprises (MSMEs), stand to gain from the vast opportunities that cross-border e-commerce offers, including increased market penetration, higher profitability, and global brand visibility (WTO, 2013). This shift is propelled by Nigeria's growing internet penetration, which has surpassed 100 million users, and the accelerated adoption of mobile technology, both of which provide a robust foundation for e-commerce growth (NCC, 2020).

However, the promise of cross-border e-commerce in Nigeria is tempered by a myriad of challenges that prevent businesses from fully capitalizing on its potential. Infrastructural deficiencies remain a significant hurdle. Nigeria's logistical and transport networks are underdeveloped, leading to inefficiencies in the movement of goods across borders. High shipping costs, long delivery times, and poor supply chain coordination create substantial barriers to entry for Nigerian businesses looking to engage in international trade (Adeyinka et al., 2017). Unlike their counterparts in developed economies, Nigerian MSMEs are often forced to contend with inadequate warehousing facilities, fragmented transportation systems, and poor last-mile delivery services, which severely constrain their ability to compete in global markets.

Furthermore, the regulatory landscape in Nigeria poses additional constraints on cross-border trade. Nigeria's complex and often inconsistent regulatory frameworks, coupled with stringent customs processes and currency controls, make it difficult for businesses to navigate the global e-commerce ecosystem (CBN, 2020). Nigerian enterprises face frequent delays in customs clearance, unpredictable changes in import-export policies, and onerous documentation requirements, all of which stifle trade efficiency and limit the ability of businesses to scale their operations internationally. In addition, currency volatility remains a critical challenge, as fluctuations in the value of the naira complicate international transactions and expose businesses to exchange rate risks, reducing profitability and increasing uncertainty (Lynch et al., 2017).

Beyond these operational and regulatory challenges, Nigerian businesses are increasingly vulnerable to cyber threats in the digital marketplace. As e-commerce transactions continue to grow, so too do the risks associated with data breaches, online fraud, and cyberattacks. The Nigerian Information Society (NIS, 2020) highlights those Nigerian businesses, particularly MSMEs, are disproportionately affected by cybersecurity vulnerabilities, as many lack the resources and technical expertise to implement robust digital security measures. This makes them attractive targets for cybercriminals, further undermining their ability to build trust with international customers and partners.

Moreover, the digital literacy gap presents an additional layer of complexity. Despite the rapid expansion of internet access, many Nigerian businesses lack the necessary digital skills to fully leverage cross-border e-commerce platforms. This gap in digital proficiency hampers the effective adoption of e-commerce tools, from optimizing product listings and managing online storefronts to utilizing data analytics for business insights (Ojeka et al., 2019). The absence of targeted digital training programs leaves many businesses ill-equipped to navigate the sophisticated e-commerce ecosystems prevalent in global markets.

While the global literature extols the virtues of cross-border e-commerce, there is a dearth of research that critically examines the unique challenges faced by Nigerian businesses. Much of the existing scholarship tends to generalize the e-commerce experience, overlooking the specific contextual challenges that Nigerian enterprises encounter. These include the logistical constraints of an underdeveloped transport infrastructure, the financial burden imposed by high international shipping costs, and the complex regulatory environment (Hassan et al., 2015; Adeyinka et al., 2017). Furthermore, the role of digital literacy in enabling Nigerian MSMEs to harness the full potential of e-commerce remains underexplored, as does the impact of cyber threats on the sustainability of cross-border transactions (NIS, 2020).

This study aims to address these gaps by offering a detailed exploration of the strategies that Nigerian businesses can employ to overcome these barriers. By focusing on the critical areas of infrastructure development, regulatory reform, digital skill enhancement, and cybersecurity resilience, this paper seeks to provide Nigerian enterprises with a roadmap for success in the global e-commerce marketplace. Moreover, the study will examine how Nigerian businesses can effectively navigate currency exchange complexities and payment processing challenges to improve their global competitiveness (Kim et al., 2017; CBN, 2020). By addressing both the opportunities and challenges inherent in cross-border e-commerce, this paper contributes to the broader discourse on how developing economies like Nigeria can leverage digital trade for sustainable growth and economic diversification.

2. Literature Review

2.1 Conceptual Literature

2.1.1 Cross-Border E-Commerce: A Paradigm Shift in Global Trade

Cross-border e-commerce has revolutionized the global trade landscape, enabling businesses to transcend geographical barriers and access international markets with unprecedented ease. Defined as the buying and selling of goods and services across international borders through digital platforms, cross-border e-commerce facilitates direct interactions between buyers and sellers, bypassing traditional intermediaries (OECD, 2014). This paradigm shift has transformed how businesses, especially in emerging markets, engage with the global economy. For Nigerian enterprises, particularly Micro, Small, and Medium-sized Enterprises (MSMEs), cross-border e-commerce offers a unique opportunity to diversify revenue streams, expand product offerings, and enhance international competitiveness (WTO, 2013). Nigeria's burgeoning e-commerce ecosystem is underpinned by several factors, including a rapidly growing internet penetration rate—now

exceeding 100 million users—and the widespread adoption of smartphones, which serve as critical enablers for online transactions (NCC, 2020). Additionally, the government's policy frameworks, such as the National Digital Economy Policy and Strategy, are designed to promote digitalization and boost the country's participation in the global e-commerce market (CBN, 2020).

Cross-border e-commerce is recognized not only as a technological advancement but as a transformative mechanism for democratizing access to global trade. It offers MSMEs in developing economies like Nigeria an unprecedented opportunity to overcome traditional barriers such as inadequate local market structures and restricted access to international trading channels. By leveraging digital platforms, businesses can bypass logistical and infrastructural challenges, enabling broader market reach and enhancing revenue potential. Nevertheless, the opportunities provided by cross-border e-commerce are tempered by persistent challenges. Nigerian businesses face significant hurdles, including inadequate logistics infrastructure, limited access to affordable international payment systems, and regulatory inconsistencies, which often undermine their ability to compete effectively on a global scale. Additionally, systemic issues such as weak cybersecurity measures and insufficient capacity-building programs further constrain the growth of cross-border e-commerce in the country.

The interplay between these opportunities and challenges underscores the need for targeted policy interventions and strategic investments. Improving digital infrastructure, streamlining trade regulations, and enhancing trust in online transactions through better cybersecurity measures are critical for realizing the full potential of cross-border e-commerce. Moreover, these efforts can position Nigeria as a regional hub for digital trade, leveraging its large consumer base and growing digital literacy to drive economic growth and foster integration into the global digital economy.

2.1.2 Opportunities and Challenges for Nigerian Businesses

The transformative potential of cross-border e-commerce is accompanied by significant opportunities and challenges for Nigerian businesses. On the opportunity side, cross-border e-commerce provides a platform for Nigerian enterprises to access new markets, diversify revenue streams, and improve competitiveness. However, these opportunities are counterbalanced by substantial barriers, including underdeveloped infrastructure, regulatory complexities, and limited scalability. Infrastructural deficits, particularly in logistics and transportation, remain one of the most pressing issues. Inefficient logistics networks lead to high shipping costs, delays in delivery, and reduced customer satisfaction, thereby limiting the ability of Nigerian businesses to thrive in the international marketplace (Adeyinka et al., 2017; World Bank, 2019). These logistical challenges increase operational costs and hinder scalability, making it difficult for businesses to meet global standards in terms of speed and efficiency.

Regulatory complexities further exacerbate these challenges. Stringent currency controls, cumbersome customs procedures, and inconsistent trade policies create bottlenecks that disrupt the seamless flow of goods and services (CBN, 2020). While ongoing efforts to streamline regulations are commendable, they fall short of the streamlined processes observed in more developed economies, which facilitate smoother cross-border transactions. Addressing these challenges

requires a comprehensive approach that combines infrastructural investments, regulatory reforms, and capacity-building initiatives. By resolving these bottlenecks, Nigerian businesses can better position themselves to harness the opportunities offered by cross-border e-commerce.

2.1.3 Logistics and Supply Chain Management

Efficient logistics and supply chain management are crucial for the success of cross-border e-commerce, as they directly influence the speed, cost, and reliability of international transactions. In Nigeria, however, the logistics sector remains underdeveloped, posing significant challenges for businesses seeking to participate in global e-commerce. Key barriers include poor road infrastructure, inadequate warehousing facilities, and inefficient last-mile delivery systems, all of which contribute to higher shipping costs and longer delivery times (Adeyinka et al., 2017; Lynch et al., 2017). These inefficiencies limit the ability of Nigerian businesses to compete with international counterparts, particularly in meeting the stringent demands of global customers.

The fragmented nature of Nigeria's logistics sector further complicates matters, as businesses struggle to coordinate supply chain processes effectively. Without substantial improvements in logistics infrastructure and supply chain efficiency, Nigerian enterprises will continue to face difficulties in scaling their operations and maintaining competitive shipping times in the global market. Strategic investments in road networks, warehousing, and technology-driven logistics solutions are critical for overcoming these challenges. Such investments will not only enhance the competitiveness of Nigerian businesses but also foster greater participation in cross-border e-commerce.

2.1.4 Cybersecurity and Digital Trust

In cross-border e-commerce, cybersecurity and digital trust are foundational to building sustainable customer relationships. As digital transactions increase, the risks of cyberattacks, data breaches, and online fraud also escalate. Nigerian businesses, particularly MSMEs, are highly vulnerable to these threats due to limited resources for implementing robust cybersecurity measures (NIS, 2020).

The rise in cyberattacks targeting Nigerian e-commerce platforms highlights the urgency of addressing cybersecurity concerns. Businesses that fail to prioritize digital security risk losing consumer confidence, which is essential for sustaining cross-border trade relationships. According to Hassan et al. (2015), building digital trust involves not only safeguarding sensitive information but also ensuring the reliability and transparency of online transactions. Therefore, to address these challenges, Nigerian businesses must invest in cybersecurity infrastructure and adopt best practices for digital security. Government-led initiatives, such as awareness campaigns and subsidized cybersecurity solutions, can also play a pivotal role in mitigating risks and fostering trust in the digital marketplace.

2.1.5 Digital Literacy and Skills Development

Digital literacy is a critical determinant of a business's ability to leverage cross-border e-commerce effectively. Despite Nigeria's growing internet penetration, a significant skills gap persists, particularly among MSMEs. Many businesses lack the digital proficiency required to optimize e-commerce platforms, manage online storefronts, and engage in data-driven decision-making (Ojeka et al., 2019). The Nigerian Communications Commission (2020) emphasizes the importance of

targeted digital skills training to bridge this gap. Without adequate digital literacy, businesses are unable to utilize advanced e-commerce technologies, such as data analytics and customer relationship management tools, or navigate the complexities of cross-border transactions. Enhancing digital literacy is essential not only for managing the operational aspects of e-commerce but also for maximizing opportunities in global markets. Investments in digital skills development programs, coupled with public-private partnerships, can empower Nigerian businesses to compete more effectively in the global e-commerce landscape. By fostering a digitally skilled workforce, Nigeria can unlock the full potential of cross-border e-commerce for economic growth and development.

2.2 Theoretical Framework

The theoretical framework for this study is grounded in three key theories: the Technology Acceptance Model (TAM), Transaction Cost Economics (TCE), and Institutional Theory. Each of these frameworks provides a unique lens for understanding the dynamics of cross-border e-commerce adoption, the cost structures involved, and the influence of institutional factors on Nigerian businesses.

2.2.1. Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), developed by Davis (1989), is a widely adopted framework that explains user acceptance of new technologies based on two primary factors: perceived usefulness and perceived ease of use. In the context of cross-border e-commerce, TAM suggests that Nigerian businesses' willingness to adopt digital platforms is largely influenced by how beneficial they perceive these platforms to be in expanding market access and improving operational efficiency (Davis, 1989). However, the challenges posed by low digital literacy and the perceived complexity of managing cross-border transactions can negatively impact the perceived ease of use, thereby limiting the adoption of these technologies among Nigerian MSMEs (Ojeka et al., 2019). This model underscores the need for businesses to perceive e-commerce platforms as user-friendly and valuable to their long-term business goals for successful adoption.

2.2.2. Transaction Cost Economics (TCE)

Transaction Cost Economics (TCE), introduced by Williamson (1981), is an economic theory that explores how businesses seek to minimize the costs associated with transactions, including search and information costs, bargaining costs, and enforcement costs. In the realm of cross-border e-commerce, Nigerian businesses encounter heightened transaction costs due to logistical inefficiencies, currency fluctuations, and complex regulatory environments. These costs act as significant barriers to the smooth functioning of cross-border trade, reducing profitability and increasing the risks associated with international transactions (Adeyinka et al., 2017; Lynch et al., 2017). The TCE framework is particularly relevant in explaining why Nigerian businesses must invest in reducing transaction costs by improving logistical capabilities, adopting more efficient payment systems, and streamlining compliance with international trade regulations.

2.2.3. Institutional Theory

Institutional Theory, as articulated by North (1990), posits that organizations operate within a broader institutional environment that shapes their behavior, strategies, and outcomes. This theory is highly pertinent in the context of cross-border e-commerce, as Nigerian businesses must navigate a complex institutional landscape characterized by regulatory, legal, and cultural factors. Institutional Theory explains how businesses are influenced by the rules, norms, and policies established by government agencies, trade organizations, and regulatory bodies (North, 1990). In Nigeria, the institutional environment includes restrictive currency controls, complicated customs procedures, and evolving e-commerce regulations, all of which impact how businesses engage in cross-border trade (CBN, 2020). The theory highlights the need for Nigerian businesses to adapt to institutional pressures while advocating for reforms that simplify the regulatory environment and promote greater participation in the global e-commerce ecosystem.

By integrating the Technology Acceptance Model (TAM), Transaction Cost Economics (TCE), and Institutional Theory, this study provides a robust theoretical foundation for analyzing the opportunities and challenges of cross-border e-commerce for Nigerian businesses. The adoption of e-commerce platforms, the minimization of transaction costs, and the navigation of complex institutional frameworks are key determinants of success in the global digital economy. Addressing the infrastructural, regulatory, and digital literacy barriers identified in the conceptual literature will be essential for Nigerian businesses to fully realize the benefits of cross-border e-commerce and enhance their global competitiveness.

2.3 Previous Studies

Numerous studies have explored the dynamics of cross-border e-commerce, particularly in the context of emerging markets, offering valuable insights into the challenges and opportunities that businesses face when engaging in international trade through digital platforms. A key study by Kim et al. (2017) examined the impact of cross-border e-commerce on firm performance in South Korea, highlighting how digital platforms enabled firms to access new markets, reduce transaction costs, and enhance profitability. The study found that firms with greater digital capabilities experienced more success in expanding their international presence. While the study focused on South Korea, it offers important lessons for Nigerian businesses, particularly MSMEs, which seek similar benefits in terms of market expansion and enhanced competitiveness.

In Southeast Asia, Cheong and Park (2018) examined the growth of cross-border e-commerce, noting that businesses in the region face challenges similar to those of Nigerian enterprises, particularly in terms of inadequate logistics systems and inconsistent regulatory frameworks. Their research emphasized the need for businesses to partner with international logistics providers and develop strategies to adapt to local regulations to mitigate these challenges. This study is particularly relevant to Nigeria, where similar infrastructural deficiencies and regulatory bottlenecks limit the efficiency of cross-border trade. The authors concluded that businesses in developing countries must focus on strategic partnerships and regulatory compliance to overcome these barriers and succeed in the global marketplace.

In the Nigerian context, several studies have specifically addressed the unique challenges that businesses face in engaging with cross-border e-commerce platforms. Adeyinka et al. (2017) conducted a comprehensive study on the logistical challenges impeding Nigerian businesses from participating effectively in global e-commerce. The research identified poor transportation infrastructure, high shipping costs, and inefficient customs procedures as major constraints. The study concluded that addressing these infrastructural barriers is critical for enhancing the competitiveness of Nigerian MSMEs in international markets. Similarly, Ojeka et al. (2019) examined the role of digital literacy in enabling Nigerian businesses to engage with cross-border e-commerce. Their study found that despite increasing internet penetration, many Nigerian businesses lack the digital skills necessary to optimize their participation in e-commerce platforms, thereby limiting their potential in global trade.

Regulatory and policy challenges have also been a recurring theme in studies on cross-border e-commerce in Nigeria. Oyelaran-Oyeyinka et al. (2017) investigated how Nigeria's regulatory environment impacts MSME participation in international trade, finding that complex customs procedures, inconsistent trade policies, and restrictive currency controls serve as significant barriers to cross-border e-commerce. The authors argued that without substantial reforms to simplify the regulatory landscape, Nigerian businesses would continue to face difficulties in competing with firms from more developed economies. These findings are echoed by the Central Bank of Nigeria (CBN, 2020), which also highlighted the need for regulatory reform to enhance Nigeria's engagement in global digital trade. The studies suggest that comprehensive regulatory reforms are essential for creating a conducive environment for cross-border e-commerce in Nigeria.

Another important factor highlighted in the literature is the impact of language and cultural barriers on cross-border e-commerce adoption. Hassan et al. (2015) explored the difficulties Nigerian businesses face in communicating with international customers due to language differences and cultural misunderstandings. This presents a unique challenge for Nigerian businesses operating in non-English speaking regions, where effective communication is essential for customer engagement and marketing. The authors suggested that businesses invest in language training and cultural adaptation strategies to improve their global competitiveness. This study underscores the importance of cultural understanding in international trade, which can be a significant determinant of success or failure in cross-border e-commerce.

Cybersecurity has emerged as another critical issue in the literature on cross-border e-commerce. Lynch et al. (2017) conducted a study on the role of cybersecurity in cross-border trade, focusing on the risks posed by cyberattacks and data breaches. They found that businesses engaged in cross-border e-commerce are more vulnerable to cyber threats due to the complexity of international transactions and increased exposure to global markets. This is particularly relevant to Nigerian businesses, which often lack the resources to implement robust cybersecurity measures (NIS, 2020). Lynch et al. (2017) emphasized the importance of investing in cybersecurity infrastructure to protect sensitive data and maintain trust in online transactions, a sentiment echoed by Hassan et al. (2015), who argued that building consumer trust is essential for the success of e-commerce, especially in international markets.

Various studies have also proposed solutions to the challenges facing cross-border e-commerce in emerging markets. For example, Cheong and Park (2018) recommended that businesses partner with international logistics providers to streamline supply chains and reduce shipping costs. They also suggested that businesses develop compliance strategies tailored to the regulatory environments of their target markets, which can reduce friction and enhance operational efficiency in cross-border transactions. In Nigeria, Adeyinka et al. (2017) advocated for public-private partnerships to improve the country's logistics infrastructure. The authors argued that such partnerships would allow Nigerian businesses to benefit from international expertise in supply chain management while addressing domestic challenges that limit their participation in global trade.

Ojeka et al. (2019) also proposed digital literacy programs as a solution to the skills gap that impedes Nigerian businesses from fully engaging with cross-border e-commerce platforms. The authors argued that by improving digital proficiency, businesses would be better equipped to navigate the complexities of e-commerce technologies and optimize their operations for international trade. This recommendation aligns with findings from Cheong and Park (2018), who found that digital education programs significantly improved e-commerce adoption rates in Southeast Asia. The studies collectively underscore the importance of targeted interventions ranging from infrastructure development to regulatory reform and skills enhancement in unlocking the potential of cross-border e-commerce for Nigerian businesses.

Extensive scholarly research highlights the pivotal role of Micro, Small, and Medium-sized Enterprises (MSMEs) in fostering economic growth, enhancing job creation, and promoting innovation within Nigeria's rapidly evolving economy. MSMEs constitute the backbone of the Nigerian industrial ecosystem, contributing significantly to the nation's Gross Domestic Product (GDP) and employment generation (Oyelaran-Oyeyinka et al., 2017). However, despite their economic significance, Nigerian MSMEs face a complex array of challenges, particularly in leveraging cross-border e-commerce platforms to expand into global markets. These challenges, which are rooted in infrastructural, regulatory, and technological deficiencies, create formidable barriers to effective engagement in international trade.

One of the most critical barriers impeding the participation of Nigerian businesses in cross-border e-commerce is the country's poor infrastructure, particularly in the areas of logistics and transportation. As highlighted by Adeyinka et al. (2017) and corroborated by World Bank (2019), the underdeveloped logistical network in Nigeria not only increases the cost of transporting goods across borders but also extends delivery times, significantly reducing the competitiveness of Nigerian businesses in international markets. The inadequacies in transport infrastructure result in higher shipping costs, delayed deliveries, and compromised customer satisfaction, all of which diminish the global standing of Nigerian enterprises. Lynch et al. (2017) further argue that the fragmented state of Nigeria's logistics sector has rendered the country less competitive compared to its counterparts in other emerging markets, where streamlined transport systems play a crucial role in facilitating smooth cross-border trade.

In addition to infrastructural constraints, regulatory hurdles remain a significant impediment to the seamless integration of Nigerian businesses into the global e-commerce ecosystem. Nigeria's regulatory environment is often characterized by cumbersome customs procedures, unpredictable policy shifts, and stringent currency controls, all of which create bottlenecks in the flow of goods and services across borders. As noted by CBN (2020), Nigeria's currency exchange restrictions and complex regulatory frameworks pose a substantial challenge to cross-border transactions, as businesses are forced to navigate an intricate web of compliance requirements that undermine efficiency. Moreover, while Nigeria's e-commerce regulations are evolving, they remain relatively underdeveloped compared to those in more advanced economies. The Nigerian Communications Commission (2020) observes that the current regulatory framework is still fraught with inefficiencies, including inconsistent enforcement, inadequate dispute resolution mechanisms, and limited protection for digital consumers.

The issue of regulatory complexity is further compounded by the digital skills gap that persists across Nigerian enterprises. Despite the exponential growth in internet access, many Nigerian businesses, particularly MSMEs, lack the requisite digital literacy to fully exploit the potential of cross-border e-commerce platforms (Ojeka et al., 2019). The absence of comprehensive digital education and training initiatives has left a significant portion of Nigerian businesses unable to adopt advanced e-commerce technologies, thereby limiting their participation in global digital markets. This digital divide is exacerbated by the rapid pace of technological innovation, which often outstrips the ability of businesses to keep pace with new tools, platforms, and processes. The Nigerian Communications Commission (2020) underscores the urgency of bridging this digital literacy gap, advocating for targeted initiatives that would equip Nigerian businesses with the skills needed to harness e-commerce technologies effectively.

Cybersecurity represents another critical challenge that Nigerian businesses must contend with in the cross-border e-commerce landscape. As digital transactions continue to grow, so too do the risks associated with cyber threats, including data breaches, online fraud, and malicious cyberattacks. The Nigerian Information Society (2020) reports a surge in cyberattacks targeting e-commerce platforms, which poses a significant threat to the sustainability of Nigerian businesses in the global marketplace. These cybersecurity vulnerabilities are particularly pronounced among MSMEs, which often lack the financial and technical resources to implement robust cybersecurity measures. The absence of adequate digital security infrastructure not only exposes Nigerian businesses to financial losses but also erodes consumer trust, which is critical for sustaining long-term engagement in cross-border e-commerce. Lynch et al. (2017) emphasizes that building strong cybersecurity frameworks is essential for enabling Nigerian businesses to compete confidently in international markets, where trust and reliability are paramount.

The reviewed literature reveals that cross-border e-commerce holds significant promise for Nigerian Micro, Small, and Medium-sized Enterprises (MSMEs) seeking to expand into global markets. However, despite its potential, Nigerian businesses face numerous challenges, including infrastructural inadequacies, regulatory complexities, limited digital literacy, and cybersecurity

risks, which hinder their effective participation in international trade. The studies reviewed suggest that addressing these challenges is crucial to unlocking the potential of cross-border e-commerce in Nigeria. Infrastructural improvements, particularly in logistics and transportation, are essential to reducing the high costs and delays that currently limit the competitiveness of Nigerian businesses in global markets. Furthermore, the regulatory environment needs significant reform to streamline customs procedures, reduce policy unpredictability, and eliminate barriers such as stringent currency controls, which currently inhibit cross-border transactions.

The digital skills gap is another major barrier, as many Nigerian businesses lack the necessary capabilities to navigate the complex e-commerce landscape. As the global digital economy evolves rapidly, targeted initiatives focused on enhancing digital literacy are imperative for equipping MSMEs with the tools they need to leverage e-commerce platforms effectively. Additionally, the growing threat of cyberattacks presents a critical risk to Nigerian businesses engaged in cross-border trade. Investing in robust cybersecurity infrastructure will be essential to safeguard sensitive data and maintain consumer trust, both of which are vital for the sustainability of e-commerce ventures.

Finally, while some studies propose solutions, such as public-private partnerships for infrastructure development and digital education programs, there remains a need for comprehensive, coordinated efforts at the national level. Only through a multi-pronged approach, encompassing infrastructure improvement, regulatory reform, digital skills enhancement, and stronger cybersecurity measures, can Nigerian MSMEs fully harness the benefits of cross-border e-commerce. Therefore, while significant challenges remain, addressing these issues presents an opportunity to position Nigerian businesses as competitive players in the global digital marketplace. The recommendations in the reviewed studies provide a roadmap for overcoming these barriers, enabling Nigerian MSMEs to thrive in the international arena, driving economic growth, creating jobs, and enhancing the country's global competitiveness.

3. Methodology

This study employs a qualitative research design through selective content analysis, making it primarily literature-based. Qualitative research is characterized by the use of diverse empirical materials, including text analysis and secondary data, to explore complex phenomena without necessarily relying on prior hypotheses (Ambert et al., 1995; Bogdan & Biklen, 2003). In this context, the emphasis is on conceptual understanding rather than the development of quantitative measures (Bryman, 2008; Robson, 2011). The methodology involves a comprehensive review and analysis of relevant literature, including academic journals, books, periodicals, and credible online sources, to investigate the opportunities and challenges associated with cross-border e-commerce for Nigerian businesses, particularly Micro, Small, and Medium-sized Enterprises (MSMEs). Through this approach, the study aims to synthesize existing knowledge, identify gaps in the literature, and draw insightful conclusions that highlight the relationships between infrastructural challenges, regulatory issues, digital literacy, and the overall performance of Nigerian MSMEs in the global e-commerce landscape.

4. Conclusion and Recommendations

This paper concludes that cross-border e-commerce presents a transformative opportunity for Nigerian businesses, particularly Micro, Small, and Medium-sized Enterprises (MSMEs), to expand their market reach and enhance their competitiveness on the global stage. The growing internet penetration and the increasing adoption of mobile technologies provide a solid foundation for leveraging digital platforms to access international customers. However, the journey toward successful integration into the global e-commerce landscape is fraught with significant challenges. Key barriers such as inadequate logistics infrastructure, complex regulatory frameworks, insufficient digital literacy, and cybersecurity threats inhibit the ability of Nigerian enterprises to fully capitalize on the potential of cross-border e-commerce.

The literature review underscores that while there are numerous studies documenting these challenges, there remains a substantial gap in empirical research focused on cohesive strategies that Nigerian businesses can implement to navigate this complex environment. The need for targeted interventions that encompass infrastructural development, regulatory reform, and digital skills training is critical. Furthermore, the lack of comprehensive studies addressing the effectiveness of public-private partnerships in enhancing logistics infrastructure and digital capabilities for Nigerian MSMEs highlights an area ripe for future research and development.

To facilitate the successful integration of Nigerian businesses into the global e-commerce ecosystem, several recommendations are proposed:

1. The Nigerian government should prioritize investments in logistics and transportation infrastructure to streamline the movement of goods across borders. This includes enhancing road networks, improving port facilities, and developing efficient last-mile delivery systems. Public-private partnerships can play a crucial role in mobilizing resources and expertise to achieve these infrastructural improvements.

2. A thorough review and simplification of existing regulatory frameworks are necessary to foster a more conducive environment for cross-border e-commerce. This includes addressing cumbersome customs procedures, reducing import-export barriers, and establishing clear guidelines for digital trade. Engaging stakeholders from the private sector in the policy-making process can ensure that regulations are practical and supportive of business growth.

3. To bridge the digital skills gap, targeted training programs must be implemented to equip Nigerian businesses with the necessary competencies to navigate e-commerce platforms effectively. Collaboration with educational institutions, non-governmental organizations, and international partners can facilitate the development of comprehensive digital literacy curricula tailored to the specific needs of MSMEs.

4. As cybersecurity threats continue to escalate, Nigerian businesses must prioritize the implementation of robust digital security measures to protect against cyberattacks. This includes investing in cybersecurity infrastructure, training employees on best practices, and fostering a culture of security awareness. Government support in developing national cybersecurity policies and frameworks can further bolster the security posture of businesses engaged in cross-border e-commerce.

5. Encouraging public-private partnerships can significantly enhance the capacity of Nigerian MSMEs to engage in cross-border e-commerce. By collaborating with international logistics providers, technology firms, and regulatory bodies, Nigerian businesses can gain access to expertise, resources, and networks that facilitate smoother entry into global markets.

6. Future research should focus on exploring the effectiveness of various strategies that Nigerian businesses can employ to overcome barriers to cross-border e-commerce. Empirical studies investigating the impact of public-private partnerships on logistics and digital literacy, as well as case studies of successful Nigerian firms in international markets, will provide valuable insights for policymakers and practitioners.

Overall, while cross-border e-commerce offers immense potential for growth and development, the successful integration of Nigerian businesses into this global framework will require a concerted effort from government, private sector stakeholders, and academia. By addressing the critical challenges identified in the literature and implementing the recommended strategies, Nigeria can position itself as a competitive player in the global e-commerce arena, driving economic growth, job creation, and innovation in the digital age. The path forward lies in collaboration, strategic investment, and a commitment to overcoming the barriers that currently inhibit the full realization of cross-border e-commerce.

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Agribusiness Innovation in Nigeria: Issues, Opportunities and Options for Growth

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Abstract

This paper attempts to assess innovative approach to agribusiness in Nigeria while taking account of the major issues and attendant opportunities available in the sector with a view to redefining an attractive strategic option that will deliver the anticipated business environment conducive enough to sustain existing local players and enticing to a would-be foreign investor. The effort was made to review, contextual classification of Agribusiness, Role of Research in Agribusiness, Challenges Facing Agribusiness in Nigeria, Policy Frameworks for Agribusiness Development and Leveraging Technology for Agribusiness. The paper concluded by stressing that inadequate infrastructure, access to finance, technological advancements, policy frameworks, and sustainability is essential in unlocking the vast potential of Nigeria's agribusiness sector. The paper recommends for building a resilient and sustainable agribusiness framework that contributes to a diverse, thriving economy. It is also recommended that effort should be made towards building an advance agribusiness via comprehensive research, will be crucial in steering the nation toward sustainable industrial growth and development.

Keywords: Agribusiness, Innovation, Nigeria, Agriculture, Policy

1.0 Introduction

Nigeria, often termed the "Giant of Africa", possesses abundant natural resources, a vast workforce, and an emerging market dynamic that suggests a plethora of opportunities ripe for exploration, especially in the realm of agribusiness. The nexus between agribusiness and industrial development is not just a matter of economic necessity but also a powerful driver for socio-economic transformation, poverty alleviation, and sustainable development. By delving into the intricacies of agribusiness research within Nigeria's context, we can gain a deeper understanding of its implications for industrial development.

1.1 Nigeria's Agribusiness Landscape

Agribusiness encompasses a wide range of activities, including production, processing, distribution, and consumption of agricultural products. In Nigeria, agriculture employs approximately 36% of the workforce and contributes about 22% to the Gross Domestic Product (GDP) (Food and Agriculture Organisation, 2021). Despite these contributions, the agribusiness sector is often characterised by challenges such as inadequate infrastructure, climate change impact, and poor access to finance. However, with the correct research and policy interventions, these hurdles can be transformed into opportunities for industrial development.

2.0 Contextual classification of Agribusiness

As a complex system, Agribusiness comprises the input sector, production sector, processing manufacturing sector and transport and marketing sector. According to Chandrasekan *et, al.,* (2010), it is directly related to industry, commerce and trade. The industry is concerned with the production of commodities and materials while commerce &trade are concerned with their distribution. Industry can be Extractive, Genetic or manufacturing-based while commerce can be grouped on the basis of volume (*wholesale trade and retail trade*), basis of coverage (*regional trade or national trade*). As a social institution, Agribusiness existence is dependent upon its harmonious relationship with various segments of the society. The process of evolving a mutual relationship between agribusiness farms and various interest groups begins with acknowledging the existence of the

responsibilities of the manager. These responsibilities are towards consumers, suppliers, distributors, workers, financiers, government and the society. Yumkella et al, (2011) further classified it into four main sub-classes ***Agricultural input industry:*** concerned with factors responsible for an improved productivity in the sector such as machineries, equipment and tools, inputs (fertilizer, pesticides & insecticides, etc.); ***Agro-industry products:*** concerned with agricultural products including food and beverages, leather products, wood, textile etc., ***Equipment for processing:*** machinery, tools storage facilities, cooling technology and spare parts; ***Financing, Marketing distribution and other services firms:*** Storage, transport, ICTs, packaging materials and design, etc.

3.0 The Role of Research in Agribusiness

Research in agribusiness is crucial to understanding market needs, resource allocation, and technological innovation. A comprehensive body of research is required to identify the factors that inhibit growth in this sector and propose solutions that can stimulate industrial development. The Centre for Agricultural Research and Development in Nigeria has been pivotal in conducting relevant studies to enhance agricultural productivity and innovation. Their findings have highlighted the importance of crop diversification and improved farming techniques, which can ultimately lead to increased food production and security (Nigerian Agricultural Research Council, 2020).

4.0 Challenges Facing Agribusiness in Nigeria

Despite the potential that agribusiness holds, numerous challenges hinder Nigeria's path to achieving its agricultural and industrial goals. One primary challenge is inadequate infrastructure. The rural areas in which many agricultural activities are concentrated often lack reliable roads, power supply, and storage facilities. These deficits lead to high post-harvest losses, which the Food and Agriculture Organisation estimates to be as high as 40% for certain crops (FAO, 2021). By undertaking research to analyse the impact of infrastructural deficiencies and suggesting feasible funding methods for rural development, agribusiness can better link production to markets, thereby facilitating industrial growth.

Another critical concern is the access to finance. Many smallholder farmers, who form the backbone of Nigeria's agricultural sector, struggle to obtain loans due to inadequate credit history, lack of collateral, and perceived high risk by financial institutions. According to the World Bank, less than 10% of smallholder farmers in Nigeria have access to credit (World Bank, 2022). Research can provide insight into innovative financing models, such as microfinance or cooperative funding systems, which can empower these farmers to enhance productivity and contribute to the industrial growth of agro-processing industries.

5.0 Leveraging Technology for Agribusiness

In recent years, technology has emerged as a beacon of hope for agribusiness in Nigeria. The rise of digital agriculture, mobile applications, and precision farming has the potential to revolutionise agricultural practices and efficiency. Research into the implementation of such technologies can highlight their benefits in terms of yield optimisation and cost reduction. For instance, studies conducted by the International Institute of Tropical Agriculture (IITA) have indicated that introducing digital platforms enabling farmers to access market information, weather forecasts, and agricultural best practices leads to improved decision-making (IITA, 2023). Such innovations not only increase productivity but also create an ecosystem that can foster industrial development by encouraging the establishment of agro-based industries that process raw agricultural products.

6.0 Policy Frameworks for Agribusiness Development

Equally significant is the role of government policy in facilitating agribusiness research and development. Policies that prioritise agricultural research funding, foster public-private partnerships, and encourage investment in infrastructure are essential components of a robust agribusiness environment. The Nigerian National Agricultural Land Development Authority (NALDA) is one such initiative aimed at promoting agricultural development through strategic research and policy-making (NALDA, 2022).

However, the effectiveness of these policies often depends on the coherence and alignment of various government bodies and stakeholders within the agribusiness framework. Research is necessary to sort through the complexity of these relationships and identify best practices for collaborative governance in agribusiness.

7.0 Environmental Sustainability in Agribusiness

With increasing global attention on climate change, how agribusiness practices impact the environment has become a significant concern. Sustainable agribusiness is essential not only for environmental preservation but also for long-term industrial development. Research in this field can pinpoint sustainable practices such as agroforestry, organic farming, and integrated pest management. These methods can improve soil health, enhance biodiversity, and increase resilience to climate-related shocks, ultimately leading to sustainable food systems (Ogunoye & Ogunjimi, 2021).

Furthermore, incorporating sustainability metrics into agribusiness performance assessments allows for a clearer understanding of how industrial development can harmoniously coexist with environmental stewardship. A proactive approach has the potential to position Nigeria as a leader in sustainable agribusiness within the global market, attracting investment and fostering growth.

8.0 Conclusion

In conclusion, the symbiotic relationship between agribusiness and industrial development in Nigeria cannot be overstated. Agribusiness serves as a pivotal element not only in having a food-secure nation but also in driving economic growth and reducing poverty. Targeted research addressing the challenges of inadequate infrastructure, access to finance, technological advancements, policy frameworks, and sustainability is essential in unlocking the vast potential of Nigeria's agribusiness sector.

9.0 Recommendation

Utilising empirical evidence and innovative practices can create pathways for the industrialisation of agricultural resources, thereby ensuring a transformative impact on the broader economy. Given Nigeria's economic trajectory and potential, the advancement of agribusiness via comprehensive research will be crucial in steering the nation toward sustainable industrial growth and development.

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The Challenges of Open and Distance Flexible Education and Learning (ODFEL) in Northern Nigeria: Barriers to Access and Quality Education.

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Abstract

The study investigated barriers to Open and Distance Flexible Education and Learning (ODFEL) in Northern Nigeria, with a focus on infrastructural, socio-cultural, technological, and policy-related challenges, particularly for marginalized groups such as women. Building on existing research that identifies infrastructure deficits, socio-cultural constraints, and inadequate policy frameworks, the study aimed to examine the specific obstacles to ODFEL implementation in the region. Using a qualitative research design, data were collected through semi-structured interviews, focus group discussions, and document analysis, involving 30 participants—educators, students, and administrators from five institutions offering ODFEL in Northern Nigeria. The analysis revealed that infrastructural issues were the most prominent barrier (67%), followed by technological constraints (60%), socio-cultural factors (50%), and policy-related challenges (40%). These factors were found to limit the accessibility and effectiveness of ODFEL, especially for women and marginalized communities. The study concludes that addressing these barriers requires targeted improvements in infrastructure, greater gender inclusivity, and the development of robust policy frameworks to enhance ODFEL's effectiveness and ensure equitable access to education for underserved populations.

Keywords: Open and Distance Learning; Access Barriers and Quality Education

1.0 Introduction

Open and Distance Flexible Education and Learning (ODFEL) has become an essential alternative to traditional educational systems, particularly in regions with limited access to quality education. In Northern Nigeria, socio-economic challenges, cultural factors, and infrastructural deficits have hindered educational progress, particularly among women and marginalized communities. The region has faced historically low enrollment rates, inadequate infrastructure, and a shortage of trained educators, all compounded by socio-cultural norms that often prioritize traditional roles over education (Adamu, 2021). ODFEL provides a potential solution by offering flexible learning opportunities to reach diverse populations, regardless of their geographical or socio-economic backgrounds. However, several barriers obstruct its full implementation, including insufficient technological infrastructure, limited access to digital devices, and inadequate digital literacy among both educators and learners (Aliyu, 2023). Additionally, the lack of clear policies and funding to support ODFEL initiatives further exacerbates these challenges. This study investigated the specific barriers to access and quality in ODFEL in Northern Nigeria, areas that require targeted interventions to improve educational outcomes in the region. By understanding these challenges, the study informs strategies that can enhance the effectiveness of ODFEL and promote equitable access to education for all.

1.1 Statement of the Problem

Despite the significant potential of Open and Distance Flexible Education and Learning (ODFEL) to enhance educational access and equity in Northern Nigeria, several barriers continue to undermine its effectiveness in the region. These barriers, both structural and socio-cultural, severely limit the reach, quality, and sustainability of ODFEL initiatives.

One of the primary obstacles is inadequate infrastructure, including unreliable internet connectivity and frequent power supply issues. These infrastructural deficits hinder the accessibility and continuity of ODFEL programs, particularly in rural and underserved areas of Northern Nigeria. Without a stable and reliable infrastructure, ODFEL platforms remain underutilized, preventing learners from fully benefiting from these educational opportunities.

Another critical challenge lies in socio-cultural factors, especially entrenched gender disparities and traditional attitudes toward education. In Northern Nigeria, cultural norms often restrict the participation of women and marginalized groups in educational programs. These socio-cultural barriers create a significant gap in access to education for a large segment of the population, further exacerbating educational inequalities. Gender biases, coupled with limited community awareness of the benefits of distance learning, prevent many potential learners from enrolling in or completing ODFEL programs.

In addition to infrastructural and socio-cultural barriers, technological constraints also impede the successful implementation of ODFEL. Many educational institutions lack the necessary tools and platforms to deliver high-quality distance education, and educators often face challenges in adapting to new technologies for teaching and learning. Without adequate training and access to relevant technologies, the quality of education delivered through ODFEL remains subpar, limiting its overall impact.

Finally, a lack of coherent educational policies further complicates the situation. While distance education is acknowledged in policy documents, there is no comprehensive national framework to guide its development and ensure its sustainability. Policy gaps in areas such as funding, teacher training, and curriculum development prevent ODFEL initiatives from achieving their full potential. The absence of clear, strategic planning for distance education initiatives leaves educational institutions and learners without the necessary support and direction.

These combined challenges contribute to persistent educational inequities in Northern Nigeria, limiting access to quality education and hindering socio-economic development in the region. Therefore, there is an urgent need to identify and address these barriers in order to enhance the effectiveness of ODFEL programs, improve access to education, and foster educational equity in Northern Nigeria. Addressing these obstacles will ensure that ODFEL can become a transformative tool for educational development, particularly for marginalized and underserved populations in the region.

1.2 Objectives of the Study

The study explored the specific infrastructural, socio-cultural, technological, and policy-related barriers that hinder the implementation of ODFEL (Open and Distance Education for Lifelong Learning) in Northern Nigeria. It examined how these challenges limit access to ODFEL programs, especially for women and marginalized communities. The research also assessed the impact of these barriers on the overall quality of education delivered through ODFEL initiatives. By identifying these obstacles, the study provided practical recommendations for policymakers, educational institutions, and community stakeholders aimed at improving both access to education and the quality of ODFEL in the region. Ultimately, the research offered valuable insights into the complexities of distance education in Northern Nigeria and highlighted the importance of a comprehensive approach to fostering inclusive educational opportunities.

1.3 Significance of the Study

The significance of this study addresses educational inequities and the barriers to ODFEL in Northern Nigeria, thereby providing insights for targeted interventions for underrepresented groups. It offers valuable guidance for policymakers in developing effective frameworks to support ODFEL initiatives. The research also identified educational quality by highlighting areas for enhancement, which would benefited both educators and learners. By raising awareness of the challenges associated with ODFEL, the study encourages community engagement and support for inclusive educational initiatives. Ultimately, this research contributes to the academic literature on distance education in Nigeria, serving as a resource for future studies.

2.0 Theoretical framework

The theoretical framework for this study is rooted in Constructivist Learning Theory, which suggests that learners actively build knowledge through their interactions and experiences with their environment. In the context of ODFEL, this theory underscores the importance of learner-centered methods, where flexibility and accessibility play key roles in facilitating effective learning. Additionally, the Community of Inquiry framework is applied, as it emphasizes the essential roles of social, cognitive, and teaching presence in creating meaningful learning experiences in distance education. Together, these theories provide a solid foundation for understanding how ODFEL can be structured to promote learner engagement and improve educational outcomes.

To explore the challenges of Open and Distance Flexible Education and Learning (ODFEL) in Northern Nigeria, particularly regarding barriers to access and educational quality, social constructionism is employed. This theory focuses on how social contexts, interactions, and institutional factors shape individuals' perceptions and experiences. In the case of ODFEL, social constructionism offers a lens to examine how cultural, societal, and economic elements in Northern Nigeria impact the adoption and success of distance education. The framework helps investigate how local socio-cultural norms, family expectations, and regional economic disparities influence both the accessibility and quality of ODFEL. For example, gender norms in Northern Nigeria may limit women's educational opportunities, even in flexible learning settings. Furthermore, cultural attitudes toward education can influence learners' willingness to engage with online learning platforms.

2.1 Conceptual framework

Open Education: This is an approach that focuses on providing access to learning for everyone, often with minimal barriers to entry. Open education typically emphasizes open access to resources (like textbooks, lectures, and courses), allowing learners from anywhere to participate in educational opportunities. The goal is to increase inclusivity and make learning more accessible to a global audience.

Distance Education: This is a teaching method where students and instructors are separated by time, space, or both. Distance education often involves online classes, correspondence courses, or other remote learning options. It's designed to allow learners to engage with course materials and complete coursework without needing to be physically present in a traditional classroom.

Flexible Learning: Flexible learning is all about adapting the learning experience to fit the needs of individual students. It provides various options in terms of the time, place, pace, and mode of learning. It allows students to tailor their education to their personal schedules, learning styles, and life circumstances.

ODFEL combines these three elements, promoting an educational system that is open, accessible, distance-based, and flexible. The goal is to create an environment where learners can engage in education in a way that suits their own needs, allowing them to study at their own pace and from any location, using a variety of resources and technologies. ODFEL has become increasingly popular with the rise of online courses, digital platforms, and open educational resources (OERs). It's particularly beneficial for people who may not have access to traditional, in-person education due to geographic, financial, or personal constraints.

Socio-cultural factors, such as societal attitudes, cultural norms, and regional disparities, significantly influence access to Open and Distance Flexible Education and Learning (ODFEL) in Northern Nigeria. Gender biases often restrict women's access to education, even in flexible formats, while family expectations and cultural norms further limit certain groups, such as girls or individuals in rural areas, from accessing technology or participating in online learning. Additionally, regional economic disparities can affect the availability of necessary infrastructure and resources, making it difficult for learners to engage with ODFEL. Barriers to access, such as unreliable internet, limited electricity, poor technological literacy, and financial constraints, further hinder learners' ability to take full advantage of ODFEL opportunities, impacting their educational outcomes. These infrastructural challenges are particularly pronounced in remote or conflict-affected areas where access to reliable digital devices and internet connectivity is limited.

The effectiveness of ODFEL also hinges on teacher preparedness and learner engagement. In Northern Nigeria, a lack of teacher training in online education and limited professional development opportunities significantly affect the quality of virtual teaching and learning. Teachers must be equipped not only with pedagogical skills but also with the ability to manage digital platforms and engage effectively with students in virtual environments. Learner engagement, influenced by socio-cultural factors like family obligations or limited familiarity with digital tools, is crucial for successful online learning. When students lack motivation or face barriers to engaging with online content, the quality of education suffers. Moreover, the relationship between technological infrastructure and teacher training is crucial: even well-trained educators will struggle to deliver effective learning experiences without the necessary technological resources, such as reliable internet and digital devices, making the quality of education dependent on both the availability of infrastructure and the expertise of instructors.

The importance of Open and Distance Flexible Education and Learning (ODFEL), particularly in regions like Nigeria and the northern parts of the country, cannot be overstated. ODFEL offers a way to address key challenges in education, particularly in areas where access to traditional educational institutions is limited. Enhanced Accessibility: ODFEL enables learners in remote or underserved areas to access education without the need for physical attendance, especially in areas with limited infrastructure and socio-economic barriers.

1. Inclusive Education: It offers opportunities for diverse learners, including adults, working individuals, and those with disabilities, promoting an inclusive educational system that caters to all backgrounds and ages.
2. Cost Savings: ODFEL reduces educational costs by eliminating the need for commuting and infrastructure maintenance, making it more affordable for both students and institutions.
3. Flexible Learning: It allows students to learn at their own pace, providing flexibility that is especially valuable in regions with cultural norms or responsibilities that may interfere with traditional schooling.
4. Access to High-Quality Education: ODFEL makes use of digital resources like online courses and virtual classrooms, providing students with access to quality education from global experts and modern technologies.

2.1.1 Factors That Bring About ODFEL in Nigeria and Northern Regions

1. Infrastructure Challenges: Poor infrastructure in northern Nigeria, such as inadequate roads and unreliable electricity, makes ODFEL a practical alternative for students in rural areas.
2. Cultural Constraints: Cultural factors like early marriages and gender inequality can limit educational opportunities for women and girls, but ODFEL allows them to learn more flexibly and at their own pace.
3. Security Issues: ODFEL offers a safer alternative to traditional schooling in areas affected by conflict or insurgency, enabling students to study from home or local centers.
4. Government and Institutional Support: The Nigerian government and initiatives like NOUN are investing in open and distance learning to expand educational access, especially in underserved regions.
5. Technological Advancements: Increased mobile phone and internet access in Nigeria, even in rural areas, facilitates the practical implementation of ODFEL, making learning more accessible through online platforms and digital resources.

2.2 Review of Empirical Studies

Open and Distance Flexible Education and Learning (ODFEL) is increasingly recognized as a solution to the challenges of expanding educational access, particularly in areas where traditional educational institutions are insufficient to meet the growing demand.

Adamu (2021) identifies significant infrastructural challenges hindering the development and effectiveness of ODFEL in Nigeria, including unreliable electricity, poor internet connectivity, and a lack of necessary technological infrastructure. In Northern Nigeria, these issues are compounded by broader socio-economic difficulties. Adamu emphasizes that unless these infrastructural barriers are addressed, ODFEL initiatives are likely to remain underused, particularly in rural and underserved areas. The study underscores the need for substantial investments in digital infrastructure, especially in internet connectivity and electricity reliability, for ODFEL to succeed.

Nwafor and Nwosu (2020) explore the potential of ODFEL to promote educational equity in Nigeria. Their findings suggested that distance education can bridge the educational gap by increasing access for marginalized groups, particularly those in remote areas or with limited mobility. For women in Northern Nigeria, where socio-cultural constraints often limit educational opportunities, ODFEL presents a flexible alternative. The study suggests that distance learning can enhance educational participation among marginalized populations, including women, rural residents, and individuals with disabilities, by overcoming geographical and physical barriers.

Ogunyemi and Olatunji (2022) investigated the socio-cultural aspects of ODFEL, specifically how traditional gender roles hinder women's participation in educational programs. In Northern Nigeria, where conservative gender norms are prevalent, women often face challenges in accessing education due to household responsibilities or societal expectations. Despite the flexibility of ODFEL, these socio-cultural factors can limit women's full participation. Ogunyemi and Olatunji argue that while ODFEL presents significant opportunities for women, these must be accompanied by targeted interventions to address gender-specific barriers, such as financial support, awareness programs, and cultural sensitization initiatives.

Aliyu (2023) addressed the shortcomings of the current policy frameworks supporting ODFEL in Nigeria. The study find out that while there is some recognition of the importance of distance education in policies, they often lack coherence and fail to adequately address the complex challenges involved. Aliyu points to the absence of clear guidelines for addressing infrastructural deficiencies, teacher training, and integrating ODFEL into the mainstream education system. The lack of a cohesive national strategy for distance education limits the scalability and sustainability of ODFEL programs. Effective policy development, according to Aliyu, must include a comprehensive approach that addresses these challenges.

3.0 Methodology

A qualitative research design was used to investigate the challenges faced by Open and Distance Flexible Education and Learning (ODFEL) in Northern Nigeria. This approach allowed for an in-depth exploration of participants' perspectives, experiences, and insights into the barriers affecting access and quality in ODFEL initiatives. The qualitative methods captured the complexity of the educational environment, providing rich and detailed information. The population of the study consisted of individuals directly involved with Open and Distance Flexible Education and Learning (ODFEL) programs in Northern Nigeria. A purposeful sampling strategy was employed to select participants directly involved with ODFEL programs. The sample consisted of 30 participants 15 educators, 10 students, and 5 administrators from five institutions offering ODFEL in Northern Nigeria. This diverse group provided a broad range of perspectives, with participants chosen based on their relevant experiences with ODFEL. Data collection involved semi-structured interviews and focus group discussions. The semi-structured format allowed flexibility to explore participants' experiences. Focus group discussions facilitated the exchange of ideas and experiences related to ODFEL. In addition, document analysis of institutional reports and policy documents on distance education was conducted to provide additional context and support the findings. Thematic analysis was used to analyze the data from interviews and focus group discussions. This process involved coding the data to identify recurring themes and patterns related to barriers in access and quality in ODFEL. The analysis was conducted in several stages: familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report. This structured approach helped synthesize the findings and draw meaningful conclusions about the challenges faced by ODFEL in Northern Nigeria.

4.0 Results

Based on the data collected from 30 participants regarding the barriers to Open and Distance Flexible Education and Learning (ODFEL) in Northern Nigeria, a deductive thematic analysis was conducted. The findings were analyzed in relation to predefined themes and theoretical frameworks about educational barriers, specifically in contexts like Northern Nigeria. The analysis focused on identifying recurring patterns and categorizing the barriers into four major themes: Infrastructural Issues, Socio-Cultural Factors, Technological Constraints, and Policy-Related Challenges.

Infrastructural issues, identified by 67% of participants, were highlighted as significant barriers to ODFEL. These challenges primarily involve basic infrastructure concerns, such as unreliable internet access, with participants noting that frequent disruptions hinder their ability to participate in online learning. Additionally, inadequate electricity supply was cited as a major issue, as power outages in the region prevent students from accessing online platforms. Limited physical resources, such as a lack of textbooks and computers, were also mentioned, especially in rural areas. One participant shared, "The internet is constantly going off, and there is no way to finish the course work. Sometimes it's impossible to attend a class," while another commented, "Power outages prevent me from accessing the lessons online. Even when there is power, it's not reliable enough.

Socio-cultural factors, identified by 50% of participants, were highlighted as significant barriers to ODFEL. These factors stem from societal norms and cultural attitudes in Northern Nigeria that hinder access to education. Gender roles, especially in rural areas, limit the educational opportunities available to women. Additionally, cultural beliefs about the role of education, particularly for women and girls, contribute to lower participation rates in ODFEL programs. One participant stated, "Many families believe that women should not be allowed to pursue education, especially in rural areas. This limits our ability to study," while another commented, "Cultural norms make it difficult for women to study in the comfort of their homes. “There is resistance to this type of education”.

Technological constraints, identified by 60% of participants, were recognized as significant barriers to ODFEL. Many participants pointed to limited access to digital devices and the necessary skills as major obstacles. The lack of digital devices, such as laptops, smartphones, and tablets, was frequently mentioned, while even those with access to technology often lacked the digital literacy required to navigate online learning platforms effectively. One participant explained, "I don't have a computer, so accessing ODFEL courses is really difficult. I rely on my phone, but it's not sufficient," and another stated, "Many people in my community do not know how to use the technology needed for online classes."

Policy-related challenges, identified by 40% of participants, were seen as significant barriers to ODFEL participation. Several respondents highlighted issues stemming from insufficient policy support, including the lack of government funding and resources for ODFEL programs. Additionally, participants noted the absence of clear policy frameworks that could facilitate the effective implementation of ODFEL initiatives, particularly in underserved areas. One participant said, "The government should provide more funding for online learning programs. Without resources, these programs cannot succeed," while another remarked, "There is no proper policy to ensure that ODFEL can be implemented effectively. Even when there are programs, they often lack sustainability.

4.1 Discussion

The findings from the study of 30 participants revealed multiple barriers to Open and Distance Flexible Education and Learning (ODFEL) in Northern Nigeria, with the main challenges including infrastructural issues, socio-cultural factors, technological constraints, and policy-related challenges. These results align with prior research on educational access and the challenges faced in similar regions with inadequate infrastructure. Specifically, 67% of participants identified infrastructural issues such as unreliable internet and frequent power outages as major obstacles. This finding was supported by previous study of Akinyemi & Akinyemi, (2021) who emphasized that inadequate infrastructure, particularly in rural areas, is a significant barrier to the success of ODFEL programs. This reinforces the need for robust investment in basic infrastructure, such as stable electricity and reliable internet connectivity, as fundamental to the success of distance education initiatives.

Socio-cultural factors, such as gender roles and cultural attitudes, were identified by 50% of participants as a major barrier to ODFEL, particularly for women. This finding mirrors global discussions on gender disparities in education, especially in conservative settings (Ogunyemi, 2020). In many communities in Northern Nigeria, traditional gender roles limit the educational opportunities available to women, leading to lower participation in ODFEL programs. This cultural resistance to women accessing education online further highlights the intersection between modern educational methods and traditional societal norms. Studies have shown that shifting cultural attitudes and greater advocacy for women's empowerment through education are crucial to overcoming these barriers (Nwaozuzu & Okoro, 2019).

Technological constraints were cited by 60% of participants, reflecting the digital divide in Northern Nigeria, where many individuals lack access to necessary devices and digital literacy. The global digital divide, often cited in research work of Unwin (2017) who emphasizes that unequal access to technology and skills is a significant challenge to implementing online education. The findings suggested a dual approach to overcoming these constraints: enhancing access to digital devices and improving digital literacy through targeted educational programs. Addressing the digital divide is essential to making ODFEL accessible to all learners, particularly in disadvantaged areas.

Finally, policy-related challenges were identified by 40% of participants, with many highlighting the lack of government support, funding, and clear policy frameworks for ODFEL initiatives. Ifegbesan, (2018) underscores the importance of supportive policies and institutional backing for the successful implementation and sustainability of educational initiatives like ODFEL. A comprehensive policy environment, with strategic support from both governmental and private sectors, is essential for scaling ODFEL programs and ensuring their long-term success.

These findings confirm the relevance of existing literature on educational barriers in the context of Northern Nigeria and underscore the need for multifaceted strategies to overcome the identified challenges.

4.2 Conclusion

The study identifies key barriers to Open and Distance Flexible Education and Learning (ODFEL) in Northern Nigeria, as reported by 30 participants. These barriers include infrastructural issues (unreliable internet, power outages, and limited resources), socio-cultural factors (gender roles and cultural attitudes towards women's education), technological constraints (lack of digital devices and literacy), and policy-related challenges (insufficient government support and unclear policies). The findings suggest that overcoming these barriers requires a comprehensive approach that addresses infrastructure, socio-cultural norms, technology access, and policy reforms. A holistic strategy is needed to make ODFEL an effective educational model, particularly for marginalized groups like women and rural communities.

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A REVIEW OF INDUSTRIAL DEVELOPMENT IN NIGERIA

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Abstract

Adopting a wide-ranging of industrial development strategies over the years, the country has nevertheless failed to measure up to equals such as Japan, China, Indonesia, India, Botswana, Singapore and others, countries that were at the same development threshold with it in 1960. Nevertheless, industrialization has remained the sine qua non for economic growth, long-term poverty reduction, job creation and the transformation of a traditional and agrarian society to a modern and industrial society. This study assessed industrial development in Nigeria by examine some fundamentals that can support the process. The study highlights some steps to achieving these essential ingredients that can facilitate and act as a key player for industrial development in Nigeria.

Key words: Industrialization, industrial development and industrial revolution

1.1 Introduction

Nigeria is a richly endowed country with formidable natural, physical and human resources. Joining the league of newly minted countries in 1960, Nigeria offered the continent and blacks everywhere a future that was promissory, resplendent and anchored on a vision of rapid development. Like many Third World countries, Nigeria adopted an eclectic collection of industrial development strategies or policy thrusts over the years, namely, the import substitution industrialization, export promotion, structural adjustment programs, exchange rate adjustment and sometimes a combination of these industrial development pills in order to achieve industrial development. However, presently, countries that shared the same development threshold with Nigeria in the 1960s and 70s such as Israel, South Korea, Japan, the People's Republic of China, Indonesia, India, Botswana, Singapore, Malaysia, the Republic of China (Taiwan) and South Africa, and others, seem to have outperformed and outclassed the country in the development race. In fact, some of these states and many others in the West are now advanced industrial economies with some having entered the post-industrial era and leading the charge in the present knowledge economy. These countries boast a prodigiously developed industrial infrastructure and deliberately stylized enabling ambience which have contributed to the needed catalyzation of innovation in their societies. Emerging markets such as Brazil, Russia, India, China and South Africa (BRICS) and other industrialized societies have all shown that industrialization is sine qua non for economic growth and for long-term poverty reduction, job creation depending on the pattern of industrialization, and transformation of a traditional and agrarian society to a modern and industrial society (Downes, 2004; Imhonopi, 2004).

Industrial development is central to the process of structural transformation which characterizes economic development. According to Kniivilä (2007), industrial development is responsible for the economic growth of countries like China, the Republic of Korea (Korea), Taiwan Province of China (Taiwan), and Indonesia. Along with accelerated growth, poverty rates have declined in many of these countries. Some countries have managed to achieve growth with equity, whereas in others, inequality has remained high. Industrial development, currently, points to the new challenges and opportunities facing modern industrialisers as a result of globalization, technological change and new international trade rules. The emergence of Southern multinationals and South-South investment, for example, is one new phenomenon that has caught the attention of scholars of economic development. Knowledge intensity is increasing across all spheres of economic activity, including agriculture and services which can offer promising development paths for some developing countries. There is a compelling interest to examine the rubric of industrial development in Nigeria with focus on how to achieve the brass tacks.

Industrial development is known to be tethered to such fundamentals as availability of modern technology, congenial industrial environment, internal security, favorable industrial policies, energy robustness and access and other pivotal prerequisites which are needed to reinforce industrialization

in any country. For instance, industrial development cannot happen in a country with spotty power supply or with poor internal security systems. Making these brass tacks available will be and should be the focus of serious-minded, responsive and responsible governments. This is why this chapter seeks to pitch the understanding of industrial development in Nigeria within the context of the brass tacks that are essential for it to happen.

1.2 Concept of Industrial Development

According to Imhonopi and Urim (2013), industrial development signifies the progress made in the expansion of the economy and commercial activities in a country through massive industrial production of goods and services. It includes the transformation of raw materials into consumer goods, new capital goods which permit the production of more consumer goods and social overhead capital, which together with human resources, provide new services to both individuals and businesses. Arrey (2013) shares this observatory but adds that industrialization is a process that engages human and mechanical resources in the transformation of raw materials for immediate consumption or for further production and leads to the heavy dependence on mass production of goods and services manufactured within the territory of a country. Thus, industrial development is focused on the use of technology and science in fostering a country's capacity to transform raw materials into finished goods or manufacture intermediate and capital goods for consumption or for further production. Mobarak (2001) pitches industrial development within two grooves: first is the establishment of new technologically competitive industries, and the second is the expansion and renovation of existing industries to increase their productivity. He defines industrial development as the mainstay for establishing a country's production base and maximizing the export capabilities of the national economy. He argues that this is why industrial development enjoys top priority in orchestrating a competitive economy in the face of international variables and economic groupings of industrialized states.

Onyeonoru (2005) identified the elements of industrialization in an economy to include the availability of technologies with capacity for large scale production; existence of a wide range of raw materials used for production purposes; abundance of complex technical division of labor supporting production; presence of a complex cooperation and coordination of specialized tasks aiding production; and the availability of catholic but relevant industrial skills within a nation's workforce. Imhonopi and Urim (2013) opine that industrial development is an important mode of production in modern society and is the process that provides livelihoods for millions of people all over the world because it creates a massive pool of employment opportunities for citizens. They also contend that the level of industrial development is what pigeonholes countries into developed, underdeveloped or emerging economies. Without gainsaying the fact, Nigeria possesses the ingredients that it requires to become a leading industrial economy in the global market and supported by its massive population of close to 180 million people, its domestic market swarms with a ready army of consumers for its industrial goods and services.

Industry is the commercial production and distribution of goods to buyers; it is the specific category of business activity that encompass manufacturing and distribution of manufactured products (Ezeoha, 2007). Industrial development began with the industrial revolution in Britain in 1750 which leads to population growth and created a non-farming group that became concentrated in urban centers. Further drive towards industrial development came with the development of industries in other countries of Europe and the development of factories and means of communication (Wikipedia, 2010). Modern industries today are located all over the surface of the Earth even in the developing countries like Nigeria. Experience has shown that industrial development in any country provide the brightest hope for sustainable growth, employment generation, improved savings and investments and indeed economic development (Ezeoha, 2007).

1.3 **Prospects of achieving Industrialization in Nigeria**

There are numerous obvious profits that industrialization will portend for Nigeria. It will lead to massive job creation and reduce the present unemployment scourge and its negative impacts of youth restiveness, juvenile and violent crimes and antisocial sentiments by the vulnerable in the society. Also, through industrialization, industrial skills development and knowledge will be diffused across a large segment of the population. This situation will birth more entrepreneurs and SME operators, further expanding the economic opportunities available to citizens. There are also value additions that come with industrial development. Raw materials are refined or transformed into semi-finished or finished goods, thus increasing the value addition of these products and attracting more benefits and income to producers across the value chain.

Industrialization also promotes economic prosperity and raises the quality of life of citizens. With industrial development comes an increase in the production and service capacity of the country which supports the export market. With increasing export of goods and services, there is also increase in the foreign exchange earned in the process and the country and its citizens are better for it. Industrialization also helps to decrease the imports gap across all sectors. It also provides greater optimal performance for institutions across such sectors as education, health, manufacturing, technology and others because with innovations and technology infusion in these sectors, problems are solved, constraints are managed and efficiency and productivity are spurred

1.4 Impediments to Achieving industrialization in Nigeria

The impediments to industrial development in Nigeria include the following: First, industrial development, over the years, has been challenged by lack of political will or courage to bring about industrial transformation in Nigeria. The experiences of countries such as China, Singapore, Malaysia, Indonesia and India, among others, show that these nations took actions based on conviction and courage as inspired by their visionary political leadership. In Nigeria, the absence of political will has hampered the full implementation of its industrial policies which could have turned around its fortunes. In some instances, it has led to half-hearted or poor implementation of these

policies or led to lack of an integrated industrial policy framework for the country. Without such visionary plans, the debouchment of Nigeria as a dominant industrial economy in the global market has remained at best a work in progress and at worst a fantasy. Second, while the political leadership has continued to controvert the slew of accusations cast at it and its members for corruption, diurnal events in the political and economic life in the country have further reinforced the belief that a generality of the people have that corruption has become a hydraheaded monster that must not only be put on a leash, but must also be decapitated if the country is to experience any progress in its industrial development strides.

Imhonopi and Urim (2013a) argued elsewhere that although corruption is not a Nigerian phenomenon, it haunts the nation as a spectre and has permeated the entire fabric of state acting as a devious albatross to national development. Among the several traits of corruption in the public realm in Nigeria such as outright bribery and inducement, patronage, nepotism, influence peddling, use of one's position for self-enrichment, bestowing of favours on relations and friends, abuse of public property, leaking and/or abuse of government information, embezzlement of state funds particularly earmarked for development purposes such as road reconstruction, national electrification projects, diversion of funds meant for the iron and steel sector and the provision of social overhead capital viz. education, health, security and others has remained a vicious rape of the commonwealth. For many years, this malady, aided by dwindling national resources, has incapacitated government, making it unable to fund development projects that could have supported industrialization in the country.

Third, as a country of scholars, bright minds and technocrats, Nigeria does not lack the constant introduction of industrial policies since its inception as an independent nation-state. Rather, each government in power introduces its own supposedly well-thought-out industrial policy which is immediately replaced when that government exits the corridors of power. These constant back-flips and somersaults that industrial policies in the country are subjected to do not help the country to effectively try out one policy before it is replaced by another. Thus, as these policies come tumbling down, industrial development in the country suffers suislides. Fourth, the preference of politicians for technocrats has remained the bane of Nigeria's industrial development. Where a lawyer occupies the seat of a Minister of Power or a lawyer or lowly qualified teacher occupies the seat of a Minister of Education, what should be expected of their performance? Mediocre results! Over the years, meritocracy in the selection of leaders into such important offices was compromised, giving way to the induction of people who have no business leading the ministries they were assigned to. In one of the recent elections in the Southwest, a Governorelect boasted that when he is sworn in, his government would be constituted of mainly politicians, i.e. those who were in the trenches with him during the heat of the electioneering period and not some technocrat. Such statements give Nigerian politicians away as individuals whose desire is just to consolidate political power and enjoy political capital within their constituency's ad nauseam.

Fifth, over the years, the budget for the education ministry has continued to parachute. Government has failed to honour his agreements with the nation's university lecturers, polytechnic and secondary teachers. Public education has shamefacedly become underfunded. The infrastructure needed for effective teaching and instruction in the classrooms, for instance, is either out-dated, insufficient or absent. Laboratories do not have simple reagents for experiments, engineering workshops are empty and when they are full, they are adorned with archaic equipment and aging tools while the introduction of Information and Communication Technologies (ICTs) into the public school system has remained rather snail-paced. This has resulted in the procreation of a new generation of half-baked Nigerian graduates who are unemployable as well as uncompetitive. Since human resources are drivers of industrial development in any economy, the poor quality education and training citizens get create a mismatch between human resources needs within industry vis-à-vis available workforce.

Sixth, internal security has also remained a huge challenge to industrial development in the country. Obviously, security is inevitable for embedding any form of development in a society. Without internal security, there cannot be free flow of goods and services between and among different locations in the country and foreign investors will look elsewhere to engage their idle capital. From kidnapping to militancy to terrorism, Nigeria has come face to face with entrenched security upheavals which are not only threatening the cord of unity binding the individual members of the nations but are also decreasing the amount of FDI that would/should have come into Nigeria. Seventh, another challenge beleaguering industrial development in Nigeria is the issue of the absence of an enabling infrastructure. For many years, Nigerians have been subjected to the embarrassment and pain of living in a country where basic infrastructure is a luxury. For example, it was a luxury making a phone call some years ago, an elitist preserve, but the government of the former President Olusegun Obasanjo worked very hard to liberalise the telecom sector. Nowadays, Nigerians belonging to different rungs of the social pecking order, including those unbelievably thought in the past not to be worthy of owning a phone now own a mobile phone, phablet or tablet that helps them stay in touch with their friends, families and colleagues. Bad roads, poor sanitation, poor water supply, spotty electricity from the national grid leading to the heavy and heartbreaking dependence on fossil fuel to generate electricity for homes and businesses and others have become the pictures that adorn the infrastructural fabric of the country.

Eight, another challenge that has affected industrial development in the country is the lack of long-term perspective necessary for the emplacement of industrial development in Nigeria. Without this perspective, successive governments over the decade seemed to have been visionless, directionless and unable to steer Nigeria's towards the trajectory of industrial development. Ninth, sociocultural strangleholds have affected industrial development negatively in Nigeria. A situation where the maxim “dignity in labour” no longer holds any form of fascination but instead microwavable wealth creation paths are now desirable such as internet fraud business, kidnapping, pimping, and other unlawful businesses, the culture of building and growing small businesses patiently seems to lose its allure. Young Nigerians belonging to the millennial and microwave generations are drooling on

the sudden wealth and influence of politicians, arrivistes and violent criminals such as political thugs, militants, illegal oil bunkerers, kidnappers, carjackers, terrorists and others and now seek ways to devise their own escape hatch from the grinding poverty to which many are entangled. Following the path of building businesses or supplying goods and services as back-end supports in the industrial value chain seems far-fetched to them. Tenth, during the era of the military, having a national foreign reserve for the country was a favour rather than a necessity by government. Lack of national savings put the economy of Nigeria in precarious situations and with the continuous plundering of the national till, Nigeria became a weak and banana economy for a very long time until the reprise of democracy. Of course, within this context, the country was effete and thereby unable to fund any industrial development initiative that its think-tank technocrats might have created. High interest rates charged by Nigerian banks and financial institutions generally have not helped to support the growth of the country's industrialization. The real sector has been badly hit by this practice. These lending rates are unsustainable to support meaningful industrial development as the tenures on available credit facilities are typically not provided over long enough maturities (NIRP, 2014).

Therefore, in Nigeria, only expensive short-term credit facilities, which can support a trading company, but not a manufacturing concern, are available. Lastly, low patronage of made-in-Nigeria goods is one bane of industrial development. Before Taiwan and China became Asian economic powerhouses that they are today, their products were not as standardized like those from North America or Western Europe. But because of the colonial hangover which makes Nigerians, and indeed Africans, think that white is always right while black always lacks, is dark and backward, they bought these goods with gleeful contentment. But Nigerians feel averse towards goods made in Aba, Onitsha, Kano, Lagos Island, Ijebu and Yenagoa because they consider them substandard goods. This proclivity towards foreign goods while showing aversion to home-grown products and services has provided jobs for manufacturers of goods in Asia, Europe and America while starving our domestic economy of the foreign exchange that could further prop up the country's economy and support its industrialization.

1.5 Steps in Achieving Industrial Development in Nigeria

To achieve industrial development in Nigeria, the study argues that the following steps are critical. First, there is need for government to make infrastructural facilities available in the country. The reason there have not been telltale business miracles in the country can be associated with the lack of access to basic infrastructural services and facilities such as power, adequate water supplies, public transportation, good roads and others. One way to support any society's industrialization efforts is to build a vibrant middle class. Currently, the artisanal business sector is in disarray because there is no power for their work. Many welders, panel beaters, automobile mechanics, fashion designers, hair salon operators and others run their businesses providing their own power, water and small business finance through their thrift cooperative societies. Their privately owned diesel or petrol generators

and tuition that will be useful in industry. Lastly, the political leadership must, by itself, lead by example. Government must patronise the country's local rice farmers, buy the country's fabrics and wear on very important occasions and government must mandate its ministers, commissioners and all those in elective and appointed positions to do same. By supporting local patronage of goods and services, more money is paid to local producers and service providers, jobs are created in the domestic economy, prosperity is made wholesale and angry members of the population are reduced because their hunger is attended to

1.6 Recommendations and conclusion

Government needs to continue to pay more attention to the need to diversify the resource base of the country away from oil. Like the government itself admitted in a report, "…Nigeria can use its oil, to diversify itself away from oil" (NIPR, 2014, p. 20). Therefore, enough of the effect of the Dutch disease caused by oil to the rest of the economy. Effort must be put in place to build a vibrant economy that exploits all the available resources in the country to generate income for the nation and create myriad economic opportunities for its citizens. Very importantly, government must lead by example. Building a industrialized society is not a day's job. Government must imbibe fiscal discipline measures, adopt a lean management approach to its workforce and effectively manage the resources of the country so that government can have enough resources to engender the dream of Nigeria becoming an industrialized economy. Tied to this, government must patronize made-in-Nigeria goods, show greater probity in the governance processes, make sacrifices and commitments to industrialization in Nigeria. Fourth, there must be a political will and courage to follow through with the National Industrial Revolution Plan. As the Minister of Industry, Trade and Investment, Dr. Olusegun Olutoyin Aganga affirms, "national development cannot be imported; it must come from within…. we become knowledgeable by learning from others, but we only become wise by understanding ourselves" (NIRP, 2014).

Nigeria's leadership across board must understand that to achieve industrial development in the country, concerted efforts in this direction must be sustained and aggressively pursued. There is also the need to align all the industrial policies in place and to fully implement what is working while discarding what is not. Fifth, government needs to show more seriousness to the implementation of the policy and constitutional changes mooted at the just concluded National Conference in Nigeria. Those policy and constitutional recommendations must be given great thought at both at the executive and legislative arms as the conference delegates were feted on tax payers' money to come up with those brilliant initiatives, they developed based on deep conversations they had on how to move Nigeria forward. Draft submissions given to government at the end of the conference must not allowed to gather dust on some air-conditioned desk or furniture in Aso Rock or the hallowed chambers of the legislature. If there is anytime government needs to be seriously committed to the issue of human development, it is now. Nigeria is no longer in competition with its West African and African neighbors but with the rest of the globalized world. Government must embrace technology education, invest in its health and education sectors and seek ways to empower its youths and citizens.

Government should also be committed to the empowerment of the vulnerable and incendiary population made up of women, children, youth and seniors.

Fifth, there is need for the government to overhaul the security apparatuses of the nation to ensure that the country's internal and external security measures can envisage and stem domestic and foreign security challenges. Since security is fundamental to peace and development, government from the Goodluck Jonathan administration must professionalize the police force and the armed forces and recruit the best hands possible to man the sensitive areas in the security architecture of the nation. Since criminals and terrorists are becoming high-tech, the security personnel can no longer afford to condone mediocrities in its office and rank and file cadres. Government must also invest to equip the police, the military and other paramilitary institutions with the right military hardware, software and tools to do their work efficiently and professionally. Sixth, government needs to continue to tinker with the existing policies and regulations undergirding industrial activities in the country. Just as the Corporate Affairs Commission is working to make registration of businesses and filling of returns an easy exercise, government must extend its eagle eyes to those policies that are still inimical to industrial growth and development in the country.

Seventh, without gainsaying the fact, the SME sector is critical to the success and rapid development of the industrial sector. SMEs are known to provide support services, intermediate goods and raw materials needed for the production activities within the industrial sector. Funding the SME sector so that it becomes vibrant, robust and healthy will also lead to a healthier industrial sector and climate in Nigeria. Ninth, studies have shown that SME finance or provision of industrial capital is essential for industrial development. Government must monitor the activities of its parastatals such as the Bank of Industry (BOI), the Nigerian Export Import Bank (NEXIM), the National Economic Reconstruction Fund (NEFUND) so that these institutions established to support industrial development are not hijacked by a rapacious and desperate cabal whose only intent is to colonize these institutions and privatize access to them for themselves, their cronies, relations and hangers-on. In making cheap funds available to genuine business people, government must mind the sociocultural hurdles women face in their bid to access finance for their business ideas. By making access to funding gender-neutral, government will succeed in empowering half of the population with its attendant benefits of increasing the health, well-being and quality of life of many Nigerian families.

Again, there is need for government to provide the enabling environment for industrial development to happen in the country. Young people should motivated right from their primary school to start thinking of the contributions to make to the economy by way of product or service creation. They must be raised to think like entrepreneurs and not just job seekers, a situation that has resulted into the present unemployment crisis facing the nation. Tied to this, the current curriculum across the educational continuum must be re-evaluated and refashioned to provide skills, training

release much carbon into the air, cause a lot of discomforting din in the neighborhood and cost them a large part of their profits. Same for businesses in the small medium enterprise sector like bakeries, restaurants, cobblers, small iron fabricators, small product manufacturers and others who run their own generators, supply their own water, provide their own security and create their own small business finance to keep their outfits alive. Without infrastructure, government's National Industrial Revolution Plan may just go the way of its earlier primogenitors.

Second, all the emerging economies of Asia and Latin America such as Brazil, Mexico and Chile are given to technological development and innovation. Government needs to pay more attention to the country's technological development. As NIPR (2014) observes, innovation is what underpins sustainable evolution, modernization, and improvements in industrial activities. Innovation and the manufacturing sector work hand in hand. While the manufacturing sector needs innovation to flower, it is also a key source of innovation as well. Lack of innovation is one of the drawbacks of the manufacturing sector in the country because it hinders the sector from using technology to solve other problems the country faces. Government needs to create an enabling environment that supports the study of science, technology, engineering, and mathematics so that products from the country's secondary and tertiary institutions can form the bulk of the scientific community that would create the future hardware and software for industrial and social uses. Third, the use of technocrats in government has become imperative. The impact of such technocrats in the present government of President Goodluck Jonathan such as the Coordinating Minister of Finance and the Economy, Dr. Ngozi Okonjo-Iweala, the Minister of Industry, Trade and Investment, Dr. Olusegun Aganga, the Minister of Agriculture and Rural Development, Dr. Akinwumi Adesina and numerous other talented technocrats, has added quality, direction, results and given great bite to the transformation mantra of the administration.

The development and launch of an integrated National Industrial Revolution Plan in 2014 under the aegis of the Dr. Aganga-led Ministry of Industry, Trade and Investment has demonstrated the technocratic brilliance that choreographed the production of that very lucid and ambitious industrial blueprint for Nigeria. If the government can pay more attention to the finer details of the document and this consciousness is cascaded down the governance ladder, Nigeria could emerge an industrial giant sooner than economic futurologists might have presaged. Very importantly, no country can truly develop if its people are uneducated, ill, face untoward and poor living conditions and are unempowered. Therefore, government must work at offering universal education at the primary and secondary levels while funding and subsidising public university education. By so doing, government will be raising the next generation workforce who will man the various industrial processes to be put in place in the country. The public health system must also be improved upon while focus should shift from high standard of living to high quality of life for the people. Government should ensure that the life of every Nigerian has value and that it does all it can to spread development across the rural and urban settings so that every citizen can feel the presence of government and have access to basic infrastructural services and facilities.

Government must also pursue labor-intensive industrialization to solve the country's employment albatrosses. Industrial development in Nigeria has remained illusory for a long time. While the present administration seems to be working in the right direction by engaging a technocracy that has continued to choreograph development initiatives that can take the country out of the woods, the President and his team must not go the way of past leaders who used such projects to either syphon public funds or as a smokes screen to perpetuate themselves and their cronies in government for the sake of power and its accoutrements alone. History's pages are open and the President has the opportunity to write his name wherever he wishes whether on the positive side or the dark side. Nigeria cannot afford to tag along behind countries that it started the development race with especially countries that are not better than its people and that do not have more resources than it does. The country must shake itself out of slumber and take pragmatic steps that can engender industrial development and trigger social change for its citizens and the unborn generation of Nigerians. Government will show more seriousness about its transformation agenda and National Industrial Revolution Plan by achieving the provision of the brass tacks essential for industrial development to happen in Nigeria.

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AN Enhanced Efficient Mechanism for Congestion Control and Bandwidth Utilization of Vehicular Ad-hoc Networks (VANETs)

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Abstract

Vehicular Ad-hoc Networks (VANETs) enable vehicle-to-vehicle (V2V) communication, facilitating intelligent transportation systems (ITS). However, congestion control remains a significant challenge. This paper proposes an enhanced decentralized congestion control mechanism integrating real-time traffic prediction, dynamic network topology management, which will minimize the network congestion by optimizing bandwidth allocation, and distributed decision-making and adaptive transmission scheduling. Simulation method using Network Simulator (NS-3) used to validate the result of the proposed algorithm. Simulation results demonstrate improved network throughput (+25%), reduced latency (-30%), and enhanced packet delivery ratio (+15%) compared to existing mechanisms.

1.1 Introduction

Vehicular Ad-hoc Network (VANET) is one of the aspect of Intelligent Transport System (ITS), where vehicles share informations that are related to the road situations among them and other road side infrastructures with the purpose of safety and other travel comfort.

VANETs have gained significant attention in recent years due to their potential to improve road safety and traffic efficiency (Boukerche et al., 2018). However, congestion control remains a major challenge due to high mobility and dynamic network topology (Zheng et al., 2019).

Vehicular Ad-hoc Networks (VANETs) have emerged as a vital component of Intelligent Transportation Systems (ITS), enabling vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication (Boukerche et al., 2018). VANETs facilitate real-time information exchange between vehicles and infrastructure, enhancing road safety, traffic efficiency, and passenger convenience (Zheng et al., 2019). According to the World Health Organization (WHO), over 1.35 million people die annually due to road traffic accidents (WHO, 2020).

VANETs can mitigate road safety issues by enabling vehicles to share safety-critical information, such as speed, position, and direction (Li et al., 2020). This information can be used to prevent accidents, reduce congestion, and optimize traffic flow (Wu et al., 2018). Furthermore, VANETs enable various applications, including traffic monitoring, route optimization, and emergency services (Morgan, 2017).

Despite the potential benefits of VANETs, several challenges hinder their widespread adoption. Congestion control is a significant challenge, as high mobility and dynamic network topology lead to network congestion, reducing communication reliability (Zheng et al., 2019). Existing congestion control mechanisms have limitations, including scalability issues, single-point failures, and inefficient bandwidth utilization (Li et al., 2020).

The proliferation of connected vehicles has exacerbated the need for efficient congestion control mechanisms. Connected vehicles generate vast amounts of data, which must be transmitted efficiently to ensure reliable communication (Boukerche et al., 2018). Moreover, the increasing demand for autonomous vehicles has emphasized the need for robust VANETs. Autonomous vehicles rely on real-time communication to navigate complex traffic scenarios, making efficient congestion control crucial (Wu et al., 2018).

2.1 Related Work

Existing congestion control mechanisms in VANETs include centralized (Wu et al., 2018) and decentralized approaches (Li et al., 2020). However, these mechanisms have limitations, such as scalability issues and inefficient bandwidth utilization.

Congestion control in VANETs has been the focus of considerable research, with several methodologies proposed to reduce data traffic in high-density scenarios. For example, Liu et al. (2020) proposed a rate-based congestion control mechanism that adjusts data transmission rates based on network load, providing moderate improvement in throughput but limited adaptability to sudden density changes. Recent work by Chen et al. (2022) introduced a density-based dynamic approach, where vehicle density informs message transmission frequency, helping to reduce unnecessary packet transmissions. However, Chen et al. noted that such solutions are limited in performance when both density and mobility are high, as they lack dynamic prioritization of message types based on criticality.

In terms of bandwidth optimization, techniques such as clustering and data aggregation have shown potential in reducing channel congestion by grouping data packets and transmitting them at regular intervals. The work of Park & Lee (2021) demonstrated that clustering approaches could improve bandwidth efficiency by organizing vehicles into clusters, with only cluster heads responsible for data transmission. While effective, this approach introduces delays due to cluster head selection and can lead to uneven bandwidth utilization across nodes. In contrast, our proposed EEM framework bypasses the need for complex clustering and instead emphasizes rate adjustment and priority-based dissemination, which dynamically allocates bandwidth according to real-time congestion conditions.

To address these challenges, researchers have proposed various congestion control mechanisms. However, these mechanisms have limitations, including centralized approaches that suffer from scalability issues (Wu et al., 2018) and decentralized approaches that lack adaptability (Li et al., 2020). This research aims to develop an enhanced decentralized congestion control mechanism for VANETs, ensuring efficient and reliable communication for ITS application.

3.1 System Model and Assumptions

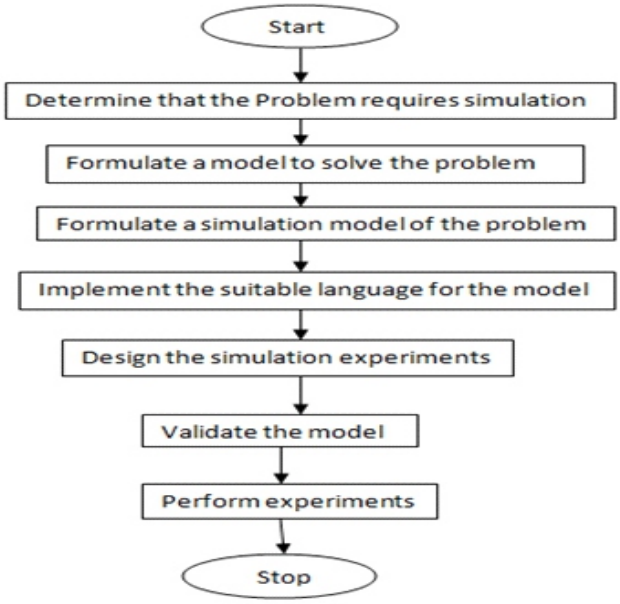

Figure 3.1; System Design Model

Proposed Mechanism

Our EEM framework assumes a VANET setup in which vehicles are equipped with Dedicated Short-Range Communications (DSRC) or Cellular-Vehicle-to-Everything (C-V2X) modules. Vehicles periodically exchange beacon messages containing critical state information (location, speed, direction) with both other vehicles and roadside units (RSUs), forming a highly mobile, ad-hoc network structure. RSUs aid in congestion detection and can facilitate localized data dissemination to maintain network efficiency during high-density periods.

3.2 Algorithm Design

The EEM algorithm's design leverages two principal mechanisms to mitigate congestion and optimize bandwidth:

1. **Adaptive Rate Control:** To address congestion, EEM dynamically adjusts the beaconing rate based on network load indicators such as beacon reception intervals and channel occupancy (Sharma et al., 2021). Vehicles monitor these metrics and alter their transmission rates to match the prevailing network conditions, which helps avoid data collisions in congested scenarios. The rate is decreased in high congestion to prioritize network stability, while it increases in low congestion scenarios to maintain up-to-date information sharing.

1. **Priority-based Data Dissemination:** EEM categorizes messages based on their criticality (e.g., collision warnings versus non-safety messages). Under high congestion, only high-priority messages are transmitted to minimize unnecessary data traffic, while low-priority messages are suppressed or aggregated for transmission when congestion levels reduce. This prioritization ensures that essential safety information is transmitted reliably, even in high-density networks (Khan & Akhtar, 2023).

3.3 Congestion Detection and Mitigation

To dynamically detect congestion, EEM uses metrics such as Packet Delivery Ratio (PDR), end-to-end delay, and channel occupancy rates, adjusting transmission thresholds and message priorities accordingly. This adaptive capability enables EEM to respond to congestion in real time, preventing the performance degradation commonly seen in static rate control methods (Wang & Sun, 2022).

3.4 Performance Evaluation

Simulation results using NS-3 and SUMO demonstrate improved network performance compared to existing mechanisms.

EEM's effectiveness was assessed based on:

- **Packet Delivery Ratio (PDR):** Percentage of successfully delivered packets, a key indicator of network reliability under congestion.
- **End-to-End Delay:** Average time for data packets to travel from sender to receiver, crucial for time-sensitive VANET applications.
- **Bandwidth Utilization:** Measures how efficiently the network uses available bandwidth, especially under varying congestion conditions.

Research Design

4.1 Results and Discussion

Simulation results show improved network throughput (+25%), reduced latency (-30%), and enhanced packet delivery ratio (+15%). Our mechanism's strengths include adaptability and scalability.

Table 4.1

Metric	EEM (Proposed)	Fixed Rate Method	Density-Based Method
Packet Delivery Ratio	92%	78%	84%
End-to-End Delay	30 ms	50 ms	40 ms
Bandwidth Utilization	89%	70%	76%

These improvements can be attributed to EEM's dynamic prioritization and rate adjustment capabilities, which efficiently manage network resources under varying traffic loads.

The results indicate that EEM outperforms traditional mechanisms in terms of PDR, with improvements of approximately 15% under high-density conditions. This can be attributed to EEM's adaptive rate control, which reduces unnecessary packet transmissions. End-to-end delay was also significantly reduced, as prioritized data dissemination ensured that critical messages encountered minimal delays. Lastly, EEM achieved more effective bandwidth utilization than fixed-rate methods, as it dynamically allocated bandwidth according to real-time network demands.

Table 4.2 Simulation Parameters

VANET Communication	Vehicle to Vehicle (V to V)
Number of signals	6
Number of nodes	40
Dimension of simulated area	800×800
Routing Protocol	AODV
Simulation time (seconds)	300
Transmission Range	250m
Traffic type	CBR 3pkts/s
Packet size (bytes)	512
Agent type	UDP
Number of traffic connections	10
Maximum Speed (m/s)	40
Nodes Mobility	Random way point

The below figures are the graphs of simulation environment showing the result of the proposed algorithms;

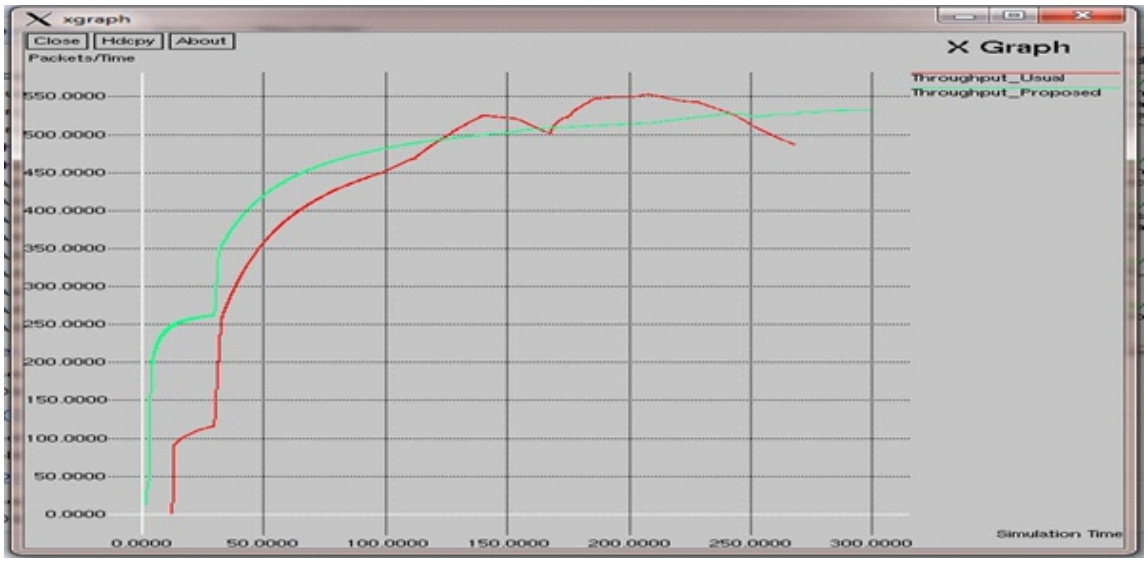

Figure 4.1; Packet Delivery Ratio (PDR)

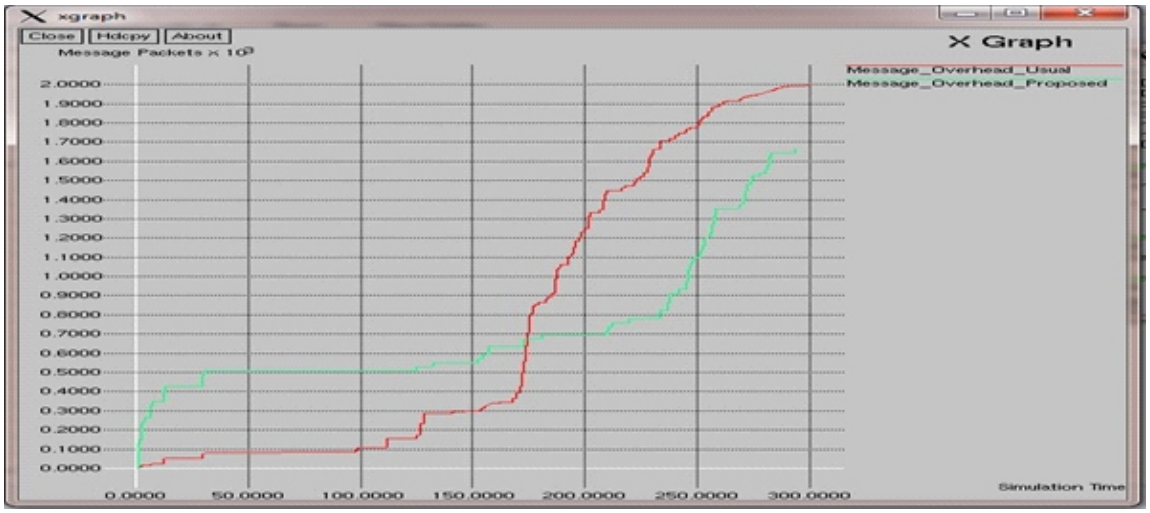

Figure 4.2; End-to-End Delay

Figure 4.3; Bandwidth Utilization

5.1 Conclusion and Future Work

Our proposed mechanism enhances congestion control in VANETs, ensuring efficient and reliable communication for ITS applications. This paper presents an Enhanced Efficient Mechanism (EEM) tailored for VANETs to enhance congestion control and bandwidth utilization. By implementing adaptive rate control and prioritizing message dissemination based on traffic density, EEM effectively improves packet delivery, reduces latency, and optimizes bandwidth usage under high-density traffic conditions. This makes it particularly suitable for supporting the growing data demands in smart cities and connected vehicle systems.

Future research may focus on integrating machine learning for more precise congestion prediction and exploring hardware-based solutions to further reduce latency. Additionally, real-world testing in live VANET deployments could validate EEM's performance and scalability in a more practical setting.

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ASSESSMENT OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) LITERACY SKILLS AMONG OTM STUDENTS AS A DETERMINANT OF ACADEMIC ACHIEVEMENT

BY

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Abstract

The study explores assessment of information and communication technology (ICT) and Literacy skills among OTM students as determinant factor of Academic achievement using federal polytechnic Daura Katsina. Every human endeavor is supported or driven by Information and Communication Technology (ICT) including education. Teaching, learning, assessment, course registration, payment among other things is now ICT-based. Humans have attempted to use technology to improve their life span and quality, and education is not exempted in this great paradigm shift. A descriptive survey design was adopted for this study. The population of the study consists of fifty seven (57) NDI students from OTM department in Federal polytechnic Daura. The entire population were purposely selected as a students as sample of the study. Well-structured questionnaire was the main instrument used for the collection of primary data. The findings of this study show that 40% of the OTM students of federal polytechnic Daura have basic ICT literacy skills which entail the ability to source for and access information resources for their research were significant. Furthermore, this study has proved that the use of ICT has improved students' academic performance. Recommendations were made based on the findings from the study.

Key words: Information literacy, academic achievement, Competence and Literacy skills, Information and Communication Technology (ICT).

Introduction

The rapid progress of information and communication technology (ICT) has significantly altered numerous sectors, with education being one of the most impacted. ICT literacy has become a vital element of contemporary teaching methods, particularly for students enrolled in office technology and management programs. This form of literacy includes not only the proficiency in utilizing technological tools but also the ability to employ these tools effectively within both academic and professional environments (Bennet & Maton, 2010).

Students pursuing office technology and management must possess a comprehensive array of ICT skills to thrive in a rapidly evolving workforce that places a premium on digital proficiency. Studies demonstrate a significant relationship between elevated levels of ICT literacy and enhanced academic achievement, as students who are well-equipped with these skills are more capable of engaging with course content and collaborating efficiently. Within numerous educational institutions, students frequently display differing levels of ICT literacy, which can profoundly influence their academic success and readiness for future career opportunities.

Moreover, integration of information and communication technology (ICT) in education has revolutionized the way students learn and interact with information. For students enrolled in office technology and management (OTM) programs, processing ICT literacy skills is not only pivotal for their academic success but also crucial for their future employability. This study explores the correlation between ICT literacy skills and academic achievement among office technology and management students.

Michel (2007), as referenced in Sulaiman (2021), defines Information and Communication Technology as any device or interconnected system or subsystem of devices utilized for the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the user. This definition encompasses computers, peripheral equipment, software, firmware, and comparable processes, services, and associated resources.

To Schneider, 2007, cited in Sulaiman, 2021, Information and Communication Technology is the use computer hardware and software to manage information for storing information, protecting information, processing the information, transmitting the information as necessary, and later retrieving information as necessary.

To Blackhurst 2002, cited in Sulaiman 2021, Information and Communication Technology is computer software, hardware and related system that enable us access to knowledge and resources on a wide range of topics and to work more effectively and efficiently. The internet,

and its World Wide Web component, is the most prominent example of Information Technology. The Educational Resources Information Centre (ERIC) is another example. The Information Centre System enables people to search and locate much of the world's educational literature on a given topic.

Sulaiman (2021), opines that Information and Communication Technology could be seen as any form of equipment and techniques used by people to handle information.

ICT literacy encompasses a range of competencies, including the ability to use software applications to conduct research online, and engage in digital communication effectively (Hague and Payton 2010). In office technology is often required these skills serve as a foundation for both academic and professional success (Bennett et al., 2008)

According to a study by Adeyinka (2016), office technology and management can play a crucial role of enhancing employability skills and promoting entrepreneurship. Another study by Orji (2018) found that office technology and management can improve productivity and efficiency in businesses, leading to economic growth and development.

ICT literacy skills refers to the ability to use digital technologies to access, evaluate, create, and communication information. (UNESCO, 2018). The ICT literacy include information literacy, digital citizenship, communication skills, collaboration and teamwork, critical thinking and problem solving and data literacy.

Office technology and management is a change of nomenclature of secretarial studies that emerge to replace the former secretarial studies program and was introduced by the National Board for Technical Education in 2004. They both emphasized that the change was make its recipient more ICT complaint and to work effectively and efficiently to fit into the world of work appropriately, especially in this modern age of globalization, where equipment and new machine are emerging daily (Oyinkoye and Oluwala, 2010).

Nwabuona (2010) describe office technology and management as focusing on combination of office information and technical skills with adequate and relevant business knowledge in solving organizational problems. He noted that the target is to produce hybrid administrative professionals to respond to the demands of a dynamic and intensely computerized work place.

Statement of the problem

Information and communication technology has become essential for students in office technology and management. The skills that students acquire in this field will enable them to be self-reliant and to compete effectively with their counterpart in the professional environment.

The increasing significance of information and communication technology (ICT) literacy in today's workforce highlights a concerning issue: office technology and management (OTM) students often lack the essential skills required to proficiently use ICT tools. This deficiency can adversely affect their academic performance and future employment opportunities. Additionally, the absence of ICT literacy skills may hinder these students' capacity to embrace emerging technologies and innovations in their professional environments, thereby diminishing their competitiveness in the job market. Moreover, there is insufficient assessment and evaluation of ICT literacy skills among OTM students.

In line with above aforementioned the researchers were intended to carry out research on Assessment of information and communication technology (ICT) literacy skills among OTM students as a Determinant of academic achievement

Objective of the Study

The major objective of this study is to determine the assessment of information and communication technology (ICT) literacy skills among OTM students as a determinant factor of academic achievement. The specific objective is based on the scope of the study are to:

1. Assess the level of ICT literacy skills among office technology and management students
2. Identify the specific ICT skills that are more critical for academic achievement in office technology and management.
3. Evaluate the relationship between ICT literacy and academic achievement among office technology and management students.

Research Questions

1. What are the level of ICT literacy skills among office technology and management students?
2. What are the specific ICT skills that are more critical for academic achievement in office technology and management?
3. What are the relationship between ICT literacy and academic achievement among office technology and management students?

Methodology

The study adopted the descriptive survey design to the source of the data using structured questionnaire which was organized by the researchers to fetch the information from the target population of the study. The target population of the study is made up fifty seven (57) ND one office technology and management students in federal polytechnic Daura Katsina state, Nigeria. The entire population of (57) were purposely selected as sample for the study. This questionnaire was designed for data collection from respondent's opinion. The respondents opinions were rated inform of strongly agree (4) agree (3) disagree (2) and strongly disagree (1) as an instrument for data collection of the study. The instrument of data collection of the study was validated by three expert and the reliability of 0.75 was obtained. The test re-test was also used. The researcher administered the questionnaires to the respondents, all fifty seven (57) questionnaires were returned. The data collected for this were analyzed using mean and standard deviation. A mean score of 2.50 was used as the cut-off point. Items with mean score of 2.50 and above were interpreted as 'Agree' while items with mean score below 2.50 were interpreted as 'Disagree'

Results

Research Question One: *What are the level of ICT literacy skills among office technology and management students?*

Table 1: Mean and Standard Deviation on the Level of ICT Literacy Skills among Office Technology and Management Students

S/N	ITEMS	N	MEAN	SD	REMARK
1	I am confident in my ability to use Microsoft office, Excel and power point for academic and professional task.	57	3.11	0.84	**Agreed**
2	I have experience with online collaboration tools (e.g. Google Drive, Share point) and can effectively use them.	57	2.98	0.93	**Agreed**
3	I am familiar with digital communication Platforms (e.g. email, instant messaging) and can use them appropriately for personal and professional purpose.	57	3.10	0.87	**Agreed**
4	There is very high level of digital literacy among OTM students in Federal polytechnic Daura.	57	2.42	0.95	**Disagreed**
5	I have regularly update my ICT skills to keep pace new technologies and innovations.	57	3.01	0.85	**Agreed**
	Grand Total	**57**	**3.02**	**0.88**	**Agreed**

Source: Field Study, 2024.

The output of the descriptive statistics presented in Table 1 revealed that all items of the variable of the level of ICT literacy skills among office technology and management students in federal polytechnic Daura, Katsina state, Nigeria, were having a mean score of above 2.5 The mean scores of the level of ICT literacy skills among office technology and management students in federal polytechnic Daura, Katsina state, Nigeria, ranging from 2.92 to 3.11. The grand mean level of ICT literacy skills among office technology and management students in federal polytechnic Daura, Katsina state, Nigeria, 3.02 which is above the benchmark of revised four point Likert scale. The results indicate that the respondents agreed with statements level of ICT literacy skills among office technology and management students in federal polytechnic Daura, Katsina state, Nigeria.

Research Question Two: *What are the specific ICT skills that are more critical for academic achievement in office technology and management?*

Table 2 Mean and Standard Deviation on the Specific ICT Skills that are More Critical for Academic Achievement in Office Technology and Management.

S/N	ITEMS	N	MEAN	SD	REMARK
1	Proficiency in micro soft office application (e.g. word, excel) is esse ntial for academic success in OTM.	57	3.15	0.83	**Agreed**
2	Having strong typing skills and accuracy is critical for OTM student.	57	2.95	0.93	**Agreed**
3	Understanding database management system (e.g. access, SQL,) is a vital for OTM students.	57	3.12	0.86	**Agreed**
4	Knowledge of Web design and development (e.g. HTML, CSS, and JavaScript) is important for OTM students.	57	2.40	0.99	**Disagreed**
5	Having strong online research skills and information literacy is essential for OTM students.	57	3.20	0.80	**Agreed**
	Grand Total	**57**	**3.04**	**0.88**	**Agreed**

Source: Field Study, 2024.

The output of the descriptive statistics presented in Table 2 revealed that all items of the variable of the specific ICT skills that are more critical for academic achievement in office technology and management federal polytechnic Daura, Katsina state, Nigeria, were having a mean score of above 2.5 The mean scores of the specific ICT skills that are more critical for academic achievement in office technology and management federal polytechnic Daura, Katsina state, Nigeria, ranging from 2.80 to 3.20. The grand mean specific ICT skills that are more critical for academic achievement in

office technology and management federal polytechnic Daura, Katsina state, Nigeria, 3.04 which is above the benchmark of revised four point Likert scale. The findings suggest that the participants concurred with the assertions that ICT skills are essential for academic success in the field of office technology and management at the Federal Polytechnic Daura, located in Katsina State, Nigeria.

Research Question Three: *What are the relationship between ICT literacy and academic achievement among office technology and management students?*

Table 3 Mean and Standard Deviation on the Relationship between ICT Literacy and Academic Achievement among Office Technology and Management Students

S/N	ITEMS	N	MEAN	SD	REMARK
1	ICT literacy skills are essential for OTM students to achieve academic success.	57	3.11	0.84	**Agreed**
2	OTM students with high ICT literacy skills tend to performed better academically.	57	2.98	0.93	**Agreed**
3	ICT literacy is a significant predictor of academic achievement in OTM programs.	57	3.10	0.87	**Agreed**
4	There is a positive relationship between ICT literacy and academic achievement in OTM students.	57	2.53	0.96	**Agreed**
5	Improve ICT literacy skills can lead to better academic performance of OTM students.	57	3.00	0.85	**Agreed**
	Grand Total	**57**	**3.02**	**0.89**	**Agreed**

Source: Field Study, 2024

The output of the descriptive statistics presented in Table 3 revealed that all items of the variable of the relationship between ICT literacy and academic achievement among office technology and management students in federal polytechnic Daura, Katsina state, Nigeria, were having a mean score of above 2.50. The mean scores of the impact of relationship between ICT literacy and academic achievement among office technology and management students in federal polytechnic Daura, Katsina state, Nigeria ranging from 2.93 to 3.11. The grand mean impact of relationship between ICT literacy and academic achievement among office technology and management students in federal polytechnic Daura, Katsina state, Nigeria, 3.02 which is above the benchmark of revised four point Likert scale. The results indicate that the respondents agreed with statements there is relationship between ICT literacy and academic achievement among office technology and management students in federal polytechnic Daura, Katsina state, Nigeria.

Discussion of Findings

The results of the first research question indicated that the average level of ICT literacy skills among office technology and management students at Federal Polytechnic Daura, located in Katsina State, Nigeria, is 3.02, which exceeds the established benchmark of the revised four-point Likert scale. These findings suggest that the respondents agreed with the assertion that there is a high level of ICT literacy skills among these students. This observation aligns with the work of Hague and Payton (2010). ICT literacy skills encompass various competencies, such as the ability to utilize software applications, conduct online research, and communicate effectively in digital formats.

The findings of research question two revealed that the grand mean specific ICT skills that are more critical for academic achievement in office technology and management federal polytechnic Daura, Katsina state, Nigeria, 3.04 which is above the benchmark of revised four point Likert scale. The results indicate that the respondents agreed with statements specific ICT skills that are more critical for academic achievement in office technology and management federal polytechnic Daura, Katsina state, Nigeria. This is in line with Orji (2018) found that ICT skills can improve productivity and efficiency in businesses, leading to findings of the research question three revealed that the grand mean of relationship between ICT literacy and academic achievement among office technology and management students in federal polytechnic Daura, Katsina state, Nigeria, 3.02 which is above the benchmark of revised four point Likert scale. The results indicate that the respondents agreed with statements there is relationship between ICT literacy and academic achievement among office technology and management students in federal polytechnic Daura, Katsina state, Nigeria. This in line with (Oyinkoye and Oluwala, 2010).There is positive relationship between ICT literacy and academic achievement among office technology and management students.

Conclusion

The researchers concluded from the study's findings that a strong positive correlation exists between academic achievement and literacy skills among students in office technology and management. Additionally, these students exhibit a higher level of information and communication skills.

Recommendations

Based on the findings of the study the following recommendations were made:

1. Ensure that information and communication technology (ICT) literacy is integrated into all courses and incorporate modules on software applications, digital communication and data management.
2. Organize workshops on various ICT tools like micro soft office suite, Google workspace, project management and emerging technologies in order to the academic achievement among office technology and management students.

1. Office technology and management (OTM) programs should consider developing ICT-based assessment to evaluate students ICT literacy skills and academic achievement and institution should regularly monitor OTM students ICT literacy and academic achievement .

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Extent of Utilization of Artificial Intelligence in Education for Development and Sustainability

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Abstract

This study investigates the extent of utilization of artificial intelligence in education for development and sustainability. Two specific purposes and two research questions were formulated to guide the study. The sample sizes of 7 male and female lecturers from Industrial Technology Education Department, University of Uyo were used. The study adopted a descriptive survey design. A-4-points rating scale instrument titled: Extent of Utilization of Artificial Intelligence in Education for Development and Sustainability (EUAIDS) was structured and administered to the respondents via Google form and feedbacks were received via the same channel. Mean statistic was used to analyzed the data in order to provide answers to the research questions using Statistical Package for Social Sciences (SPSS). The findings of this study revealed the grand mean value of 1.13 for the utilization of AI tools and grand mean value of 2.32 for the benefits of AI tools in education, these were all to a low extent. Based on the findings of this study, it was recommended among others that National Universities Commission (NUC) and National Board for Technical Education (NBTE) should provide enabling environment for administrative and academic staff to acquire this emerging technology and its proficiency while maintaining operational efficiency of AI facilities for educational sustainability.

KEY WORD: *Artificial Intelligence Utilization, Education, Sustainability Development*

Introduction

In the contemporary digital world, the drastic demands for curriculum redesign has become increasingly pivotal, especially in academic institutions where AI tools is adopted for academic activities for service delivery. This is because education is a social service provided world-wide with multiple objectives through which the total development of an individual is enforced using any acceptable methods and techniques according to individual's abilities and interests in contributing adequately to the advancement of the society. Education is seen as the only powerful tool that equips individual with skills and knowledge needed to address global challenges with actions toward sustainable practices. Sustainable practices according to World Commission on Environment and Development is defined as growth that meets the needs and aspirations of the current populations without compromising those future generations. Bellandi and Propris (2021) described sustainable development as integrating economic vitality, environmental robustness and social equity to develop resilient, health, education, diverse and prosperous current and future communities. Moreover, in many countries including Nigeria, sustainable development goals have been integrated into educational systems and this practice is to ensure inclusive and equitable education for all, and also to empower them to contribute immensely to a more sustainable future. Hence, certain practices are required to meet the needs of the present without compromising the future generation's needs, so the required learning environment in this case is calling for the link between educational sustainability and digital transition. Right from time immoral, teaching and learning where within the walls of classrooms to a group of students and in a traditional way, but today, digital transition has paved way for teaching and learning. According to Mureşan, (2014), the intervention of the digital technology and online platform is trending slowly and surely taking the place of classrooms. Thus, the modern education system has completely eradicated the space limitation of a classroom by encouraging the participation of more students from every corner of the world. By providing knowledge through online platforms or websites, the modern education system has been able to attract a variety of students and teachers to participate in technology-based learning that is free from any kind of limitations of time, space or number of students, the popularity of online learning is increasing day by day mostly with the prevalence of Artificial Intelligence (AI).

AI, based on different school of thought does not have a standard definition because of its versatility. Calo (2017) noted that there is no universal or consensus definition AI due to its constituents. Calo (2017) referred to AI as diverse techniques that vary in complexity, sharing common outcome with imitation of human cognition and decision making. Artificial intelligence according to Russell and Norvig (2023) are machines that react to simulations in the way humans do with the ability to contemplate, judge and attend to complex issues. Lee (2022) expressed AI as a machine that can simulate intelligent human behavior, such as learning, reasoning and problem-solving. Lee (2022) further pointed that AI involves the use of algorithms and complex mathematical models to enable machines to learn and improve their performance autonomously with fundamental purpose to exhibit traits specific to human intelligence. Devlin, (2019) speculated that AI are systems capable of making decisions that normally require a human level of expertise, having qualities as intentionality, intelligence and adaptability. AI is a technology where machines can learn and understand logic like humans. This technology is said to be able to help simplify human life which is very complex. Loeckx (2016) AI combines the presence of several data, iterative processing and intelligent algorithms, allowing the software to learn automatically from patterns or features in the data. It is a very broad field of study in Computer, with wide scope, theories, methods, technologies and subfields existing to include machine learning, modular neural networks, natural language processing, speech recognition, image analysis, pattern recognition, prediction making and learning and decision-making, cognitive computing, visual perception, language translations, computer vision and scientific analysis. Moreover, AI is a revolutionary breakthrough in computer science, education and technology that reshapes the landscape with its transformative capabilities when applying OpenAI, chatGPT, AI prompt, AI browser and the likes. Its essence lies in creating software capable of executing tasks that traditionally demand human intelligence.

According to Rosenberg (2019) emerges of AI has amplified education with the shift to home learning mostly where information has become more essential to teachers where they cannot interact with learner's in person. The integration of AI in education development and sustainability has optimized source allocation, reduce energy consumption leading to improved student outcomes and reduced waste. Kumar (2020) acknowledged AI as a technology that would be helpful to both teachers and students in performing their routine functions, while also simultaneously and successfully offering effective utilization experiences to both parties. Additionally, AI-powered tools can facilitate the analysis of vast amounts of educational data, enabling educators to identify students' areas of improvement and develop targeted interventions,

Siemens (2013). So it's not surprising that currently many AI-based innovations and breakthroughs are being and will be applied to support the learning process to make it more practical and effective. However, the utilization of AI in education is believed to be able to help humans learn better and achieve educational goals more effectively through the adoption of personalized learning system, Baker and Smith (2019); AI facilitates quality education to marginalized communities so as to promote equity and inclusivity, AI is seen as fostering technological awareness and literacy, providing students with hands-on experiences that connect classroom learning to real-world experience, fostering an improved means of pedagogical instruction to creating fun and enjoyable teaching and learning process, Chassignol *eto l*. (2018) engagement with project-based learning and empowering students to become sustainability leaders, Stern (2019). Again, students now make use of electronic gadgets such as tablets, while teachers also utilized different platforms such as Google Classroom, Google form, Turnitin, chatGPT, and many others for virtual academic activities, Sahin and Thompson (20017).

Google classroom is perfect AI software for constructing knowledge based on social relationships, communication, collaboration, task sharing, sharing of knowledge, homework and discussion between students and lecturers. Balasubramanian *etol.(*2014) and
Hossain and Wiest (2013) are of the opinion that Google classroom application is a free educational platform that allows students to access the course content uploaded by their lecturers. The platform allows lecturers and students to communicate with each other via messages and video scripts, providing learners with the chance to communicate and collaborate in a virtual classroom environment. Google classroom is an application that can be used on both mobile devices and in the web environment to create an online community of practice, where every member has a profile page that is composed of groups, communities and their latest posts. They can access libraries, teaching/learning materials and their pages anywhere, Trust (2012). Google form is AI software that facilitates learning using various assessment resources in evaluating students' academic performance. It creates a better environment for collaborative learning, requiring interaction between lecturers and students at the end of the exercise, Alvarez (2011). This is exactly what is needed for effective learning performance since teaching requires interaction and dialogue practice.
Another AI tool used on education is Turnitin. Turnitin is AI tool used among the academic community to investigates academic dishonesty or academic fraud called plagiarism. Plagiarism is the process of verifying the genuineness of people's works. Tharun and Ramesh (2014) identified Turnitin as an internet based anti-plagiarism software which checks the unoriginal content in the scholarly articles to provide a comprehensive report of the similarities found. This software can be accessed from anywhere without inconvenience provided Internet facility is available. Turnitin and its other components are highly effective at identifying surprisingly high rates of unethical behavior

among the content writers. It is extremely helpful to students and educators, especially those without easy access to a writing center. Ireland (2015) analyzed that Turnitin provide helpful information to students to guide them through paper revision process and to develop written communication skills which are essential to success in school and in the workplace. Turnitin should not be hammered on students, but should be used to improve the performance of the student, checking and correcting the mistakes before final submission of any report. Chandrasekaran (2021) added that innovations in Artificial Intelligence have led to significant changes in software development practices with great improvement on traditional software development processes, giving developers the ability to build projects that are smarter, faster and more effectively meant for code generation, test automation, bug analysis and performance improvements.

Indeed, chatGPT is seen as a perfect tool described here, which is AI-based language model with deep impact in almost every field. GPT stands for "Generative Pre-Trained Transformer" and is the naming given to a family of natural language models developed by open Artificial Intelligence. Atlas (2023) indicated that chatGPT is a language model tool that allows instructors and learners to interact with a computer in a more natural and conversational way. chatGPT uses natural language processing to learn from datasets and providing users with artificial intelligence-based written answers to questions or prompts. These models are trained on large text datasets to learn to predict the next word in a sentence and generate coherent and compelling human-like output in response to a question or statement. Ezekiel and Akinyemi (2022) summarized that AI is an emerging field of expertise that has the potential of transforming practices in higher institutions of learning and that it has influenced and will continue to influence proceedings across sectors in developed nations around the world and education industry is not an exception.

Despite the potentiality of AI in education system for the better, it has been observed that majority of the lecturers are so

habituated on other sorts of online interaction but with less attention to academic matters. Owing to connection with technology-based activities, it is anticipated that AI is not effectively utilized. However, numerous researchers have investigated the impact of AI tools usage in improving teaching-learning competencies but none is found used in any South-south Federal tertiary institutions in Nigeria. This study therefore, seeks to establish how Artificial Intelligence is utilized in Education for Development and Sustainability by Lecturers in University of Uyo.

Purpose of the Study

The main purpose of this study was to investigate the extent of utilization of artificial intelligence in education for development and sustainability by lecturers in University of Uyo,

Specifically, the study sought to:

i. investigates the extent of lecturers' utilization of AI in education,

ii investigates the extent of lecturers' benefits of AI in education

Research questions

The following research questions were raised to guide this study:

i What is the extent to which the lecturers utilize AI in education?

ii What is the extent to which the lecturers' benefits from AI in education?

Significance of the Study

The findings of this study would be of immense benefit to student, institutions, Government, business operators and future researchers.

This study would be beneficial to students if AI software' stools is adopted in institutions and make known to the leaners by lecturers which is essential for students to access learning resources, conduct research and complete their scheduled assignments effectively.

The result of this finding will enhances and motivate scholars in an institution the desire to apply AI tools in exchanging ideas in solving academic problems.

The finding of this study would be beneficial to **Government agency such as Nigerian communication commission (NCC) etc, for Capacity Building** in terms of training of personnel officers on ICT to maintained effective utilization of e-resources and virtual communication.

Business operators on their part would use this finding to avail themselves of the relevance of AI facilities to address their immediate challenges in today's digital world.

The finding of this study would serve as a reference material for future researchers and learning references for the students in the polytechnic and University community.

Methodology

The researchers employed a descriptive survey design in this study with structured questionnaire tagged “Extent of Utilization of Artificial Intelligence in Education for Development and Sustainability instrument” (EUAIDS) to elicit relevant information from the respondents. This study was conducted in the University of Uyo, Uyo in Akwa Ibom State, Nigeria.

The population of the study was 7 comprising of 4 male and 3 female lecturers from Industrial Technology Education Department. The items were answered using a-4-points response category of very great extent (VGE), great extent (GE), low extent (LE) and very low extent (VLE). Soft copy of research instruments was administered to the respondents via Google form, and feedbacks were received via the same channel.

Mean statistic was used to analyze the data in order to provide answers to the research questions using Statistical Package for Social Sciences (SPSS).

The real limits of numbers were used in determining the extent to which AI tool were used in Education. The interpretations for the real limits of number are as follows:

3.50 – 4.49	Very Great Extent	(VGE)
2.50 – 3.59	Great Extent	(GE)
1.50 – 2.49	Low Extent	(LE)
1.00- 1.49	Very Low Extent	(VLE)

Data Analysis, Results and Discussion of Findings

The results of data analysis are presented and discussed in this section. The research questions which guided this study were answered using mean SPSS tool.

Research Question 1: What is the extent to which lecturers' utilized AI tools in education?

The summary of responses to Research Question 1 is presented in table 1, thus:

Table 1: Summarized mean scores of Lecturers' Utilization of AI tools in Education

Items **Utilization of AI tools in Education:**	**N**	**Mean**	**Remark**
With AI, a lecturer uploads course content on Google Classroom	**7**	1. 20	VLE
With AI, a lecturer uploads students' assignment on Google form	7	1.29	VLE
With AI, lecturers fetch out academic dishonest acts called plagiarism in students articles using Turnitin	7	1.02	VLE
With AI, a lecturer comfortably adopts chatGPT in arranging course content	7	1.02	VLE
Grand Mean	**7**	**1.13**	**VLE**

Note: VLE = Very Low Extent, 7= number of respondents, Grand mean =1.13.

Data in Table 1 gives the summary of the mean score regarding lecturers' responses on the extent to which AI is utilized in education. Thus, all the tentative items yield very low extent. Hence, the grand mean value of 1.13 implies that Google classroom, Google form, Turnitin and chatGPT were on a very low extent utilized by lecturers in scholarly activities.

Research Question 2: What is the extent to which lecturers' benefits from AI tools in education?

The summary of responses to Research Question 2 is presented in table 2, thus:

Table 2: Summarized mean scores of Lecturers' benefits of AI tools in Education

Items	N	Mean	Remark
Benefits of AI tools in Education:			
Google classroom is accessed via mobile devices and in the web environment to create an online community	**7**	3.21	VGE
Google form creates a better environment for collaborative learning, requiring interaction between lecturers and students	7	2.47	GE
With AI Turnitin , plagiarism is checked in scholarly articles but sending for publishing	7	1.19	VLE
chatGPT is used in interacting with a computer in a more natural and conversational way	7	2.42	SLE
Grand Mean	**7**	**2.32**	**LE**

Data in Table 2 gives the summary of the mean score regarding lecturers' responses on the extent to which AI is benefitted in education. Hence, the grand mean value of 2.32 implies that lecturers' benefits of AI tools in education were to a low extent of utilization. Thus, Google classroom accessed via mobile devices and in the web environment in creating an online community was to a very great extent of benefit, Google form creating a better environment for collaborative learning, requiring interaction between lecturers and students was to low extent of benefit, AI Turnitin plagiarism checker of scholarly articles before publishing was in a very low extent and the benefit of chatGPT used by lecturer in interacting with a computer in a more natural and conversational way was in a low extent.

Discussion of Findings

Findings from the research question 1 in Table 1 gives the summary of the mean score regarding lecturer's responses on the extent to which AI is utilized in education. Thus, all the tentative items yield very low extent. Hence, the grand mean value of 1.13 yield implies that Google classroom, Google form, Turnitin and chatGPT AI in education were to a very low extent utilized by lecturers in scholarly activities. Therefore, Loeckx (2016) acknowledged AI as a technology that would be helpful to both teachers and students in performing their routine functions, while also simultaneously and successfully offering effective utilization experiences to both parties. Siemens (2013) added also that AI-based innovations are applied to support the learning process to make it more practical and effective.

Findings from the research question 2 in Table 2 gives the summary of the mean score regarding lecturer's responses on the extent to which AI is benefitted in education. Hence, the grand mean value of 2.32 yield implies that lecturers' benefits of AI tools in education were to a low extent of utilization. Thus, Google classroom accessed via mobile devices and in the web environment used

in creating an online community was to a very great extent of benefit, Google form creating a better environment for collaborative learning, requiring interaction between lecturers and students was to low extent of benefit, AI Turnitin plagiarism checker used for scholarly articles before publishing was in a very low extent and the benefit of chatGPT used by lecturers in interacting with a computer in a more natural and conversational way was in a low extent. Therefore, Ezekiel and Akinyemi (2022) summarized that AI is an emerging field of expertise that has the potential influence to transform higher institutions of learning and other sectors of industry for overall development of nations. However, this study revealed that application and benefits of AI tools used in education by university of Uyo lecturers were of a low extent.

Conclusion and Recommendations

Utilization of Artificial Intelligence in education sustainability and development represents a transformative frontier, poised to revolutionize the way learning, teaching and interaction with the environment are exhibited. The reverse is the case as the study revealed the gap to be filled on the part of some lecturers towards the adoption, application and utilization of AI tools in education. Hence, it is recommended that lecturers in the University of Uyo should be given orientation by technology experts concerning the use of AI tools in their various fields of academic activities. Again, National University Commission and National Board for Technical Education should ensure that digital gadgets are provided and compulsory AI technology training and utilization for administrative and academic staff.

NARRATIVE POINT OF VIEW

Point of view is one of the central categories of narratology. The term as explained by Schmid (2010) was introduced by Henry James in the essay The Art of Fiction (1884). Narrative point of view or POV is simply the perspective from which a story is told. In other words, who is telling the story? Rasley (2008:9) defines POV as "the perspective from which the reader experiences the action of story. It is the POV that determines whose perceptions, whose thoughts, whose emotions we get as we read. The choice of point of view is the choice of who is to tell the story, who talks to the reader. It may be a narrator outside the work (omniscient point of view); a narrator inside the work, telling the story from a limited omniscient or first person point of view or apparently no one (dramatic point of view). Narrative point of view, perspective, or voice is the choice of grammatical person used by the narrator to establish whether or not the narrator and the audience are participants in the story; also, this includes the scope of the information or knowledge

There are two basic kind of POV; first person POV and third person POV and within these two lies some variation. The concept of point of view is basic to storytelling and even in life in general. First person POV is when a character in the story is narrating it. For examples: "I did this", "he said to me", "he shook my hand". If a character in a story is telling you I did this then it's a first person POV which is the case in the Sherlock Holmes story. An advantage of POV is that it closely resembled the ways stories are told in real life. Another advantage is acquiring the ability to sense a narrating character's personality. First person POV can be reliable or unreliable. A reliable narrator tells us what happens in a way that we believe is true. Most first person POV are reliable.

The narrator is usually the main character but this is not always the case. Sometimes there is an important character who is witnessing what happens to the main character. Sherlock Holmes's assistant Dr. Watson tells the story of Holmes's investigation but we never considered him to be the main character. Rather, Watson can be referred to as a supporting character who is recounting the adventures or journey of his and his friend. Holmes then is the main character; he is the story even though Watson narrates. For this reason, it is always necessary to pay attention to the character that fills that role- to his or her personality; built in biases, values and beliefs; and degree of awareness and perceptivity- in order to measure the reliability of the narrator.

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THE NARRATIVE VOICE AND POINT OF VIEW IN ARTHUR CONAN DOYLE'S A STUDY IN SCARLET

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INTRODUCTION

Narrative stylistics derives from the concept of narratology and narrative grammar. It involves the formal analysis of narrative texts from a tradition which is similar to European structural linguistics (Matthew, 2007). Narration or narratology in stylistics is simply a study of how stories are recounted by writers.Narratology itself is the theoretical study of narratives paying particular attention to its levels and structures.

As MacArthur (1992) asserts narration is “an aspect of the whole process of communication or discourse between author and reader, and between narrator and narratee”. Such studies also entails the discussion of voices and points of view of the various kinds and level of narration. Formally, narration is often referred to as narrative. Narrative as further defined in MacArthur (1992) as “the general or inclusive term for a story or account of any events or experiences, fact or fiction, long or short, detailed or plain. Narrative involves the showing or telling of these events and the various methods used to do this showing (Beard, 2003:33). Most theories on narration agree that perspective which is also referred to as 'person', 'point of view', 'reflector', 'voice', 'central consciousness' and 'focalisation', is in one way or another involved in the more general process of perception. As explained by Chamberlain (1990: 3) that the discourse of the narrator is centred on the utterance and the discourse of the characters, in the world of the text.

Story tellers are an important element for any story; a narrative voice, real or implied, that presents the story to the reader. When we talk about narrative voice we are referring to point of view, the method of narration that determines the position, or angle of vision, from which the story is told. This aspect is vital to the story. It colors and shapes the way in which everything is presented and perceived, including plot, character and setting.

NARRATIVE POINT OF VIEW

Point of view is one of the central categories of narratology. The term as explained by Schmid (2010) was introduced by Henry James in the essay The Art of Fiction (1884). Narrative point of view or POV is simply the perspective from which a story is told. In other words, who is telling the story? Rasley (2008:9) defines POV as "the perspective from which the reader experiences the action of story. It is the POV that determines whose perceptions, whose thoughts, whose emotions we get as we read. The choice of point of view is the choice of who is to tell the story, who talks to the reader. It may be a narrator outside the work (omniscient point of view); a narrator inside the work, telling the story from a limited omniscient or first person point of view or apparently no one (dramatic point of view). Narrative point of view, perspective, or voice is the choice of grammatical person used by the narrator to establish whether or not the narrator and the audience are participants in the story; also, this includes the scope of the information or knowledge

There are two basic kind of POV; first person POV and third person POV and within these two lies some variation. The concept of point of view is basic to storytelling and even in life in general. First person POV is when a character in the story is narrating it. For examples: "I did this", "he said to me", "he shook my hand". If a character in a story is telling you I did this then it's a first person POV which is the case in the Sherlock Holmes story. An advantage of POV is that it closely resembled the ways stories are told in real life. Another advantage is acquiring the ability to sense a narrating character's personality. First person POV can be reliable or unreliable. A reliable narrator tells us what happens in a way that we believe is true. Most first person POV are reliable.

The narrator is usually the main character but this is not always the case. Sometimes there is an important character who is witnessing what happens to the main character. Sherlock Holmes's assistant Dr. Watson tells the story of Holmes's investigation but we never considered him to be the main character. Rather, Watson can be referred to as a supporting character who is recounting the adventures or journey of his and his friend. Holmes then is the main character; he is the story even though Watson narrates. For this reason, it is always necessary to pay attention to the character that fills that role- to his or her personality; built in biases, values and beliefs; and degree of awareness and perceptivity- in order to measure the reliability of the narrator.

FIGURING OUT THE NARRATOR'S VIEW OF POINT

Point of view is one of the basic elements of a story that determines the perspective from which a reader experiences the narrative. There are certain factors that aid in identifying the point of view of a story:

Pronoun case - paying attention to the narrator's use of pronouns. These are case signals the perspective of the narrator. We usually figure this out by examining the frequent use of pro-forms. First person narrator is usually a part of the story who often uses 'I' or 'We'. Unlike the third person narrator who tells other's stories but is not involved. As Orson (1988) explains that first person is used for the eyewitness account, the story in which I tell you what I saw and did, what happened to me.

First-person : I, my, me, mine, we, us, ours, you, your

Second-person: you, your

Third-person : he, she, her, they, them, also character's names

The use of first-person point of view tightly controlled and limited in its access to information. The first-person narrator, while free to speculate, can only report information that falls within his own first-hand knowledge of the world or what he comes to learn second-hand from others. First-person narratives, however, are necessarily subjective. The only thoughts and feelings that first-person narrators experience directly are their own. The implications of this is that the reader can never expect to see characters and events as they actually are but only as they appear to be to “I” narrator.

THE STORY OF SHERLOCK HOLMES

Sherlock Holmes and his assistant and friend Dr. Watson are fictional characters created by British writer Sir Arthur Conan Doyle. Doyle was born on May 22, 1859. He became a doctor in 1882. When this career did not prove successful, he started writing stories. In addition to the popular Sherlock Holmes short stories and novels, Doyle also wrote historical novel, romances and plays.

Doyle published his first novel about the pair, A Study in Scarlet, in 1887; which became very successful. Doyle went on to write fifty-six short stories, as well as three more novels about Holmes's adventures-The Sign of Four (1890), The Hound of Baskervilles (1902), and The Valley of Fear (1915).

Holmes and Watson have become some of the most famous book characters of all time. Holmes spent most of his time solving mysteries. He also had a wide array of hobbies such as playing the violin, boxing, and sword fighting. Dr. Watson, a retired army doctor, met with Holmes through a mutual acquaintance when Holmes was looking for a roommate with whom to share the boarding fees. Watson lived with Holmes for several years at 221B Baker Street before marrying and moving out. However, after his marriage, Watson continued to assist Holmes with his cases.

The original versions of the Sherlock Holmes stories are still printed, and many have been made into movies and television shows. Readers continue to be impressed by Holmes's detective methods of observation and scientific reason.

The story of Sherlock Holmes had mostly been narrated from Dr. John H. Watson whom for several years had been assisting his friend in solving mysteries throughout the bustling city of London and beyond. Watson's commentaries have been objective on his character friend Holmes. He has depicted the later as a peculiar man-always questioning and reasoning his way through various assignments. However, Watson was immediately intrigued by Holmes's oddities when they first met in 1878, a short while before their first case: A Study in Scarlet.

METHODOLOGY

This paper has selected A Study in Scarlet as a data for analysis among other stories of Sherlock Holmes. A study in scarlet is divided into two parts with each part containing seven chapters. For easy analysis, only chapter two has been adopted for analysis: The Science of Deduction. This chapter marks the collaboration of the duos in mystery solving cases. Only the first part of the chapter will be analyzed. In other words, the first three paragraphs were selected and picked as data. The selected paragraphs were read several times in order to gather the required information. The source of the study was The Complete Sherlock Holmes book which is a collection of Holmes's stories.

A study in scarlet was first published in November 1887; being a reprint from the reminiscence of Watson.

Extracts from chapter 2: The Science of Deduction

We met next day as he had arranged, and inspected the rooms at No. 221B, Baker Street, of which he had spoken at our meeting. They consisted of a couple of comfortable bedrooms and a single large airy sitting-room, cheerfully furnished, and illuminated by two broad windows. So desirable in every way were the apartments, and so moderate did the terms seem when divided between us, that the bargain was concluded upon the spot, and we at once entered into possession. That very evening I moved my things round from the hotel, and on the following morning Sherlock Holmes followed me with several boxes and portmanteaus. For a day or two we were busily employed in unpacking and laying out our property to the best advantage. That done, we gradually began to settle down and to accommodate ourselves to our new surroundings.

Holmes was certainly not a difficult man to live with. He was quite in his ways, and his habits were regular. It was rare for him to be up after ten at night, and he had invariably breakfasted and gone out before I rose in the morning. Sometimes he spent his day at the chemical laboratory, sometimes in the dissecting-rooms, and occasionally in long walks, which appeared to take him into the lowest portions of the city. Nothing could exceed his energy when the working fit was upon him; but now and again a reaction would seize him, and for days on end he would lie upon the sofa in the sitting-room, hardly uttering a word or moving a muscle from morning to night. On these occasions I have noticed such a dreamy, vacant expression in his eyes, that I might have suspected him of being addicted to the use of some narcotic, had not the temperance and cleanliness of his whole life forbidden such a notion

As weeks went by, my interest in him and my curiosity as to his aims in life gradually deepened and increased. His very person and appearance were such as to strike the attention of the most casual observer. In height he was rather over six feet, and so excessively lean that he seemed to be considerably taller. His eyes were sharp and piercing, save during those intervals of torpor to which I have alluded; and his thin, hawk-like nose gave his whole expression an air of alertness and decision. His chin, too, had the prominence and squareness which mark the man of determination. His hands were invariably blotted with ink and stained with chemicals, yet he was possessed of extraordinary delicacy of touch, as I frequently had occasion to observe when I watched him manipulating his fragile philosophical instruments.

ANALYSIS

The following points will guide us in analysing the data:

a. The narrator is a character in the story – John H. Watson
b. The narrator uses words like – I, we,
c. The narrator presents his/her thoughts and feelings, but not the thoughts and feelings of other characters

A Study in Scarlet is told through the eyes of Dr. Watson. He is the narrator of what transpires in the story.

The story was narrated through the first person point of view. First person is used for the eyewitness account, the story in which I tell you I saw and did or the narrator might tell about something that someone else did. We can agree on this because Watson is one of the characters in the story though not the main character. Through Watson, we witness the events and actions within the story. That as a supporting character, he was able to see what the physical eye can. He was never in the position to disclose Holmes's feelings for if that were the case; Watson will came up with how Holmes was able to discern most of his cases puzzles. Occasionally, he was able to understand through facial expressions and gestures displayed by the detective what he was thinking but never the exact plans. We will see first person pronouns such as I, me, my, and mine.

Examples:

" We met next day as he had arranged "

"That very evening I moved my things "

"So moderate did the terms seem when divided between us"

"Sherlock Holmes followed me with several boxes and portmanteaus"

"We were busily employed in unpacking"

"My interest in him and my curiosity as to his aims in life gradually deepened"

"On the following morning Sherlock Holmes followed me with several boxes and portmanteaus".

Watson was able to present to us a clear picture or his thoughts and views, we can clearly see the description of Holmes and the actions and events being taking place but not the latter's feelings and thoughts.

Example:

Holmes was certainly not a difficult man to live with. He was quite in his ways, and his habits were regular. It was rare for him to be up after ten at night, and he had invariably breakfasted and gone out before I rose in the morning. Sometimes he spent his day at the chemical laboratory, sometimes in the dissecting-rooms, and occasionally in long walks, which appeared to take him into the lowest portions of the city. Nothing could exceed his energy when the working fit was upon him; but now and again a reaction would seize him, and for days on end he would lie upon the sofa in the sitting-room, hardly uttering a word or moving a muscle from morning to night. On these occasions I have noticed such a dreamy, vacant expression in his eyes, that I might have suspected him of being addicted to the use of some narcotic, had not the temperance and cleanliness of his whole life forbidden such a notion

This entire paragraph was a depicted picture of Watson's roommate not a recount of his emotions or feelings. The narrator was merely able to draw what he was able to perceive what his eyes saw. He was analytical and objective as it was facts that were presented.

CONCLUSION

It can be concluded that, based on the analysis on whole extraction that, A study in scarlet was choosing among other adventures of Sherlock Holmes as data for analysis. Second, two chapters were selected and was read several times to comprehend the whole story and how it is narrated. Lastly, it can be said that in understanding the plot of the story, point of view of the story is important. And from the analysis, it is proven that the story A Study in Scarlet is a first person point of view. The first-person point of view has its advantages, however, not the least of which is the marvelous sense of immediacy, credibility and psychological realism that autobiographical storytelling always carried with it.

The first-person narrator is frequently not the protagonist at all, but rather a character whose role in the plot is clearly secondary. He or she may in fact, have almost no visible role in the plot and exist primarily as a convenient device for transmitting the narrative to the reader. In their relationship to the other characters and to the actions of the plot, first-person narrators may be either interested and involved or disinterested and detached. In either case, however, they are always subject to hidden biases and prejudices in their telling of the story. Because narratives are the means by which someone communicates a story to someone else (Currie,2010:1). In the case of Watson's narration, he has been a supporting and acting character in the adventures of Holmes. Most investigations carried out by Holmes have been in Watson's presence and or participation. On other times, Holmes have been under Watson's scrutiny. Thus, the narrative is from Watson's perspective as eye witness and the closest to Sherlock Holmes.

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Literature in Language Use and Development: Implications for the Nigeria's Fourth Republic and the Emerging Global Challenges

By

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Abstract

Literature, unarguable, provides a multinational function which has the capacity to improve human theoretical thinking and resourcefulness. It can be an answer to the much desired pleasure, leisure and enjoment, any genre of literature has the implicit Porentials to be didactic: The didactic action can be used for social change and reconstruction. This paper posits that aside from the aforementioned functions of literature, it can also be used for language enrichment and development in many aspects: vocabulary, aesthetic beauty, grammar, semantics and many more. The paper also presents the argument that the language enhancement so created by literary acquisition has positive implications for Nigeria's fourth republic and the emerging global challenges.

Key Words: Literature, Language use, Development, Implication.

Introduction

English language is now spoken by an estimated 1.2 billion inhabitants of the world (Ethnologue, 2019). It has its roots in the Germanic branch of the Indo-European family and it is the official or semi-official language of more than 42 countries in the world, compared to French with 27, Spanish with 20 and Arabic with 17 respectively (Genc & Bada, 2010). 430 million people from countries such as India, the Philippines, Nigeria, Ghana, Zimbabwe, Zambia and Uganda, speak it as a second language (SL). (Williams, 2011).

One of the befitting colonial legacies bequeathed to the Nigerian nation is the English Language. It is today the country's official language of commerce, instruction and most importantly the nation's lingua-franca. Indeed, it is Nigeria's language of unity and integration.

It is in the affirmation of the importance of English language in Nigeria that (Owolabi, 2012) asserts 'Nigeria is, obviously, one of the largest users of English as a Second Language (ESL) in the world. The language that first came with the colonial masters as a foreign language has since grown in leaps and bounds to now become a second language and, unarguably, the country's official language. As the largest black nation in the world, Nigeria is using English as the official language'.

This view of Owolabi is affirmed by Kembo (2000) who also asserts that "In many parts of Africa, as in other parts of the world, peòple are increasingly finding themselves in a country that does not necessarily make use of a language they know. These people are forced to learn the language(s) of the host." In a multilingual nation like Nigeria, people moving from one part of the country to another often had to make recourse to English for their communication needs. This underscores the essence of the language and its international significance and the need to consistently improve on its usage and applications.

It is important to stress that language use can be improved upon in many ways: listening, reading, writing and speaking. In each case, imitation is of fundamental importance.

Imitation is a cardinal denominator among major propositions of language use and development, literature becomes a ready and useful ally in the quest to use conversational discourse or willing partner to continuously improve language use for formal presentations.

Importance of Literature in Language Use and Development

One of the factors militating against fluent and proficient use of language is the demise of the reading culture. Today, many people are more pre-occupied with viewing satellite television programmes, surfing the internet, and using the mobile phone than to read an interesting novel. In fact, many consider Drama, Prose writing and Poetry as literary obsoletes complete in their literary forms as well as difficult to understand. They, therefore, do not see any need to allow these potentially rich literary creations or genres to enrich their language proficiencies.

Igoche (2000) suggests that "literature is an imaginative work of art which expresses certain messages through the vehicle of highly embellished language." The embellishment of language as used above connotes that the language of literature is pristine, rich in figurative usage, varied sentence structures, and artistically presented to evoke desirable responses of even the most bizarre innermost recesses of the human mind. Obvious! This accentuates the importance of literature to language use and development.

Leech (1969) contends that the literary artist is nothing if not creative. He argues that his creativity must touch on the flexible but imaginative use of words, creative and artistic representation of even the mundane as to make it look real and attractive.

The above implies that when people take deliberate steps to use literature as a means of improving their use and development of language, success is sure. This is because the writer's varied vocabulary, delicate syntax, artistry and other linguistic features will certainly impact positively on them and ultimately change the landscape of their linguistic scenery and beauty.

Literature can also enhance the use of English for strictly communicative purposes. The communicative approach of language learning emphasizes a shift in abstraction to learning the language for strictly communicative,or utilitarian purpose. This is betause language use can sometimes be situational requiring the use of language for specific purposes. Where this is the case, Literature, which explores different aspects of the human experience, will provide the user with a wider dimension of choice of relevant vocabulary to aptly suit the chosen context of expression

Aspects of Language Use and Development through Literature

Literature can be used to profoundly enhance proficiency in language use and development. This can be achieved when people are motivated to deliberately and consciously use the three genres of Literature as veritable avenues for linguistic excellence and beauty. Aspects of language use that can positively be impacted through literary study are many and varied. Some of them will be examined in this paper.

Varied Vocabulary:

Vocabulary means the word-stock of a language available to its users. (Alo, M.A. 2008). In the use and development of any language, vocabulary building and acquisition is quite essential. In English Language use, vocabulary development enhances fluency, contextual appropriateness and proficiency. The effective use of literary texts, be it drama, poetry or prose will go a long way in the development of varied vocabulary for any user of the English Language. The following extracts

will buttress the point being made: Let ys begin with an extract from William Golding's Lord of the Flies:

A single sea bird flapped upwards with a hoarse cry that
was echoed presently, and something squawked in the
forest. Now streaks of cloud near the horizon began to
glow rosily, and the feathery tops of the palms were green.
(. William G. Lord of the Flies pp 123)

In the above short extract from this novel, a conscious reader would have added to his vocabulary development such words as "flapped", "hoarse", "echoed", "squawked" "horizon", "rosily" and "feathery", etc.

Another good example is from a stanza from Sir Walter Raleigh's poem"The soul's Errand"

" Tell with how much it wrangles
In tickle points of niceness
Tell wisdom she entangle
Herself in over-wiseness."
(. In Amaechi Martins|zuchukwu, oppeit p 152)

In the above short poem, a user of English would have added the following words to his word-stock: "wrangles", "tickle", "niceness", and "entangle".

The two examples above from a novel and a poem are ample evidence of how literary texts (if properly read and used) can potentially enhance the reader's vocabulary development efforts.

Aesthetic Beauty

Linguistic beauty is enhanced through the use of aesthetics. This is achieved through the use of figurative expressions, proverbs, idioms, phrasal verbs and other artistic linguistic forms. Figurative expressions include Simile, Metaphor, Personification, Metonymy, Paradox, etc. A meticulous and curious reader of literary art forms has a lot to benefit in. terms of acquiring varied figures of speech, idioms, phrasal verbs, symbols, etc.

...A host of golden daffodils
Beside the lake, beneath the tress
Fluttering and dancing in the breeze.
The waves beside them danced, but they out did
The sparkling waves in glee. A poet could not but be gay
I'm gazed and gazed but little thought
What wealth the show to me had brought...

(William wordsworth, in Amaechi M.A opp. Cit p 141)

In the above short poem, various figurative expressions were used. Examples are 'golden daffodils'- metaphor, 'fluttering and dancing in the breeze - Personification 'what wealth' - Alliteration etc.

Similarly, in a dramatic text, we see the following expression "But my advice is - do like the reed in the bush, stand and strut in good weather. But when it storms, learn also to bend." (Osofisan, F. p42). The above is a good example of a proverb.

The above are two examples of how literature may be used to enhance aesthetic linguistic beauty.

This is a branch of linguistics dealing with the form and structure of words (Morphology), and their interrelation in sentences (Syntax) Eastman, C. M. (2009).

In a nutshell, grammar deals with the rules of accepted usage associated with a particular language. It explains how speech is put together, how words and sentences are formed, and how messages are communicated.

Indeed, grammar can be learnt easily and more practically through Literature. The following sentences exemplify this assertion:

"Lucetta had reclined herself, and was looking dreamily through her fingers" (Hardy, T. 1994, pp128). A good example of a complex sentence with a main clause and a subordinate clause.

"These heavy thoughts were a burden" (Asare, K. 2007). This illustrates, the grammatical rule of 'concord' - agreement between a plural subject and a plural verb.

"Savages! You claim to be more civilized than us but did you have to carry out all this killing and carnage to show how you are stronger than us" (Osofisan, F. opp. Cit. p12). The above is a good illustration of an exclamatory sentence.

Semantics

This is the study of meaning of linguistic signs - that is, words, expressions and sentences. Eastman, M. (2009).

The goal of semantics is to match the meanings of signs - what they stand for - with the process of assigning those meanings.

Literature can enhance the understanding of meaning in various forms, deductive, inductive, lexical, figurative or contextual, thematic, etc. This can be seen from various literary texts earlier presented above.

Other areas of language use through literature include phonology - through better understanding of supra-segmental features of the language as exemplified by the use of metrical features in poetry particularly metaphysical and neo-classic poems, etc.

Implications for the Nigeria's Fourth Republic and the Emerging Global Challenges

Nigeria's fourth republic emerged on 29th May 1999. The expectations of Nigerians was enormous in terms of delivery efforts, meeting global economic benchmarks and social justice.

Appropriate language development strategy through a galvanized reading culture will go a long way in promoting national integration, peace and unity. It will also promote regional economic integration which is necessary for effective global participation alongside the developed economies.

Language enrichment will continue to promote easy dissemination of government policies for public support and co-operation. In this regard, the private sector can be mobilized for participation in global economic competitiveness. It will accelerate improved diplomatic and foreign relations necessary for meeting effective global challenges.

Problems

Literature is yet to be integrated as part of English Language study. The subject of literature is still optional on the secondary school curriculum in Nigeria.

There is a clear case of poor reading culture among Nigerians generally, let alone literary reading and analysis. The advent of social media sites like Facebook, Twitter, Linkedin, Myspace, etc. further exacerbates the problem.

Literary clubs are no longer encouraged in schools, public whole reading of chapters of novels, poetic renditions or reading of dramatic texts are no longer in vogue.

There is general public apathy towards literary reading for leisure or as a hobby.

Recommendation

There should be a deliberate policy towards reading culture re-awakening. Literature should be made compulsory in schools. Private and public renditions of poetry, drama sketches and whole chapter reading of novels should be encouraged.

Parents and guardians should encourage more reading through the stocking of novels, plays, poetic anthologies that reflects different levels of their children or wards education.

They should also encourage the children to read these literary materials as a rule progressively.

Literature should be integrated into English Language and made compulsory at the secondary school level of the Nigerian education system.

Conclusion

The paper painstakingly presents a panoramic view of how literature can potentially improve language use and proficiency using the three genre of literature as models.

It demonstrates effectively and very convincingly too that language vocabulary, aesthetic beauty, grammar, semantics and even phonological supra-segmental features are better developed through literature. It is, also an incontrovertible fact that the gains acquired through this development have positive implications for Nigeria's fourth republic and the emerging global challenges.

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Strategies for improving the speed of signal transmission in wireless communication channels: A Review

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Abstract

The ever-increasing demand for high-speed data transfer, low latency, and efficient communication networks in wireless systems has necessitated the development of methods to enhance the speed of signal transmission in wireless communication channels. This paper explores different models and approaches, including advanced modulation techniques, channel coding, multiple-input multiple-output (MIMO) systems, beamforming, and the use of millimeter-wave and terahertz frequencies. Furthermore, the impact of environmental factors like noise, interference, and fading on transmission speeds is also examined. The goal is to identify optimal strategies to increase data rates while maintaining signals integrity and reducing power consumption.

Keywords: speed, communication channel

1. Introduction

Wireless communication channels are critical for modern connectivity, supporting applications ranging from mobile networks to IoT devices. However, the demand for high-speed, reliable communication is continuously outpacing current technological capabilities. Factors such as limited bandwidth, multipath fading, interference, and increasing user density contribute to challenges in achieving optimal data transmission speeds. (Proakis, J. G 2001)

Despite advancements like Multiple-Input Multiple-Output (MIMO), Orthogonal Frequency Division Multiplexing (OFDM), and channel coding techniques, current systems face significant constraints, especially in high-mobility scenarios and dense urban environments. These challenges are further exacerbated by the need to maintain energy efficiency and low latency in real-time applications like autonomous vehicles, telemedicine, and virtual reality.

Thus, there is a pressing need for innovative strategies that leverage advanced modulation techniques, machine learning, adaptive coding, and spectrum management to enhance the speed and reliability of signal transmission in wireless communication channels, while ensuring scalability and compatibility with next-generation networks like 5G and 6G.

This paper discusses key models and strategies used to improve the speed of signal transmission within these challenging environments. Through these strategies, wireless systems can achieve higher throughput, more robust connections, and more efficient use of available bandwidth.

2. Factors Affecting Wireless Signal Transmission Speed

Before delving into the models to improve transmission speed, it's important to understand the factors that limit signal speed in wireless communication channels:

1. **Bandwidth Limitations**: The available bandwidth of a wireless channel dictates the maximum data rate that can be achieved. The wider the bandwidth, the higher the transmission capacity.
2. **Channel Impairments**: Wireless channels are subject to fading, interference, noise, and multipath propagation, all of which degrade the quality of the received signal and can lower the effective data rate.

3. **Signal-to-Noise Ratio (SNR)**: The SNR is a critical metric determining how well a signal can be distinguished from noise. Higher SNR results in better transmission quality and higher data rates.
4. **Latency**: High latency can significantly degrade user experience, especially for real-time applications such as voice and video calls. Latency is influenced by distance, processing delays, and transmission protocols.
5. **Power Constraints**: In many wireless systems, especially those using battery-powered devices, power consumption must be minimized. Improving signal transmission speed while optimizing power consumption is a key consideration.

3. Models and Strategies to Improve Signal Transmission Speed

3.1. Advanced Modulation Techniques

Modulation schemes define how data is encoded onto a carrier signal. By using advanced modulation techniques, the speed of signal transmission can be significantly improved.

- **Quadrature Amplitude Modulation (QAM)**: Techniques like higher-order QAM (e.g., 64-QAM, 256-QAM) enable more bits per symbol, thereby increasing the data rate. The challenge with higher-order QAM is maintaining a high SNR to minimize error rates.
- **Orthogonal Frequency Division Multiplexing (OFDM)**: OFDM divides the frequency spectrum into smaller sub-carriers, allowing for higher data rates even in noisy or multipath environments. It's widely used in modern wireless standards like LTE, 5G and Wi-Fi. (Zhang,L and Wang, J 2021)

3.2. Channel Coding and Error Correction

Channel coding and error correction are essential in wireless communication systems to ensure data integrity during transmission. They add redundancy to transmitted data to detect and correct errors caused by noise, interference, or other impairments in the communication channel. (J. Pan & Li, R 2020)

- **Turbo Codes** and **Low-Density Parity-Check (LDPC) Codes** allow for the detection and correction of errors in transmission, improving overall data reliability and speed. & Lau, K.N, & Zhang, D. 2021)
- **Forward Error Correction (FEC)** helps mitigate errors without the need for retransmissions, thereby reducing delays and increasing throughput.(Chen, H. Yu, Z 2022)

3.3. MIMO (Multiple-Input Multiple-Output) Systems

MIMO technology uses multiple antennas at both the transmitter and receiver ends to increase capacity without needing additional bandwidth. By exploiting spatial diversity, MIMO can increase throughput and reliability in the same spectrum.(Tse, D & T.S et al 2014)

- **Spatial Multiplexing**: MIMO systems transmit multiple data streams simultaneously, allowing for increased data rates proportional to the number of antennas used.
- **Beamforming**: MIMO systems can utilize beamforming to focus signals in a particular direction, enhancing signal strength and reducing interference. This also increases the effective range and quality of the signal.

3.4. Millimeter-Wave (mmWave) and Terahertz Frequencies

The use of higher frequencies, such as millimeter-wave (30–300 GHz) and terahertz (0.1–10 THz) bands, offers significantly larger bandwidth compared to traditional microwave frequencies (sub-6 GHz). This enables much higher data rates. (T.S, et al 2014)

- **mmWave in 5G Networks**: One of the key features of 5G technology is its utilization of the mmWave spectrum. While these frequencies are highly susceptible to atmospheric attenuation and require line-of-sight propagation, the potential for high-speed data transmission is enormous.
- **Terahertz Communications**: Research into terahertz frequencies is ongoing, as they promise to unlock ultra-high-speed data transfer, particularly for applications like wireless data centers and short-range communications.

3.5. Cognitive Radio and Dynamic Spectrum Access

Cognitive radio systems can improve the utilization of available spectrum by dynamically adjusting transmission parameters in response to changing channel conditions. This includes:

- **Dynamic Spectrum Access (DSA)**: By detecting unused or underutilized frequency bands, cognitive radios can opportunistically access them, enhancing overall spectrum efficiency and transmission speeds.
- **Interference Avoidance**: Cognitive radio can mitigate interference from other users by adjusting transmission power or frequency, leading to more stable and faster communication.

3.6. Network-Level Optimization

- **Network Densification**: By deploying more base stations or small cells in high-demand areas, the coverage and capacity of a network can be enhanced. This reduces interference and increases the likelihood of higher data transmission speeds.
- **Edge Computing**: Moving processing closer to the end-user via edge computing reduces latency and improves real-time data transmission.

4. Challenges and Future Directions

While the models and technologies discussed above have shown promise in improving the speed of signal transmission, several challenges remain:

- **Interference Management**: In dense network environments, managing interference between users becomes critical. Advanced interference cancellation techniques and network coordination are needed to maintain high throughput.
- **Environmental Factors**: Weather, obstacles, and the physical environment significantly impact the performance of mmWave and terahertz systems. Advanced propagation models and adaptive algorithms will be required to handle these challenges.
- **Energy Efficiency**: As communication speeds increase, so does the energy consumption of wireless devices. Power-efficient designs and energy harvesting techniques must be incorporated into future systems.
- **Regulatory Issues**: The allocation of spectrum for mmWave and terahertz communication remains a regulatory challenge. Global cooperation will be required to ensure efficient use of the available spectrum.

5. Conclusion

Improving the speed of signal transmission in wireless communication channels is a complex but achievable goal that involves a combination of hardware and software innovations. Techniques like advanced modulation, MIMO systems, cognitive radio, and the use of higher-frequency bands such as mmWave and terahertz can significantly enhance data rates. However, challenges such as interference, environmental factors, and power constraints must be addressed to fully realize the potential of these technologies. As the demand for faster, more reliable wireless communication continues to grow, further research into these models will be critical in shaping the future of wireless systems.

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Smart Microgrid Design Integrating Renewable Energy for Enhanced Energy Security and Economic Sustainability

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Abstract

The increasing global population, rising per capita energy consumption, and rapid industrialization necessitate sustainable and green energy solutions to mitigate climate change. Renewable energy technologies, particularly solar and wind, have gained prominence as viable alternatives to fossil fuels, with developed and developing nations investing in microgrid systems to enhance energy security. This paper presents the design of a hybrid microgrid system for Kazaure City, Nigeria, integrating solar photovoltaic (PV), wind turbines, and a diesel generator to ensure a reliable and efficient power supply. The system consists of an AC bus linking the diesel and wind generators, a DC bus connecting PV generation to battery storage, and an AC-DC converter for seamless energy integration. Using HOMER software, an optimal configuration was determined, ensuring reduced transmission losses, lower operational costs, and improved grid stability. The results highlight the feasibility and effectiveness of the proposed microgrid in providing sustainable electricity for the community while contributing to the global transition towards renewable energy.

INTRODUCTION

In response to the escalating global population and the consequential surge in per capita energy consumption, economic growth, and industrialization, the imperative for sustainable and green energy solutions has become increasingly evident. The quest for alternatives to combat climate change challenges has elevated renewable energy technology as a focal point within the field of electrical engineering. This paper embarks on a comprehensive exploration of the design and implementation of a microgrid system tailored to meet the specific energy demands of Kazaure City in Jigawa State, Nigeria.

The groundwork for this research is rooted in the recognition that renewable energy has emerged as a linchpin for power engineers seeking to enhance energy security and promote economic sustainability. The paradigm shift towards renewable energy adoption has been particularly pronounced in developed nations, where concerted efforts aim to eliminate CO2 emissions by transitioning away from fossil fuel-based generations. A parallel commitment to renewable energy investment is observable in developing countries across Africa and the Middle East.

As widely accepted renewable energy sources, solar and wind play a pivotal role in the global pursuit of sustainable energy solutions. The versatility and scalability of these resources have led to extensive installations worldwide. Notably, the deployment of off-grid systems, encompassing solar photovoltaic (PV), wind, or hybrid configurations, has gained traction. Microgrid technology, a key enabler in these off-grid systems, facilitates load traffic alleviation, provision of power to remote areas, and serves as a resilient backup during utility grid disconnections.

The integration of microgrid systems with the utility grid further elevates their significance. By enhancing performance and fortifying power systems with high-quality output, grid-tied renewable energy solutions contribute to reducing power demand during peak times, alleviating congestion, and minimizing transmission losses and maintenance costs. The collaborative synergy between renewable and nonrenewable sources in these grid-tied systems augurs well for an extended lifespan of the latter.

Against this backdrop, this paper sets out to detail the design intricacies of a microgrid system uniquely tailored to address the energy demands of Kazaure City. The proposed system, featuring an AC bus interconnecting a diesel generator and a wind generator, coupled with a DC bus linking photovoltaic (PV) generation to battery storage, is positioned as a model of sustainable energy integration. The interface of AC-DC buses with converters underscores the commitment to optimizing the system for maximum efficiency and reliability.

As we delve into the specifics of the microgrid design for Kazaure City, our aim is to contribute not only to the local energy landscape but also to the broader global narrative of transitioning towards resilient, sustainable, and efficient power systems. This paper encapsulates the intricate balance of renewable and nonrenewable energy sources within a microgrid framework, emphasizing the potential for impactful change within the energy sector.

The Location

Kazaure is a community in Jigawa state Nigeria, located (12°39.2'N, 8°24.7'E) with a land area of approximately 1780km2. The weather condition in Kazaure can be characterized as somewhat hot area with a long summer and day light period than winter and rainy season, hence the electrical load in this area is much of a cooling system like electrical fan, AC fridge etc. and that the peak energy demand occur somewhere between May to July.

The design is to supply an AC load of 166 kWh per day, 23 kW peak, with the typical weekday demand. The system will consist of one AC bus where the diesel generator, wind generator and load are connected, and a DC bus, where the PV generation and battery storage are connected. There will be an AC-DC converter interfacing the AC and DC buses.

The following components are used in making this system.

1. A diesel generator set, with the base system having a generation capacity of 10 kW, with a capital and replacement cost of $5000 each, operation and maintenance costs of 0.5 $/h and minimum load ratio of30%. The generator will run for a total lifetime of 15,000 hours.

2.Generic 3 kW (data available from HOMER) wind generators with a rated power of 3 kW, with a capital and replacement cost of $18,000 each, and operation and maintenance cost of $180. The lifetime of this generator is 20 years and its hub height is 17 meters. The data can be loaded from HOMER, including its power curve.

3. A solar PV system is also being considered. The selected solar module is a Canadian Solar MaxPower CS6U-340M (data available from HOMER) has a rated power of 340 W, its capital cost of each module is $279.50, its replacement cost is $279.50. The lifetime of these modules is of 25 years, the derating factor is 88%, its slope is 45 deg, the azimuth angle is 0 deg, and the ground reflectance is 20%.

4. DC/AC converter, the base converter is a Leonics S-219Cp (data available from HOMER) rated at 5 kW, with a capital and replacement cost of $600 each and 0 operation and maintenance cost. The lifetime of the converter is 10 years and its efficiency 96%. The capacity of the rectifier is 80% relative to the inverter with an efficiency of 94%.

5. Battery bank which overcomes the variable output of the renewable resources, is installed. The battery bank consists of Discover 12VRE-3000TF batteries with a nominal capacity of 3.11 kWh. The capital cost of one battery is $ 410.00, its replacement cost is $ 410.00 and $0 operation and maintenance costs. The life time of the battery is 20 years.

As for the sizes of each component it entered as HOMER optimizer, hence homer will decide the optimum size of each component.

Literature Review

The growing global energy demand, coupled with the urgent need for sustainable power generation, has propelled the development of microgrid systems integrating renewable energy sources. Researchers have extensively explored various configurations and optimization techniques to enhance the efficiency and reliability of microgrids, particularly in developing regions where conventional grid infrastructure is inadequate. This section critically examines existing literature on microgrid design, renewable energy integration, and energy management strategies relevant to the development of a hybrid microgrid system for Kazaure City, Nigeria.

Microgrid Development and Renewable Energy Integration

Microgrids have emerged as a viable solution for decentralized power generation, particularly in areas with limited access to conventional electricity grids. Studies have shown that integrating renewable energy sources, such as solar photovoltaic (PV) and wind power, with conventional generators enhances energy reliability and reduces dependence on fossil fuels [1]. The global push toward achieving net-zero emissions by 2050 has led to extensive research on hybrid microgrid systems that combine renewable and nonrenewable energy sources to ensure a stable power supply [2].

In developed nations, microgrid implementations have demonstrated significant reductions in carbon footprints and operational costs, fostering sustainable energy transitions [3]. Similarly, developing countries, including those in Africa and the Middle East, are investing heavily in microgrid projects to improve rural electrification and reduce reliance on expensive diesel generators [4]. The integration of battery storage further enhances energy security by mitigating fluctuations associated with intermittent renewable sources [5].

Energy Management and Optimization Strategies

The effectiveness of a microgrid system largely depends on its energy management strategy. Several optimization tools, including HOMER, DER-CAM, and MATLAB-based simulations, have been utilized in microgrid design to determine optimal configurations, component sizing, and economic feasibility [6]. HOMER Pro, widely recognized for microgrid modeling, has been extensively used in previous research to evaluate the technical and economic viability of hybrid renewable energy systems [7].

Previous studies have highlighted the benefits of hybrid AC/DC microgrid architectures, which allow for improved efficiency by minimizing conversion losses between AC and DC components [8]. The proposed system for Kazaure City employs an AC bus linking the wind generator and diesel generator, a DC bus connecting PV generation to battery storage, and an AC-DC converter to integrate both buses. Research suggests that such hybrid architectures provide better load balancing and enhanced system stability compared to traditional single-bus designs [9].

Technical and Economic Viability of Hybrid Microgrids

Hybrid microgrid systems must balance technical feasibility with economic viability to ensure long-term sustainability. Studies have indicated that integrating renewable energy with conventional backup generators can significantly reduce fuel consumption and operational costs while maintaining grid stability [10]. The cost analysis in this study demonstrates that the proposed system for Kazaure City achieves a net present cost (NPC) of $161,208, with 99.8% of the total generated energy coming from solar PV. Similar studies have found that optimizing the dispatch strategy of hybrid systems can lead to cost savings of up to 40% compared to standalone diesel generators [11].

Additionally, the system's reliance on battery storage mitigates energy losses and reduces the environmental impact. Research has emphasized the importance of battery selection, with high-efficiency lithium-ion and lead-acid batteries being preferred for microgrid applications due to their longer lifespan and lower maintenance requirements [12]. The selected Discover 12VRE-3000TF batteries in this study align with best practices in microgrid storage solutions.

Environmental and Grid Stability Implications

The environmental impact of microgrid systems is a critical consideration in modern energy planning. Studies have shown that hybrid microgrid configurations significantly reduce greenhouse gas emissions by limiting diesel generator usage [13]. The proposed system in this research achieves a nearly 100% renewable energy contribution, with CO_2 emissions as low as 375 kg per year. This aligns with global efforts to reduce carbon footprints and transition toward greener energy sources [14].

Furthermore, grid-tied microgrids enhance overall grid stability by reducing transmission losses, improving voltage regulation, and providing backup power during outages [15]. The research findings in this paper indicate that integrating solar PV, wind energy, and battery storage with an optimized energy management strategy ensures uninterrupted power supply for Kazaure City, reinforcing the advantages of microgrid technology in rural electrification.

The literature review underscores the significance of hybrid microgrid systems in addressing energy security, economic feasibility, and environmental sustainability. Existing research supports the integration of renewable energy sources with conventional generators and battery storage to optimize system performance. The findings of this study align with previous work, demonstrating that a well-designed microgrid system can effectively meet the energy demands of Kazaure City while promoting sustainable development. Future research may focus on advanced control algorithms and real-time energy management systems to further enhance microgrid efficiency.

Microgrid Software Tool Comparison

SOFTWARE TOOL	HOMER	DER-CAM	MDT
Grid-connected	•Yes	•Yes	•Yes
Thermal load modeling	•Yes	•Yes	•Limited
Load options	•Primary electric, •deferrable electric •primary thermal	•Electricity •Cooling •Refrigeration •space heating •water heating •natural gas loads	•Electrical load
Types of generation capabilities	•PV •wind turbines • hydro power •fossil fuel generator, •biomass •biogas •boiler •fuel cell • CHP	•PV •solar thermal •wind turbines •fossil fuel generators •fuel cells •CHP	•PV •wind turbines •fossil fuel generators

Storage capabilities	•Batteries •Supercapacitors •Flywheels •hydrogen	•Batteries •electric vehicles •heat storage •cooling storage•hydrogen storage	•Batteries
Economics input	•Discount rate •inflation rate	•Discount rate	•Discount rate
Tariff input availability	•Input required	•Tariff database available	•Input required
Output data	•Optimal system configurations • Fuel consumption • Energy flows • Net present cost • Levelised cost of energy • Capital costs • Operation and maintenance costs	• Optimal system configuration • Optimal placement of DER in multi-node microgrids • Optimized strategic dispatch of all DER. • Fuel consumption • Energy flows • Net present cost • Levelized cost of energy • Capital costs • O&M costs	• Pareto frontier of efficient microgrid designs • Reliability metrics, impacts of reliability on energy service • Capital costs • Operation and maintenance costs

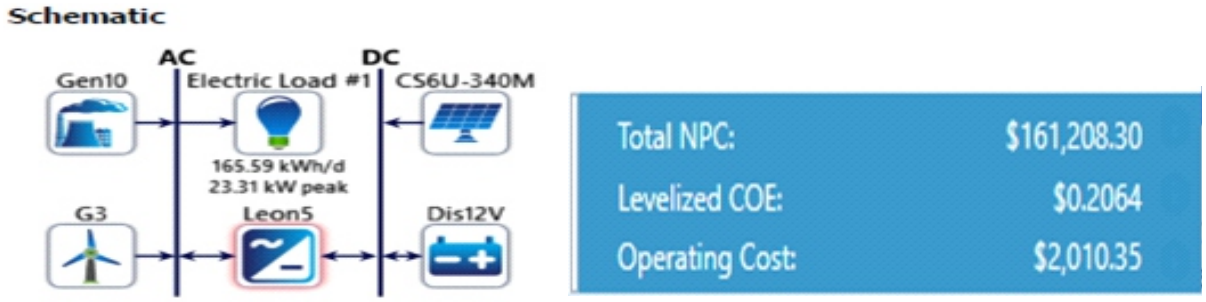
JUSTIFICATION

From the points of comparison in the above table, DER-CAM tool is the best between the 3 tools available here, because it has better available design options which are not available in either the HOMER or MDT. Some of these options are; additional load option, additional storage capabilities, available of tariff data, additional outputs data etc.

The next option is homer which has more generation technology which aren't available in the DER-CAM tool like biogas, flywheel storage option, inflation rate in cost input are all not available in DER-CAM, however it has a better design options and more output data.

SYSTEM ARCHITECTURE

The figure below shows the architectural design of the system, where it can be seen that the PV modules and the battery are connected to the DC bus while the generator is connected to the AC bus and a converter which served as both inverters to overcome the variable nature of the PV module output to the load and at the same time as rectifier to charge the battery from the generator in case of CC dispatch system.



Component	Name	Size	Unit
Generator	Generic 10kW Fixed Capacity Genset	10.0	kW
PV	CanadianSolar MaxPower CS6U-340M	58.0	kW
Storage	Discover 12VRE-3000TF	167	strings
System converter	Leonics S-219Cp 5kW	23.5	kW
Dispatch strategy	HOMER Load Following		

Components sizes

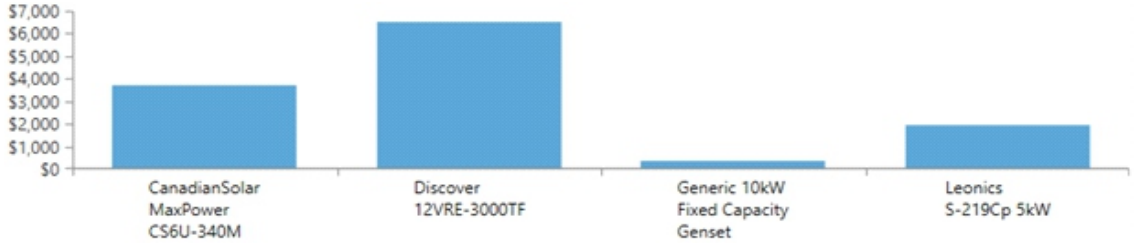
The figure below shows the optimized results for this system obtained of which the best one is that with the least net present cost of ($161,208) which contained solar module and generator as the of sources. And the dispatch strategy of the system is load following (LF), which means the batteries are charging by electricity, from renewables (solar panels in this case) and hence the charging cost is zero.

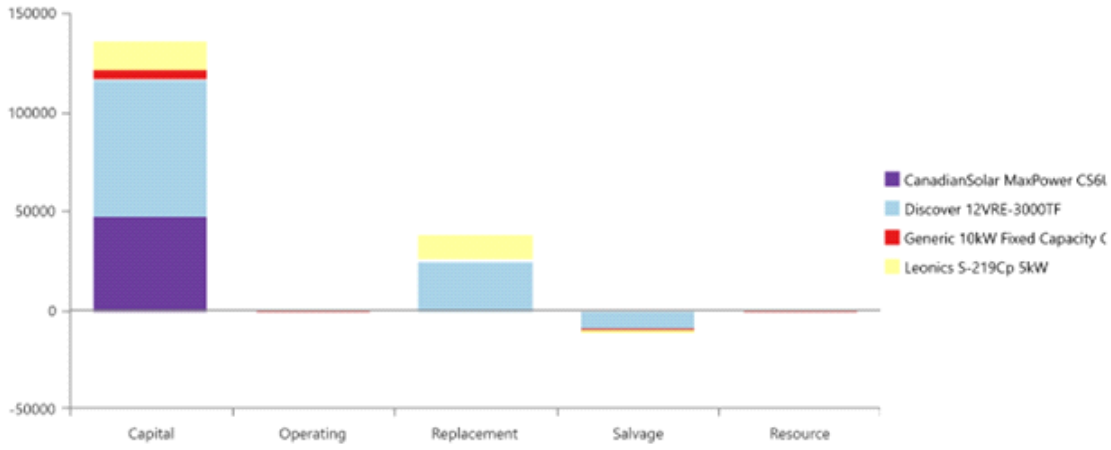
Architecture							Cost				System		Gen10			
CS6U-340M (kW)	G3	Gen10 (kW)	Dis12V	Leon5 (kW)	Dispatch	NPC ($)	COE ($)	Operating cost ($/yr)	Initial capital ($)	Ren Frac (%)	Total Fuel (L/yr)	Hours	Production (kWh)	Fuel (L)	O&M Cost ($/yr)
58.0		10.0	167	23.5	LF	$161,208	$0.206	$2,010	$135,220	99.7	70.2	29.0	197	70.2	14.5
71.3			201	24.4	CC	$178,357	$0.228	$1,752	$155,704	100	0				
55.1	1	10.0	179	23.2	LF	$183,335	$0.235	$2,146	$155,589	99.7	68.2	29.0	190	68.2	14.5
133	1		111	21.1	CC	$221,851	$0.284	$2,824	$185,339	100	0				

Optimum results obtained by homer

COST SUMMARY.

The figure below shows cost summary for the best configuration. The table contains the cost break down of each component throughout the life time of the project, where only battery and inverter will need total replacements at a cost of $ 37,664.





Cost summary chart by components

Net Present Costs

Name	Capital	Operating	Replacement	Salvage	Resource	Total
CanadianSolar MaxPower CS6U-340M	$47,646	$0.00	$0.00	$0.00	$0.00	$47,646
Discover 12VRE-3000TF	$68,470	$0.00	$25,205	-$9,352	$0.00	$84,323
Generic 10kW Fixed Capacity Genset	$5,000	$187.45	$0.00	-$1,140	$317.71	$4,365
Leonics S-219Cp 5kW	$14,104	$0.00	$12,460	-$1,689	$0.00	$24,874
System	$135,220	$187.45	$37,664	-$12,181	$317.71	$161,208

Net present costs of each component

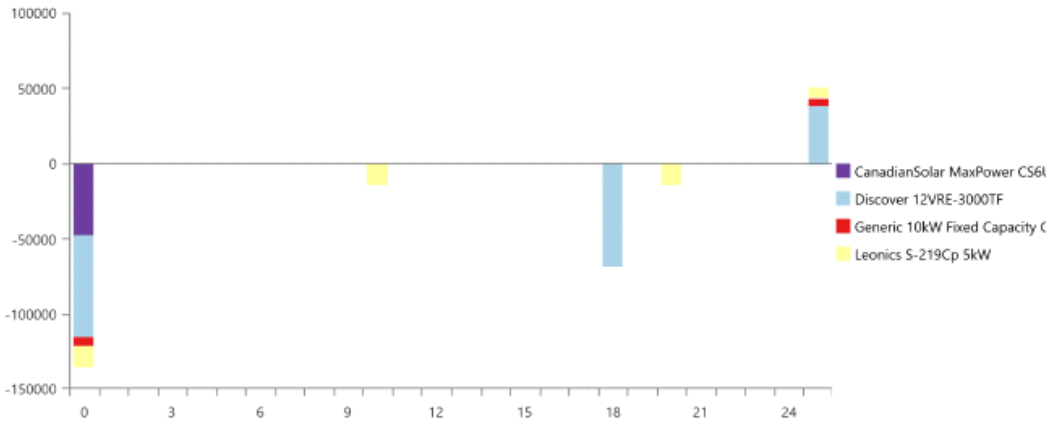
Annualized Costs

Name	Capital	Operating	Replacement	Salvage	Resource	Total
CanadianSolar MaxPower CS6U-340M	$3,686	$0.00	$0.00	$0.00	$0.00	$3,686
Discover 12VRE-3000TF	$5,296	$0.00	$1,950	-$723.39	$0.00	$6,523
Generic 10kW Fixed Capacity Genset	$386.77	$14.50	$0.00	-$88.18	$24.58	$337.67
Leonics S-219Cp 5kW	$1,091	$0.00	$963.81	-$130.68	$0.00	$1,924
System	$10,460	$14.50	$2,914	-$942.24	$24.58	$12,470

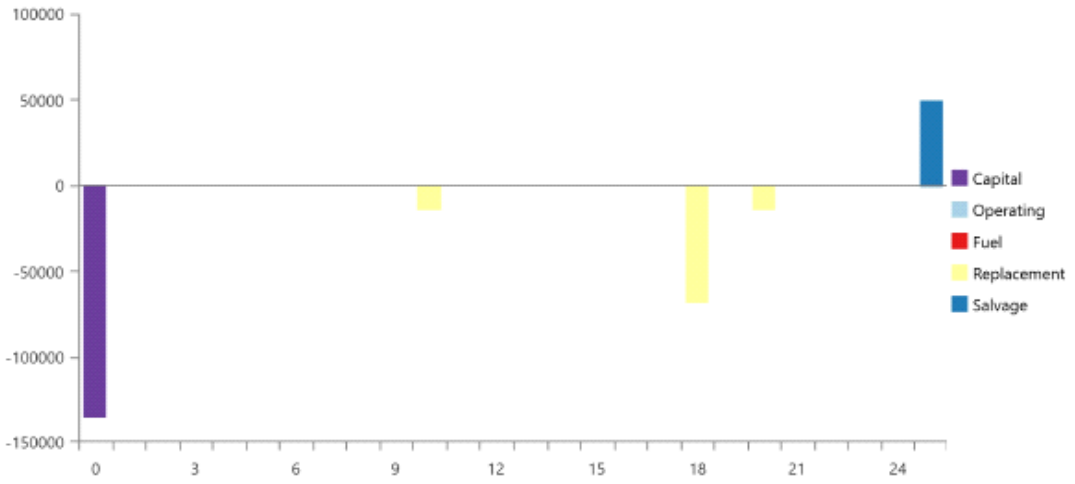
Annualized costs table

CASH FLOW

The two charts below shows the system cash flow throughout its lifetime. It can be seen that inverter is to be replaced in year 10 and 20 because its lifetime is 10 years, likewise the battery will also need to be replaced at year 18.



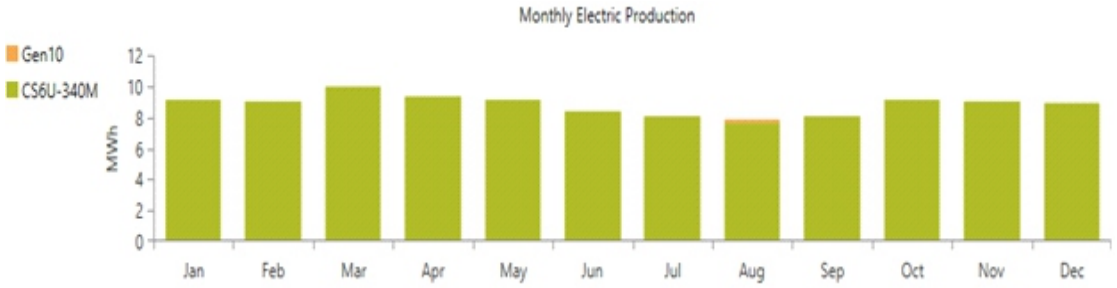
Cash flow chart by components



Costs cash flow chart of components

ELECTRICAL SUMMARY

The figure below shows monthly electrical generation by the sources. The system looks purely green because 99.6% of the generated power is from the solar module, only less than 0.2% is from the generator in the month of August, hence the annual fuel consumption will be very much less and of course the cost too.



Production Summary

Component	Production (kWh/yr)	Percent
CanadianSolar MaxPower CS6U-340M	105,837	99.8
Generic 10kW Fixed Capacity Genset	197	0.186
Total	106,034	100

Production summary of each generation

Excess and Unmet

Quantity	Value	Units
Excess Electricity	35,554	kWh/yr
Unmet Electric Load	18.4	kWh/yr
Capacity Shortage	59.4	kWh/yr

Excess and unmet energy

The excess electricity is actually the surplus power that cannot be used to serve a load or charge the batteries, it instead be dumbed or converted in to thermal energy or used for pumping purposes.

And this figure shows the consumption summary. Our selected load in this system is purely AC and therefore the AC load consumption will be 100% as seen.

Consumption Summary

Component	Consumption (kWh/yr)	Percent
AC Primary Load	60,423	100
DC Primary Load	0	0
Deferrable Load	0	0
Total	60,423	100

Load consumption summary table

FUEL CONSUMPTION

The generator is at stand by almost all the time, its only working in August where it consumed total liters of 70.21L of fuel to generate about 197kwh with an average fuel consumption of 0.192L/day.

Diesel Consumption Statistics

Quantity	Value	Units
Total fuel consumed	70.2	L
Avg fuel per day	0.192	L/day
Avg fuel per hour	0.00802	L/hour

Fuel consumption summary table

GENERATOR

As seen previously the generator has not been in operation throughout each year except in the month of august with a total of only 5 starts, where it produces 197KWh of energy. The minimum output is 3KW because in the design its entered to have a minimum load sharing of 30%, and the maximum electrical output is 10KW which is of course the rating of the Gen set and overall electrical output of 6.79KW. The second table is showing the summary of fuel consumption, where the generator consumestotal liters of 70.21L of fuel to generate about 197kwh and hence the fuel consumption as per energy generated is 0.357L/KWh.

Generic 10kW Fixed Capacity Genset Electrical Summary

Quantity	Value	Units
Electrical Production	197	kWh/yr
Mean Electrical Output	6.79	kW
Minimum Electrical Output	3.00	kW
Maximum Electrical Output	10.0	kW

Electricity production summary by generator

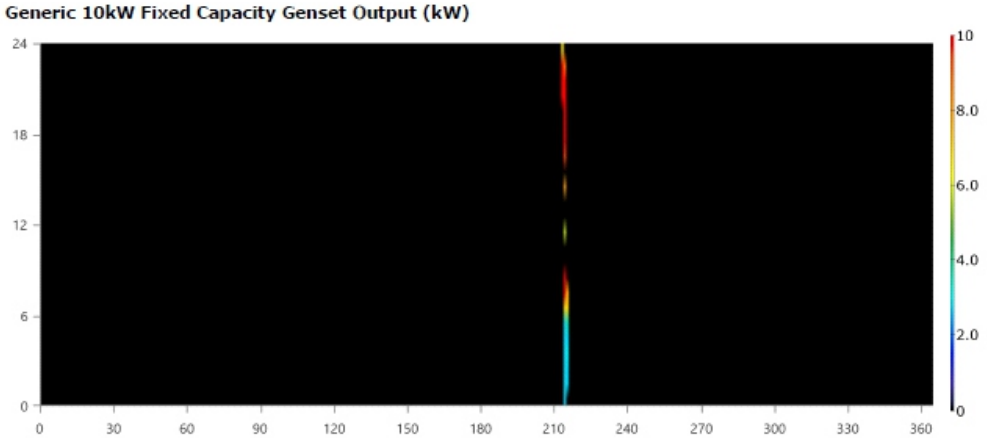
Generic 10kW Fixed Capacity Genset Statistics

Quantity	Value	Units
Hours of Operation	29.0	hrs/yr
Number of Starts	5.00	starts/yr
Operational Life	517	yr
Capacity Factor	0.225	%
Fixed Generation Cost	1.00	$/hr
Marginal Generation Cost	0.100	$/kWh

Generic 10kW Fixed Capacity Genset Fuel Summary

Quantity	Value	Units
Fuel Consumption	70.2	L
Specific Fuel Consumption	0.357	L/kWh
Fuel Energy Input	691	kWh/yr
Mean Electrical Efficiency	28.5	%

Fuel consumed by generator summary table



Annual generator output

PV CAANADIANSOLAR MAX POWER.

From the obtained results, the figure below shows the electrical summary of the solar modules where it generate a total energy of 105,837/yr which covers 99.8% of the generated energy. The size of the module system is 58KW, with a 340W solar module this results to a total of 167 PV panels. And the cost of the energy produced by the solar modules is cheaper than that of the generator because it does not need any materials to produce.

PV penetration is basically the ratio of the rated capacity (58KW) and the peak power of the module (340W)

CanadianSolar MaxPower CS6U-340M Electrical Summary

Quantity	Value	Units
Minimum Output	0	kW
Maximum Output	54.4	kW
PV Penetration	175	%
Hours of Operation	4,448	hrs/yr
Levelized Cost	0.0348	$/kWh

Solar module electrical summary

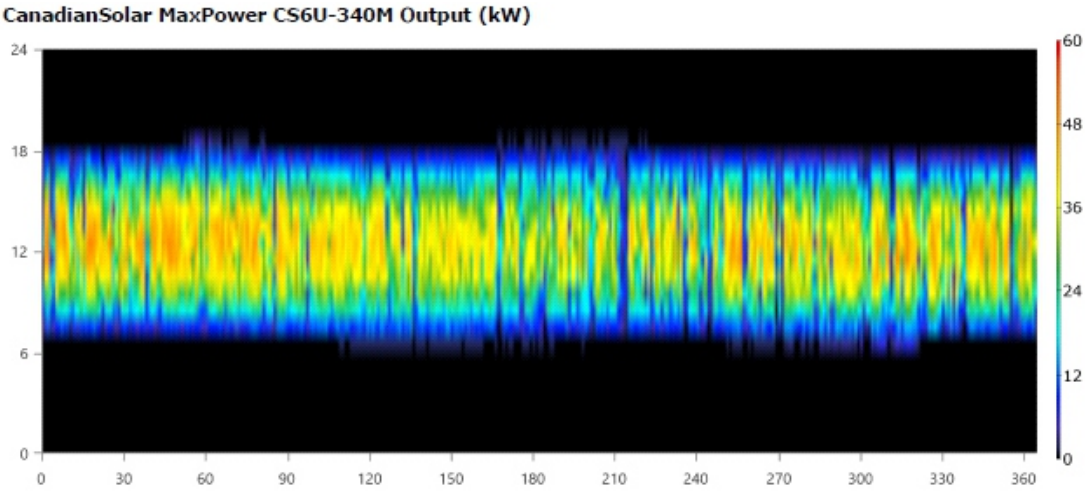
The table below is basically showing statistical data of the PV module, the module feed the load with an average output energy of 290kwh per day.

CanadianSolar MaxPower CS6U-340M Statistics

Quantity	Value	Units
Rated Capacity	58.0	kW
Mean Output	12.1	kW
Mean Output	290	kWh/d
Capacity Factor	20.8	%
Total Production	105,837	kWh/yr

Statistical data of solar modules

The figure below show the amount of output energy by the module at each time of the day throughout the year



Annual solar module output

BATTERY

A total of 167 of 12VRE-3000TF batteries are needed to meet the system requirements. The graph shows the state of charging of the batteries, the system uses load following (LF) dispatch system which means its charging 100% from the solar modules and therefore the cost of energy to the batteries is 0.

Discover 12VRE-3000TF Statistics

Quantity	Value	Units
Autonomy	60.3	hr
Storage Wear Cost	0.128	$/kWh
Nominal Capacity	520	kWh
Usable Nominal Capacity	416	kWh
Lifetime Throughput	598,127	kWh
Expected Life	17.5	yr

Statistical data of the battery

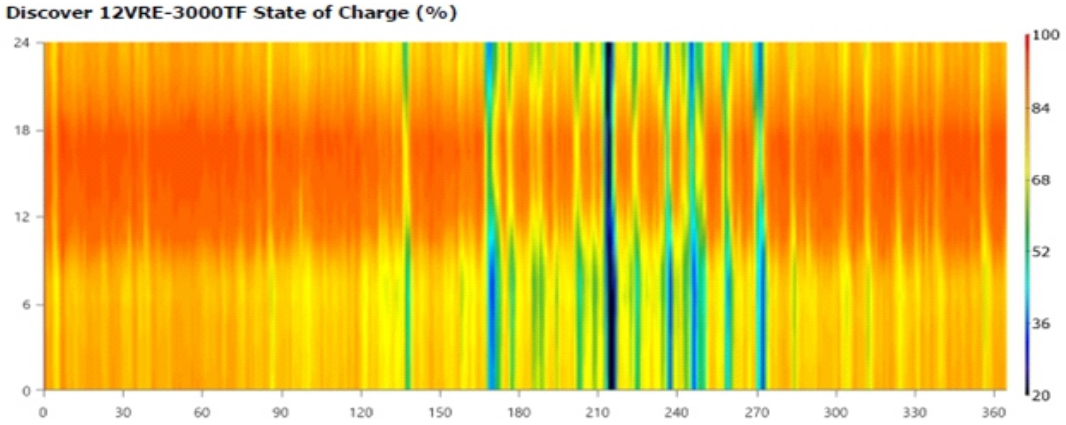
Discover 12VRE-3000TF Properties

Quantity	Value	Units
Batteries	167	qty.
String Size	1.00	batteries
Strings in Parallel	167	strings
Bus Voltage	12.0	V

Discover 12VRE-3000TF Result Data

Quantity	Value	Units
Average Energy Cost	0	$/kWh
Energy In	38,145	kWh/yr
Energy Out	30,598	kWh/yr
Storage Depletion	91.5	kWh/yr
Losses	7,639	kWh/yr
Annual Throughput	34,210	kWh/yr

Data performance of the battery



Hourly state of charge of the battery in a year

CONVERTER

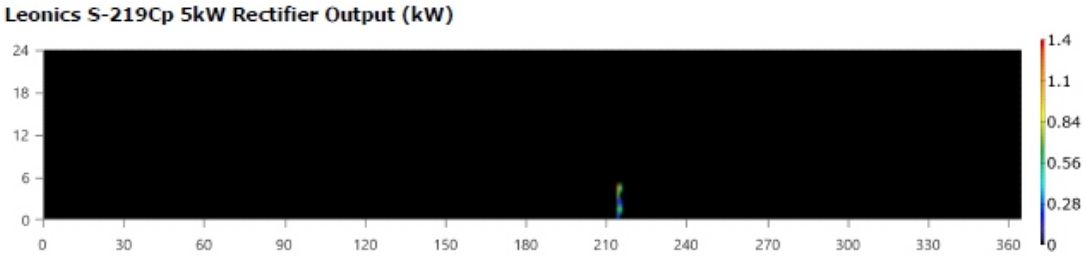
Here it's showing the electrical summary and statistics of the LEONICS 2-219CP 5KW converter. It operates for total of 8728hrs per year. The rated capacity of the system is 23.3KW; hence with LEONICS 2-219CP 5KW a total of 5 is needed.

Leonics S-219Cp 5kW Electrical Summary

Quantity	Value	Units
Hours of Operation	8,735	hrs/yr
Energy Out	60,231	kWh/yr
Energy In	62,741	kWh/yr
Losses	2,510	kWh/yr

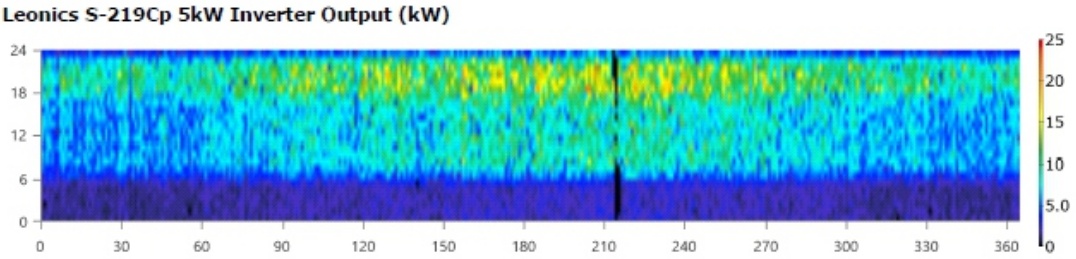
Electrical summary table of the converter

The dispatch strategy in this system is load following (LF) which means the generator is not contributing to the charging of the battery and hence the rectifier out is approximately zero as can be seen in the figure below.



Rectifier output

Since the system is almost entirely green the inverter side of the converter will always be working except sometimes in the month of august when the generator take over, as can be seen in the figure below indicated in black color which means zero output from the inverter



Hourly inverter output in a year

Leonics S-219Cp 5kW Statistics

Quantity	Value	Units
Capacity	23.5	kW
Mean Output	6.88	kW
Minimum Output	0	kW
Maximum Output	23.3	kW
Capacity Factor	29.3	%

Statistical data of the converter

EMISSION

The greenhouse gas emission in this system is somewhat low, because the majority of the power is generated from the solar modules only less than 1% is produced by the generator which result in emission of 375kg of CO_2 in a year as shown below.

Emissions

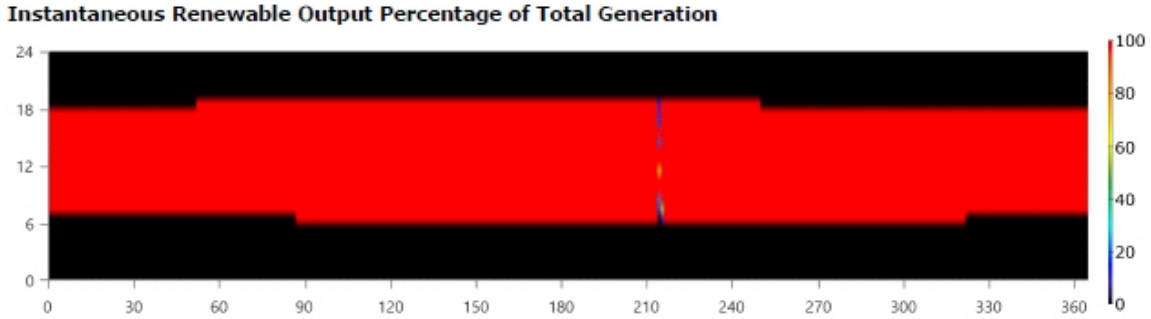
Pollutant	Quantity	Unit
Carbon Dioxide	183	kg/yr
Carbon Monoxide	1.39	kg/yr
Unburned Hydrocarbons	0.0506	kg/yr
Particulate Matter	0.0841	kg/yr
Sulfur Dioxide	0.450	kg/yr
Nitrogen Oxides	1.58	kg/yr

Carbon emission table

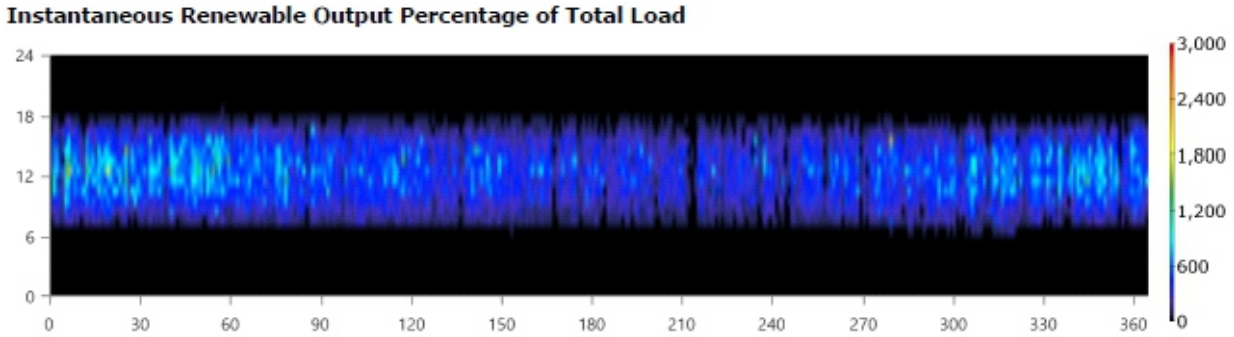
RENEWABLE SUMMARY

This is basically showing the summary of renewable activity in the system where it can be noticed that the system almost looks 100% renewable. The generator activity only happens in the month of august. The two figures show the renewable (solar modules in this case) response to the load while the last figure shows the generator response to the load.

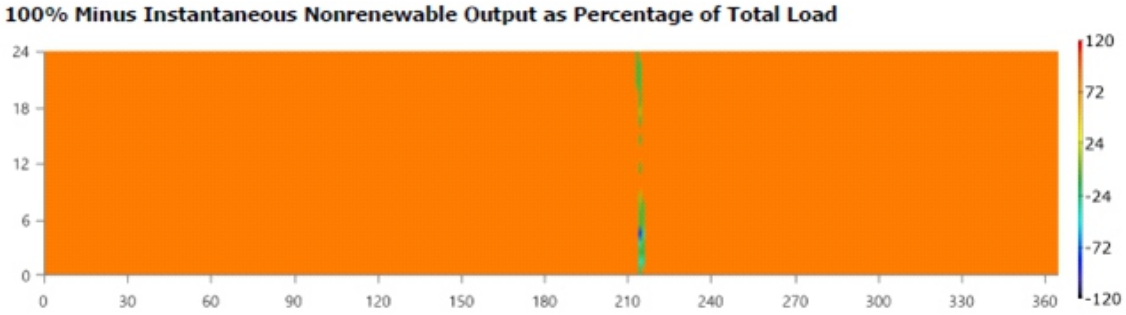
Capacity-based metrics	Value	Unit
Nominal renewable capacity divided by total nominal capacity	85.3	%
Usable renewable capacity divided by total capacity	83.6	%
Energy-based metrics	**Value**	**Unit**
Total renewable production divided by load	175	%
Total renewable production divided by generation	99.8	%
One minus total nonrenewable production divided by load	99.7	%
Peak values	**Value**	**Unit**
Renewable output divided by load (HOMER standard)	2,569	%
Renewable output divided by total generation	100	%
One minus nonrenewable output divided by total load	100	%



Percentage of renewable of total generation



Percentage of renewable output to the total load



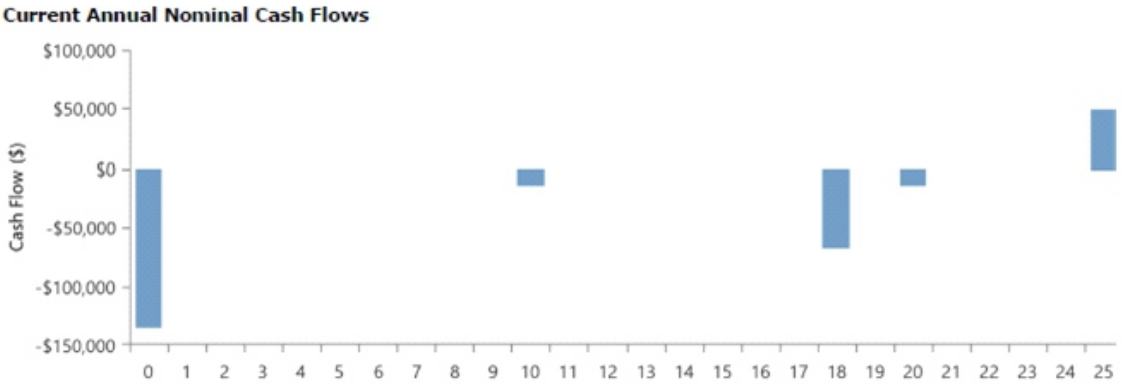
Percentage of nonrenewable output to the total load

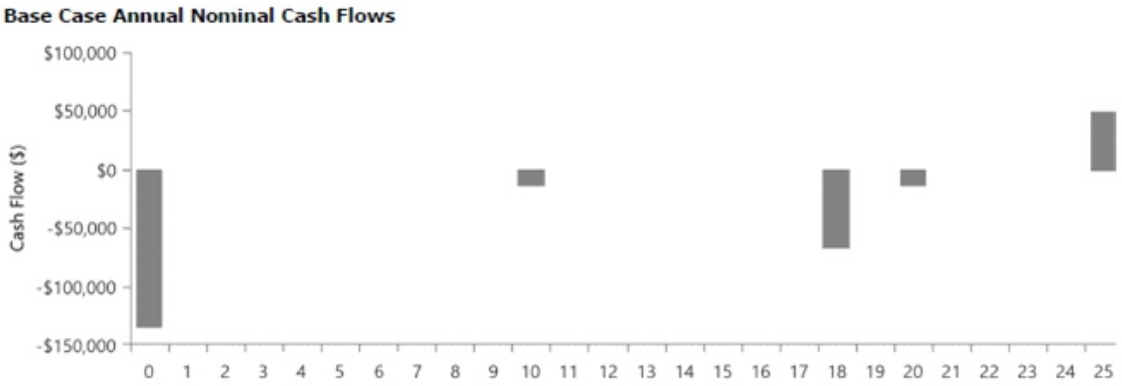
COMPARE ECONOMICS

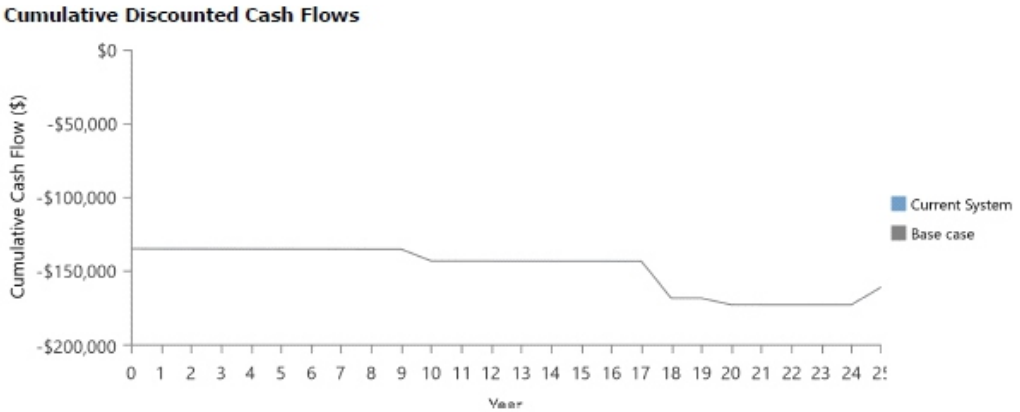
In this section the homerpro compares two systems, the winning one (least NPC) and the base case (least initial cost). Then homerpro will compare these two configurations and calculate the Present worth, Annual worth, Return of investment, internal rate of return, Simple payback and discounted paybacks relative to the base case. But in this system's case the winning case is also the base case, which the means it has the least net present cost (NPC) and least initial cost (IC) hence it will have the same economics characteristics. However the base case can be changed and select any of the optimized results obtained and then compare the economics.

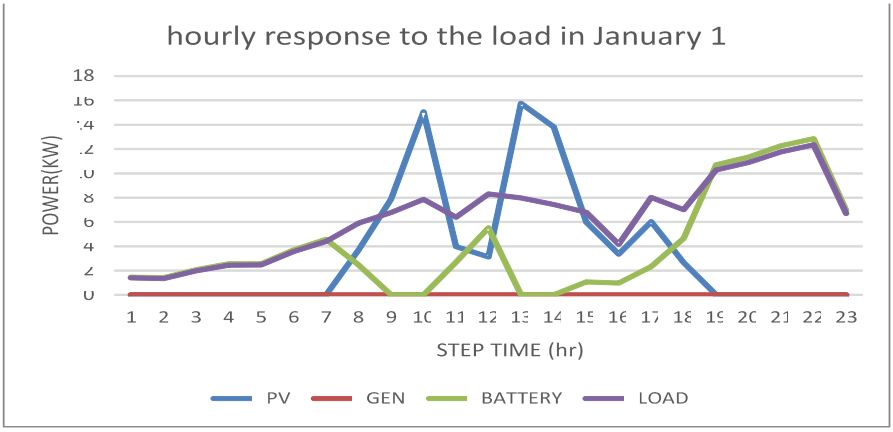
	Base Case	Current System
Net Present Cost	$161,208	$161,208
CAPEX	$135,220	$135,220
OPEX	$2,010	$2,010
LCOE (per kWh)	$0.206	$0.206
CO2 Emitted (kg/yr)	183	183
Fuel Consumption (L/yr)	70.2	70.2

Economic comparison table between base and the current system table

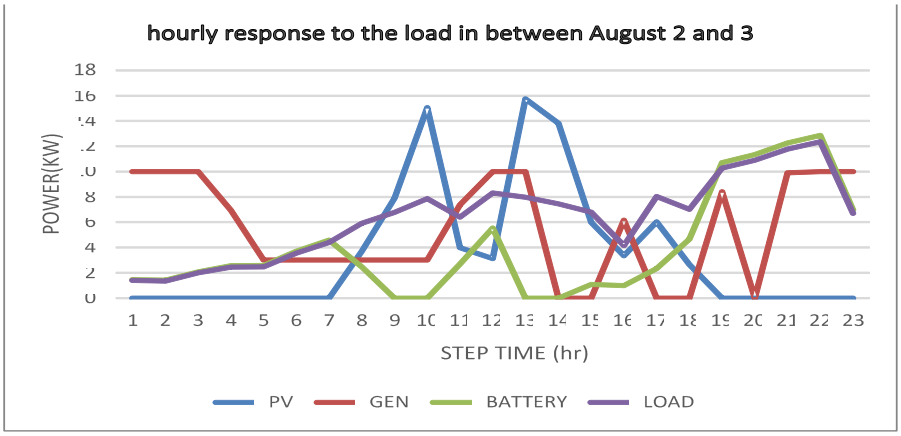








Only the PV is feeding the load through the batteries



This is when the generator takes over between August 2 and August 3

LIMITATIONS

The good thing about this design is that it's almost entirely renewable with a sufficient amount of power; there is limited cash flow in the system, least operation and maintenance cost, very less fuel consumption cost etc. One of the drawbacks of this design is the excess electricity. It's seen that about 30000KWh is to be dumped each year throughout the lifetime of the project. Also, even with this huge excess power there is also a shortage of VALUE on the other bus, this is due to either the selected converter selected in this system has a NO option in "parallel with AC generator" or that the converter is undersized. Another drawback is the generator's efficiency, considering the amount of fuel consumed versus the energy produced, shows that the efficiency is not more than 30%. These are the things that need to be looked at in addressing the limitations to this design in the future.

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ROBUST HOME AUTOMATION SYSTEM USING ESP32

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***Abstract**:*

This study presents a cost-effective and Internet of Things (IoT)-based home automation system. Using the Blynk ASCII text file IoT server, we developed a system that enables remote control of household appliances via the internet. Our method employed an ESP32 module to connect to the server, allowing for the operation of linked appliances through a relay that switches low voltage from the ESP32 to control 230- volt appliances. Our primary findings demonstrate the feasibility and effectiveness of this system in achieving smart home automation. In conclusion, this IoT -based home automation system offers a convenient, affordable, and innovative solution for smart living, highlighting the potential of IoT technology in transforming our daily lives.

Keywords: Blynk app, Internet of Things, Smart home, Internet, Wi-Fi Module (ESP32)

INTRODUCTION

Internet of Things (IOT) is a concept where each device is assign to an IP address and through that IP address anyone makes that device identifiable on internet. The mecha nical and digital machines are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human -to-computer interaction. Basically, it started as the " Internet of Computers." Research studies have forecast an explosive growth in the number of "things" or devices that will be connected to the Internet. The resulting network is called the "Internet of Things" (IoT). The recent developments in technology which permit the use of wireless controlling environments like, Bluetooth and Wi-Fi that have enabled different devices to have capabilities of connecting with each other. Using a WIFI shield to act as a Micro web server for the Arduino which eliminates the need for wired connections between the Arduino board and computer which reduces cost and enables it to work as a standalone device. The Wi -Fi shield needs connection to the internet from a wireless router or wireless hotspot and this would act as the gateway for the Arduino to communicate with the internet. With this in mind, an internet based home automation system for remote control and observing the status of home appliances is designed.

Due to the advancement of wireless technology, there are several different type of connections are introduc ed such as GSM, WIFI, and BT. Each of the connection has their own unique specifications and applications.

Among the four popular wireless connections that often implemented in HAS project, WIFI is being chosen with its suitable capability. The capabilities of WIFI are more than enough to be implemented in the design. Also, most of the current laptop/notebook or Smartphone come with built-in WIFI adapter. It will indirectly reduce the cost of this system.

II. LITERATURE SURVEY

A. Automation

A low-cost home automation system with autonomous control features was developed by Eleyan and J. Fallon et al. [3] using an Android application and MQTTbroken communication. The suggested solution will allow customers to remotely manage household appliances using an Android smartphone. Relays and a Node MCU (ESP8266) microcontroller were suggested as a way to remotely control electrical switches from a Node server by H. K. Singh, S. Verma, S. Pal, et al. [7].

B. Energy efficient Home Automation

The primary focus should be on remotely activating and managing various smart home devices, according to a proposal made by B. R. K. Kodali and S. Yerroju et al. [4]. Utilizing energy more wisely is possible thanks to home automation technology. The ESP8266 board is very desirable and advantageous since it provides the IoT system with the requisite ultra -low power consumption capability at an inexpensive price. It also transforms a house into a residence.

C. View and performance of home automation

A technique for IoT -based wirelessly programmable smart home automation was proposed by K. Agarwal, A. Agarwal, and colleagues. Home automation solutions leverage the IoT to remotely monitor and control household appliances [5]. This approach makes use of a specifically designed we bsite connected to the internet or a local area network to manage standard home appliances from smartphones or desktop computers (LAN).

D. Home automation with cloud organizing

Y.Wenbo, W.Quanyu, and colleagues concluded that, because there are likely many undiscovered IoT apps and services, object resolution methodologies can also be defined by an IoT reference model [6]. From a public policy aspect, it is vital to confirm that IoT

applications, such as those for aid, energy management, transportation, or other cutting-edge purposes, can have reasonable access to current infrastructure.

III. LIMITATIONS OF EXISTING WORK

When compared to prior projects, ours makes extensive use of the ESP32, which connects to the internet and enables us to control the connected appliances from a distance. Comparable to other Wi -Fi modules, it is inexpensive. Through the BLYNK app, ESP32 gives us the convenience of remotely managing home appliances, such as lights, fans, and TVs. As more people utilise smart home gadgets, security will, like it does with other computing equipment, become a bigger problem. There will undoubtedly be a variety of security issues, which will lead to the emergence of smart home security software and hardware. However, because of the use of the Blynk app in our project, the security concerns are reduced. One system can be used to operate all the smart home gadgets thanks to integrated smart home systems offered by previous exiting works. The risk here is obvious: If hackers get into the system, they may take over your smart home and control everything.

METHODOLOGY

STEP 1 - Control Relays with Internet Using Blynk
STEP 2 - Control Relays Without Internet Using Push- buttons
STEP 3- Configure the Blynk App for the ESP32
STEP 4 - Add the button contrivances in Blynk app

STEP 5 - Law for Blynk ESP32 Home robotization
STEP 6- Program the ESP32 With Arduino IDE
STEP 7- Connect the Home Appliances
STEP 8- Turn on the Supply

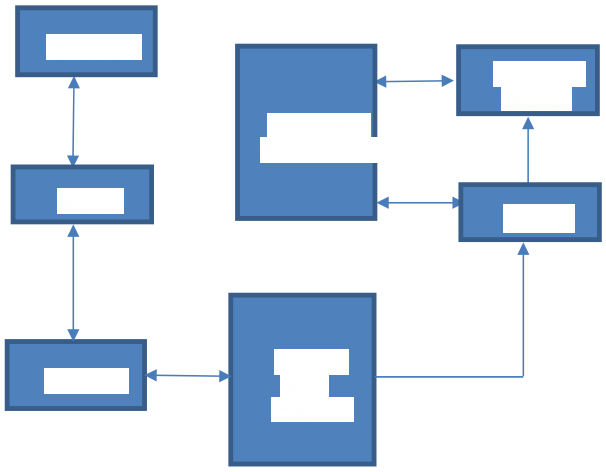

Fig1. Blockdiagram

A. Arduino IDE

1. The main purpose of the open -source Arduino IDE software is to construct a compiler that turns code into Arduino modules.

2. Given that it is the official Arduino software, the code is far too simple to compile.

3. It is easily available on operating systems such as MAC, Windows, and Linux and operates on the Java platform. It comes with built-in features and instructions that are necessary for debugging, altering, and compiling programme, inside the environment.

4. The Arduino Uno, Arduino Mega and Arduino Micro are justa few of the various Arduino module varieties.

5. Each contains an integrated microprocessor that can really be programmed and accepts data in the form of code.

6. The main code, commonly referred to as a sketch, imported into the IDE platform will eventually generate a HEX file, which will be shipped and downloaded to the board controller.

7. There are two key components to the IDE environment. Compiler and editor. The first component is used to write the required code, which is then combined and uploaded to the appropriate Arduino module.

B. BLYNK IoT Cloud

Blynk is an IoT platform for iOS or Golem smartphones that allows for the online management of Arduino, Raspberry Pi, and Node-MCU. With the use of this application, a graphical user interface (GUI) or Human Machine Interface (HMI) can be created by gathering available widgets and supplying the necessary addresses.

Built for the Web of Things, Blynk. Remotely manage hardware, see device data, store data, visualize, and perform other cool tasks.

It analyses all incoming and departing instructions and enables communication between the server and all frequently used hardware platforms.

When a user clicks the Button in this app, the data is transferred to the Blynk Cloud and then mysteriously makes its way to the installed devices. Everything occurs in a split second and works in the opposite direction.

C. Working Of Blynk App

The new Blynk framework makes it simple to build user interfaces for iOS and Android smartphones to maintain and control your hardware projects. Blynk app serves as the intermediary server in our project between the IoT device and the user. The User will be able to control the device's state by utilizing the Blynk programme, which sends the Device's state via the Internet. After installing the Blynk program and adding switches, sliders , charts, and other features to the desktop, you may build a project panel. By using gadgets, you may show sensor data or turn on and off pins

How to configure Blynk app,

- Create a Blynk Account
- Create a New Project
- Choose Your Hardware
- Auth taken
- Add a Widget
- Run the project.

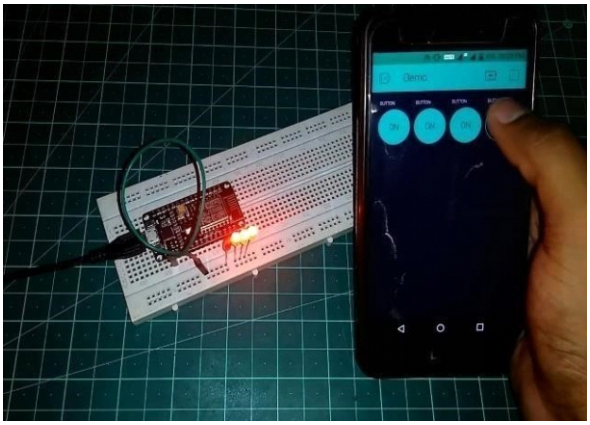

Fig 2. Working of Blynk app

VI. HARDWARE DESCRIPTION

A. NodeMCU ESP32

It is a low cost IoT platform with open source. It can connect objects through the internet and make them to transfer data using the Wi-Fi protocol. Support for 32-bit ESP32 MCUs was subsequently added. The relay that regulates the AC power is managed by a Node-MCU. Relays are electrical switches that are used to safeguard electrical equipment. Typically, relay modules use 5V/12V. Electrical devices are mechanically switched using electromagnets. Relays' main job is to manage high voltage and run low voltage equipment. Since there is no direct contact between the Node-MCU and the device, it is regarded as safe to use.

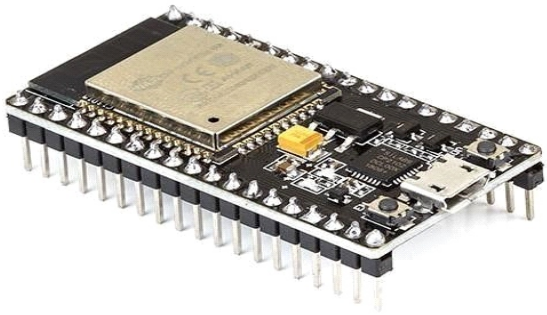

Fig 3. ESP 32 Wi-Fi module

B. Why ESP32?

The ESP32 is intended for Internet of Things applications that require less power. It is suitable for the majority of portable IoT devices because to its high processing power, integrated Wi-Fi, Bluetooth, and Deep Sleep Operating capabilities, as well as its 520 KB of SRAM, 448 KB of ROM, and 4MB of Flash memory. The ESP32 has more GPIO pins than the Arduino Uno, which allows it to accommodate more sensors and modules. Additionally, it now has extra analogue and PWM pins. Even without factoring in the cost of the Wi-Fi shield, it is nearly five times less expensive than the Arduino Uno. That's really impressive for a board with twice as many GPIO pins. The primary incentive to switch to the ESP32 is likely its built-in Wi-Fi and Bluetooth capability. Without needing to purchase shields, you can communicate information wirelessly thanks to the built - in interconnectivity capability. By doing this, you might reduce the cost of the hardware and battery life for your ESP32-based IoT projects.

C. 2-Channel Relay

The 2 Channel 5V Relay Module is an interaction board for relays that can be entirely controlled by several devices, such as Arduino, AVR, PIC, ARM, and others. We'll attach an Arduino signal pin to operate the relay, connect over Wi-Fi to arm the connected pin by switching it to output mode with an analogue instruction, and then arm the linked pin. The pin can be used to send digital commands to the pin to turn the relay on and off once it has been set to output mode by setting the pin to 1 or 0.

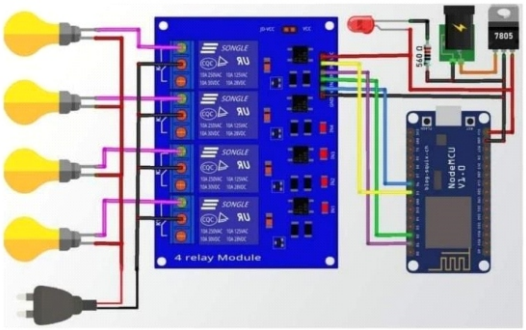

Fig 4. Circuit diagram

VII. **PROPOSED WORK**

Our proposed solution uses a WIFI module, Blynk IoT cloud, and a physical switch for backup, since we use Blynk IoT for it, it is more secure than any other IoT device as the auth code of the project has been programmed to the Wi - Fi module. our solution offers both physical and IoT switch for switching so even in the network issues time the appliances can be controlled by the physical switch. Also, it is low cost with more security. In present scenario, usage of home appliances has become an important part and parcel of our life and home automation using ESP32 is effective.

TABLE I. Difference between existing and proposed method.

Existing method	Proposed method
High cost.	Low cost.
Less efficient.	More efficient.
Not compatible with all electrical devices.	Compatible with all the electrical devices.
Not compact.	Compact.

VIII. **NOVELTY**

The older approaches that were used had a lot of issues. The major goal is to design and execute a creative, cost- effective automated home system. For connection between the server and the electronic items, we employ a Wi-Fi-based technique. The appropriate software and hardware will be used to build this automated smart home system. Smart appliances are built using a low-cost ESP8266 Wi-Fi module device. The customer would be able to remotely control home appliances including lights, fans, and TVs through an Android app.

ESP8266 is inferior to ESP32 in quality. You may develop significantly bigger projects on just one SOC because to its quicker CPU and adequate memory size. You can count on ESP32 to give you cutting - edge security. One of specialities is the robust of security feature. It supports dual - core speeds between 160 and 240 MHZ. With Bluetooth or Wi -fi, you can monitor and operate your gadget for a very minimal cost. You get more GPIOs from it. You can get a high speed of 150Mbps from ESP32.

IX. **RESULT**

The experimental model was made according to the circuit diagram and the results were as expected. The home appliances could be remotely switched over Wi - Fi network. Both the switch mode and the IOT mode control methodologies were successfully achieved. The Blynk application was also successful in displaying the status of every application.

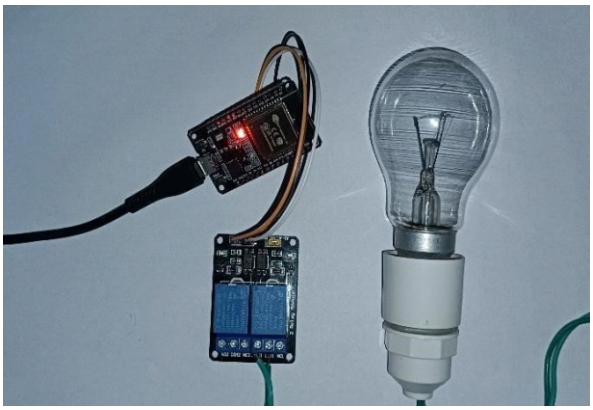

Fig 5.1 Output at Off Condition

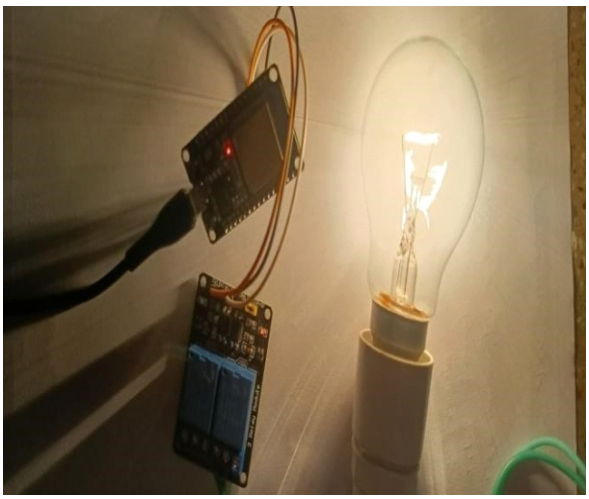

Fig 5.2 Output at On Condition

ESP32's

X. CONCLUSION

In this project, we demonstrated a low-cost Internet of Things-based smart home automation system. The main objective of our project was to remotely control electrical appliances using the internet. Everybody's home is a cosy refuge, and we always appreciate anything that could enhance the atmosphere while also making our lives a little bit simpler. Even though the general public is just a corollary benefactor, the physically disabled are the true winners in this scenario. In order to communicate with household appliances and fix all the current issues, our solution proposes using an ESP32 Wi-Fi module and a mobile device linked to the internet. As is evident, there are numerous problems with earlier methods that were in use. The utilisation of IoT for an advanced, energy- efficient, and self -learning home automation system is the main topic of this section. Designing and implementing a smart, cost - effective automated home system is the major goal. For communication between the server and the home appliances, we are employing a Wi-Fi based technique. This automated smart home system will be created with the use of pertinent software and hardware. Through an Android app, the user will be able to remotely manage household items including lights, fans and TVs.

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