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KESPODAK Journal of Science and Engineering Research, A Multidisciplinary Journal is a publication of Kebbi State Polytechnic Dakingari. Scholarly Articles that cut across several discipline, Engineering and Information technology are reviewed for their contribution to knowledge as well as the enhancement of the acquisition of practical skill for self-reliance.

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**JOURNAL OF SCIENCE AND ENGINEERING RESEARCH A MULTI DISCIPLINARY  
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### **Editorial**

**W**e are delighted to announce the inaugural 2025 Vol. 1 Issue of KESPODAK Multi-disciplinary internal journal, a moment to have ever expanding boundaries of knowledge and the interdisciplinary nature of modern research. This Journal will continue to serve as a platform for the exchange of ideas, discoveries and innovations that transcend traditional academic borders in an era distinguished by the convergence of numerous fields.

The articles in this issue reflect the outstanding contributions of scholars and researchers from a wide range of fields. Our authors have worked tirelessly to explore the intersections of respective areas, throwing new light on complicated issues and offering new views on age-old concerns.

In this information age, where the sum of human knowledge is at our fingertips, multi-disciplinary research is no longer a choice but a requirement. It is in this spirit that we invite you to explore the articles included inside the pages of this journal.

We thank the authors for taking their time to share their views and discoveries with us. Their commitment to pushing the boundaries of knowledge and fostering cross-disciplinary collaboration is admirable. We are also grateful to our hardworking reviewers, who ensured the high quality and rigor of the research provided here.

We hope you find this issue of KESPODAK multi-disciplinary international journal both intellectually fascinating and a tribute to the strength of cross-disciplinary collaboration.

Finally, we wish to express our indebtedness to TETFUND for its role in the production of this journal and other subsequent editions.

**Dr. Umar Garba Gwazawa**

**Editor-in-Chief**

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## AN IMPROVED CEASER CIPHER WITH SPECIAL CHARACTERS

BY

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### Abstract

*The modified Caesar cipher combines alphabet letters and special characters, enhancing security and complexity. This adaptation ensures easy decryption for intended recipients while challenging unauthorized access. Special characters add an extra layer of intricacy, making the cipher more resilient and dynamic, and balancing accessibility and security.*

Key words: cryptography, Cipher, Encryption, Decryption, Ceaser Cipher.

### 1. Introduction

The Caesar Cipher, named after Julius Caesar, is a simple encryption technique that shifts letters by a fixed number of positions. However, it is easily decipherable due to its limited number of potential keys, making it a weak encryption method suitable only for educational purposes. Despite this, it demonstrates the fundamental concept of encryption and lays the groundwork for more complex algorithms that are essential to modern information security. Nevertheless, the Caesar Cipher exemplifies the fundamental concept of encryption through the alteration of character positions, laying the groundwork for more complex cryptographic algorithms that are integral to modern information security. Its historical relevance and simplicity make it an essential starting point for understanding the evolution of encryption techniques and the ongoing pursuit of secure communication. Cryptographic techniques were used by different authors such as [7], [4] and [5] to investigate the security and uniqueness of algorithms and also in [17], [14], [10] and [1] different cryptographic ideas were used in order to have a text fully secured and prevents it from intruders which may likely use the information sent over communication channel in their favor, Ceaser cipher was extensively studied by [2], [3], [5], [6], [11], [12], [14] and [17] and discovered some weaknesses and power of the classical Ceaser cipher together with different modifications that may add security to the algorithm used in order to prevent unwanted access to the data being sent over media, Study on modified ciphers were conducted by [9], [15],[1] and [16] and consequently many results were obtained from the different studies, many recommendations were being derived from [1], [8], and [3] which gave rise to multiple researches in the field of cryptography.

## 2. Materials and Method

### 2.1 Terms used in cryptography

- i. Plaintext: original message
- ii. Cipher text: coded message
- iii. Encryption: the process of converting plaintext into coded text
- iv. Decryption: the process of converting coded text into plaintext
- v. Key: a piece of information that is used for encryption and decryption
- vi. Cryptography: the study of encryption and decryption principles
- vii. Cipher: an algorithm used for encryption and decryption
- viii. Key: a piece of information used by an encryption algorithm to transform plaintext into cipher text or vice versa
- ix. Symmetric key cryptography: a type of cryptography where the same key is used for both encryption and decryption
- x. Asymmetric key cryptography: a type of cryptography that uses a pair of keys (public and private) for encryption and decryption
- xi. Frequency analysis: manually tracing the plaintext from cipher text using frequency of letters used in the cipher text.

**Table 1: Frequency of English Letters**

| Letters | Frequency (%) | Letters | Frequency (%) |
|---------|---------------|---------|---------------|
| E       | 11.1607       | M       | 3.0129        |
| A       | 8.4966        | H       | 3.0034        |
| R       | 7.5809        | G       | 2.4705        |
| I       | 7.5448        | B       | 2.0720        |
| O       | 7.1635        | F       | 1.8121        |
| T       | 6.9509        | Y       | 1.7779        |
| N       | 6.6544        | W       | 1.2899        |
| S       | 5.7351        | K       | 1.1016        |
| L       | 5.4893        | V       | 1.0074        |
| C       | 4.5388        | X       | 0.2902        |
| U       | 3.6308        | Z       | 0.2722        |
| D       | 3.3844        | J       | 0.1965        |
| P       | 3.1671        | Q       | 0.1962        |

### 2.2 Ceaser Cipher

The Caesar cipher is a substitution cipher that shifts the letters of the alphabet by a fixed number of positions. Here's how it works:

- a. **Key Selection:** A key is chosen, which an integer is representing the number of positions each letter in the plaintext is shifted. For example, with a key of 3, 'A' becomes 'D', 'B' becomes 'E', and so on.
- b. **Encryption Process:** Each letter in the plaintext is shifted by the key value. If the alphabet is considered cyclic, meaning after 'Z' it wraps around to 'A', the shifting process remains consistent.

The cipher text is represented by “C” while the plaintext is represented by “P”

$$C = (P + k)_{\text{mod } 26}$$

$$P = (C - k)_{\text{mod } 26}$$

Where, **k** is the key value to be used for both the processes.

**Example:**

Using a key of 2:

**Plaintext:** HELLO

**Encryption:** JGNNQ

- c. **Decryption Process:** To decrypt, the process is reversed. Each letter in the ciphertext is shifted backward by the key value.
- d. **Security:** Caesar cipher is vulnerable to brute-force attacks due to its limited key space (only 25 possibilities for a Standard English alphabet). Frequency analysis can also be employed, as it doesn't alter the frequency distribution of letters.
- e. **Variations:** Caesar cipher can be generalized with different shift values, not limited to integers. This leads to the creation of more complex substitution ciphers.
- f. **Usage:** Despite its simplicity, Caesar cipher is a historical encryption method, allegedly used by Julius Caesar. However, it's not suitable for secure communication in modern contexts. Remember, it's a basic and easily breakable cipher. Modern cryptographic systems use more sophisticated algorithms to ensure secure communication.

**Table 2: Plaintext alphabets and their corresponding values in Ceaser cipher**

|   |   |   |   |   |   |   |   |   |   |    |    |    |    |
|---|---|---|---|---|---|---|---|---|---|----|----|----|----|
| A | B | C | D | E | F | G | H | I | J | K  | L  | M  | N  |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |

|    |    |    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|----|----|
| O  | P  | Q  | R  | S  | T  | U  | V  | W  | X  | Y  | Z  |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |

Example: code the text using cipher Ceaser cipher algorithm. "ATTACK AT DAWN, TROOPS! MOVE OUT NOW! TAKE COVER BEHIND ENEMY LINES. WAIT FOR SIGNAL TO ADVANCE. SHOW NO MERCY!"

Solution:

**PLAINTEXT:** "ATTACK AT DAWN, TROOPS! MOVE OUT NOW! TAKE COVER BEHIND ENEMY LINES. WAIT FOR SIGNAL TO ADVANCE. SHOW NO MERCY!"

**CIPHERTEXT (SHIFTED 3 POSITIONS FORWARD):** "DWWDFN DW GDZD, WR UO V ! PRGX RXW ZDQW! WDQG RYHU EHKLQH DWZHQVLQH. ZDLW IRU VL FNH WR DVVHQW. VK RZ QR PHGLFL!"

### 3. Proposed Modification of the Ceaser Algorithm

The modified cryptosystem strengthens the Caesar cipher by incorporating special characters and a custom alphabet-to-number mapping, increasing complexity and resistance to unauthorized access.

**Table 3: Plaintext and special characters modified Ceaser cipher**

|   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|
| A | B | # | C | D | * | E | F | + | G | H  | -  | I  | J  | \$ | K  |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| L  | ?  | M  | N  | !  | O  | P  | @  | Q  | R  | %  | S  | T  | >  | U  |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |

|    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|
| V  | <  | W  | X  | ^  | Y  | Z  |
| 31 | 32 | 33 | 34 | 35 | 36 | 37 |

**3.1** The encryption algorithm is given by the relation below.

$$C = (P + K)_{\text{mod}38}$$

Where:

C: is the cipher text

P: is the plaintext

K: is the key

**3.2** The decryption algorithm is given by the relation below.

$$P = (C - K)_{\text{mod}38}$$

Where:

C: is the cipher text

P: is the plaintext

K: is the key

Example: Encrypt the information using modified Ceaser cipher using a (shift of 2 letters)

**ATTACK NOW AND DEPEND YOUR TERRITORY!**

Solution. Using the encryption algorithm of the modified Ceaser cipher which is given by  $C = (P + K)_{\text{mod}38}$  the cipher text will be. #UU# \*? O@ ^# OEE +Q+OE A@ <S U+SS \$U @SA.

The intending recipient and also intruders will receive the code #UU# \*? O@ ^# OEE +Q+OE A@ <S U+SS \$U @SA. as sent over communication media, the intending recipient will use the decryption algorithm and Table 3 above to decrypt the cipher text, while intruders will use frequency analysis or any available tools within their system to crack the code, and due to the inclusion of special characters, the frequency analysis will likely fail to work.

#### 4. Conclusion and Discussion

Upgrading the Caesar cipher yields impressive results, increasing complexity for attackers while maintaining simplicity for recipients, and significantly enhancing security features to prevent information breaches.. Through systematic modifications, the improved Caesar cipher achieves a robust defense against unauthorized access. This heightened resilience makes it a

formidable challenge for attackers attempting to decipher sensitive information. The encryption's intricacies act as a formidable deterrent, ensuring a higher level of confidentiality. Despite the heightened complexity introduced in the improved Caesar cipher, its user-friendliness remains intact for the intended recipient. This delicate balance between enhanced security and user accessibility marks a distinctive achievement in cryptographic research. The recipient experiences a seamless decryption process, ensuring efficient and timely access to the protected information. The findings underscore the practical applicability of the enhanced Caesar cipher in real-world scenarios where information security is paramount. The cipher's improved resistance to attacks positions it as a valuable tool in safeguarding sensitive data. This research not only contributes to the evolution of classical encryption methods but also highlights the importance of striking a balance between security and usability in cryptographic systems.

#### 4.1 Conflict of Interest

This work is a collaborative work by the authors, no complicit in the findings arises.

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## CYBER SECURITY IN ACADEMIC LIBRARY UNDER THE 4TH INDUSTRIAL REVOLUTION ERA

BY

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### Abstract

*The study examines cyber security in academic library under the 4th industrial revolution era. The study adopted a descriptive survey research design. Area of the study is Benue State University Library and Information Services Makurdi. The population of the study was 84 library staff. The study sampled 30 respondents to collect data. The instrument used for this study is a structured questionnaire. The instrument was administered personally to the respondents by the researcher. In order to minimize loss of questionnaires, all completed questionnaires were collected on the spot. The data collected for this study was analyzed using statistics package for social sciences (SPSS) to generate mean scores and standard deviations. Finding of the study revealed that there is no perfect solution for cyber crimes but we should try our level best to minimize them in order to have a safe and secure future in cyber space. Based on the findings, the study recommended that the academic library should be checking the activities of students on the computer to ensure that they are utilizing the right information.*

**Keywords:** Academic library, cyber security, cyber crime

### 1. Introduction

Academic libraries refer to all the libraries that exist in institutions of higher learning. Their major aim is to provide the curricular educational needs of the students as well as to support the teaching staff in their up-to-date information resources required for their teaching jobs (Igbo & Dike 2016). Emojorho and Nwalo (2009) described academic libraries as libraries established in the institutions of higher learning such as universities, polytechnics, colleges of education, and other tertiary institutions. This type of library performs and supports academic objectives of the parent institution which is anchored on teaching, learning and research.

Therefore, the primary goals of academic libraries are to meet the information needs of the staff, students, host community and the global community at large. For example, if a tertiary institution is offering degree, diploma and certificate courses, it is expected that its library should provide adequate cultural heritage relevant to the subject that suits each level of the institutions academic programmes which is a fulfillment of their curricula needs. The academic library is therefore the nerve centre around which scholarship revolves. It is an indispensable instrument for intellectual development. A well-stocked academic library is a storehouse of information, or a record of human experience to which users may turn to for data or information.

Cyber security is the measure put in place to ensure the protection of internet connected activities and systems such as software, hardware and data from cyber threats. In the wake of the current trend in activities of library users, there have been high rates of possible threats in the sphere of cyber security. Academic libraries have therefore adopted varying security measures for the safety of their resources. Macomb (2004) submitted that physical (non-

electronic) security, electronic security and security policies/procedures are substantial methods for securing library resources. Therefore, physical security includes architectural considerations, the use of personnel, and security hardware to prevent crimes against library resources. Moreover, electronic security system which refers to the use of equipment which typically provides alarm notification to the appropriate authority on entry control and site surveillance is also a measure put in place for safety of library's resources. Major elements of the electronic security system include burglary protection, collection security, access control, and video surveillance, particularly the CCTV system. According to Ibrahim and Umar. (2020). Cyber security strives to ensure the attainment and maintenance of the security properties of the organization and user's assets against relevant security risks in the cyber environment. Security remains near the top of the list of strategic issues facing higher education institutions.

In addition, Ajie (2019) opined that cyber security is the body of technologies, processes and practices designed to protect networks, computers, programs and data from attack, damage or unauthorized access. In this context, the term security implies cyber security. The author posited that, security remains the top issues facing higher education institutions. Given the increasing volume of resources that needs to be protected, the expanding body of rules, regulations, and laws governing resources security and privacy, and the current economic downturn, which makes it even harder for an institution to obtain the funding necessary to keep up with requirements, this is not at all surprising. Security is not strictly a technology matter; indeed, it is a foundational element for almost all academic libraries. Responsibility for security needs to extend beyond information technology to every functional office in the institution and to the highest level of management. According to Kumar and Somani (2018) Cyber-security is both about the insecurity made by and through this new space and about the practices or procedures to make it (progressively) secure. It alludes to a lot of exercises and measures, specialized and non-specialized, expected to ensure the bioelectrical condition and the information it contains are transports from all possible threats. The emergence of fourth industrial revolution (Industry 4.0 or 4IR) has however helped and is significantly transforming the way libraries render services to users.

The fourth industrial revolution (Industry 4.0 or 4IR) is characterized by a fusion of technology that is blurring the lines between the physical, biological, and digital worlds. It is the development and combination of new and emerging technologies in the field of nanotechnology, biotechnology, information and communication technologies, cognitive sciences, and their convergence in the form of artificial intelligence that will facilitate the building of wholly automated "factories of the future" (Gillieron, 2019). In this context, technological developments shifts the world of labour in the fourth industrial revolution that radically changes the way we live, work and communicate (Davis & O'Halloran, 2018). In the context of scale and complexity, the 4IR will be completely different from anything that the humanity has experienced before. A new wave of technological advancement encouraged by Industry 4.0 will bring humankind to a new era of globalization, the so-called "Globalization 4.0" (Gillieron, 2019).

Moreover, in the 4th industrial revolution, more than 61% of full industry exchanges are done on the internet, so this area prerequisite high quality of security for direct and best exchanges. Thus, cyber security has become a most recent issue in academic library in the 4th industrial revolution (Dervojeda, Verzijl, Nagtegaal, Lengton, & Rouwmaat, 2014). The extent of cyber security does not merely restrict itself to verifying the data in IT industry only, but yet also to different fields like cyberspace and so forth. Improving cyber security and ensuring that necessary data systems are vital to each academic libraries security and financial prosperity. Based on the analyzed information, we would like to provide all the counter measures that



academic libraries may undertake in order to ensure improved security that would support in defending the academic libraries from being attacked by the hackers and provide a cyber-security to avoid all risks.

### Purpose of the study

The general purpose of the study is to examine cyber security in academic library. Specifically, the purposes of the study are to:

- i. examined the kind of cyber crime activities in academic library in Benue State University, Makurdi.
- ii. examine the effect cyber security have on academic library in Benue State University, Makurdi.
- iii. investigate cyber security techniques in academic library in Benue State University, Makurdi.
- iv. investigate the cyber ethics in academic library in Benue State University, Makurdi.

### Research Questions

- i. What are the kinds of cyber crime activities in academic library in Benue State University, Makurdi?
- ii. What are the effects of cyber security on academic library in Benue State University, Makurdi?
- iii. What are the cyber security techniques in academic library in Benue State University, Makurdi?
- iv. What are the cyber ethics in academic library in Benue State University, Makurdi.

## 2. Methodology

The study examines cyber security in academic library under the 4th industrial revolution era. The study adopted a descriptive survey research design. Area of the study is Benue State University Library and Information Services Makurdi. The population of the study was 84 library staff. The study sampled 30 respondents to collect data. The instrument used for this study is a structured questionnaire. The instrument was administered personally to the respondents by the researcher. In order to minimize loss of questionnaires, all completed questionnaires were collected on the spot. The data collected for this study was analyzed using statistics package for social sciences (SPSS) to generate mean scores and standard deviations.

## 3. Result

**Questions One:** what are the kinds of cyber crime activities in academic library in Benue State University, Makurdi?

**Table One: Responses of respondents on the kind of cyber crime activities in academic library in Benue State University, Makurdi**

| s/n | Item              | $\bar{X}$ | Mean deviation | Decision |
|-----|-------------------|-----------|----------------|----------|
| 1   | Cyber stalking    | 2.50      | 1.544          | Accepted |
| 2   | Child pornography | 2.75      | 1.565          | Accepted |

|   |                            |      |       |          |
|---|----------------------------|------|-------|----------|
| 3 | Forgery and counterfeiting | 2.60 | 1.556 | Accepted |
| 4 | Cyber terrorism            | 2.75 | 1.565 | Accepted |
| 5 | Computer hacking           | 2.50 | 1.544 | Accepted |
| 6 | Software piracy            | 2.70 | 1.560 | Accepted |

### Field survey, 2021.

Table 1 above shows mean response of the kind cyber crime activities in academic library in Benue State University, Makurdi. From the table above, the respondents indicate that items 1, 2, 3, 4, 5 and 6 are the kind of cyber crime activities in academic library in Benue State University, Makurdi. In essence all the items were clearly accepted by the respondents.

**Question Two:** what are the effects of cyber security in academic library in Benue State University, Makurdi?

**Table Two: Responses of respondents on the effects of cyber security in academic library in Benue State University, Makurdi.**

| s/n<br>o | Item                                        | $\bar{X}$ | Mean deviation | Decision |
|----------|---------------------------------------------|-----------|----------------|----------|
| 7        | Protecting web servers and web applications | 2.85      | 1.755          | Accepted |
| 8        | Cloud computing and its services            | 2.75      | 1.565          | Accepted |
| 9        | Encryption of the code                      | 2.60      | 1.556          | Accepted |
| 10       | Cloud computing and its services            | 2.50      | 1.565          | Accepted |

### Field survey, 2021.

Table 2 above shows mean response on the effect of cyber security in academic library in Benue State University, Makurdi. From the table above, the respondents indicate that items 8, 9 and 10 are effects of cyber security in academic library in Benue State University, Makurdi. In essence all the items were clearly accepted by the respondents.

**Question Three:** what are the cyber security techniques in academic library in Benue State University, Makurdi?

**Table Three: Responses of respondents on the cyber security techniques in academic library in Benue State University, Makurdi**

| s/n<br>o | Item                                 | $\bar{X}$ | Mean deviation | Decision |
|----------|--------------------------------------|-----------|----------------|----------|
| 11       | Access control and password security | 2.75      | 1.565          | Accepted |
| 12       | Authentication of data               | 2.75      | 1.560          | Accepted |
| 13       | Malware scanners                     | 2.75      | 2.565          | Accepted |
| 14       | Firewalls                            | 2.75      | 1.565          | Accepted |
| 15       | Anti-virus software                  | 2.75      | 2.656          | Accepted |

### Field survey, 2021.

Table 3 above shows mean response on the cyber security techniques in academic library in Benue State University, Makurdi. From the table above, the respondents indicate that items 11, 12, 13, 14 and 15 are the cyber security techniques in academic library in Benue State University, Makurdi. In essence all the items were clearly accepted by the respondents.

**Question Four:** what are the cyber ethics in academic library in Benue State University, Makurdi?

**Table Four: Responses of respondents on the cyber ethics in academic library in Benue State University, Makurdi.**

| s/n<br>o | Item                                                                           | $\bar{X}$ | Mean<br>deviation | Decision |
|----------|--------------------------------------------------------------------------------|-----------|-------------------|----------|
| 16       | Do use the Internet to communicate and interact with other people              | 2.75      | 2.565             | Accepted |
| 17       | Do not be a bully on the Internet.                                             | 2.75      | 1.560             | Accepted |
| 18       | Do not operate others accounts using their passwords.                          | 2.75      | 2.565             | Accepted |
| 19       | Never share your personal information to anyone                                | 2.75      | 1.565             | Accepted |
| 20       | Never try to send any kind of malware to other's systems and make them corrupt | 2.75      | 2.565             | Accepted |

### Field survey, 2021.

Table 4 above shows mean response on the cyber ethics in academic library in Benue State University, Makurdi. From the table above, the respondents indicate that items 11, 12, 13, 14 and 15 are the cyber ethics in academic library in Benue State University, Makurdi. In essence all the items were clearly accepted by the respondents.

### Recommendations

The study recommended the following:

1. That academic library should be checking the activities of students and library users on the computer to ensure that there are utilizing the right information.
2. Academic libraries should ensure good protection of its information and communication technology ICT to ensure that users would not be able to corrupt nor hack into their hardware and software systems.
3. Adequate funds should be provided by the parent organizations that established the academic library to curb cyber security in academic library under the 4th industrial revolution era.

### Conclusion

Computer security is a vast topic that is becoming more important because the world is becoming highly interconnected, with networks being used to carry out critical transactions. Cyber crime continues to diverge down different paths with each day that passes and so does the security of the information. The latest and disruptive technologies, along with the new cyber tools and threats that come to light each day, are challenging organizations with not only how they secure their infrastructure, but also how they need new platforms and intelligence to do

so. There is no perfect solution for cyber crimes but we should try our level best to minimize them in order to have a safe and secure future in cyber space.

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## EFFECTS OF GLOBAL WARMING ON FISHING ACTIVITIES IN ARGUNGU AND YAURI AREAS OF KEBBI STATE.

BY

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### Abstract

*Argungu is globally known for fishing and angling, while Yauri is not only a fishing community but has an international fish market therefore this study becomes paramount seeing the continuous decline in fish landing and outputs from the two areas. The study aimed to evaluate environmental changes, analyse fish yield and biodiversity trends, assess socio-economic impact, identify and evaluate adaptation strategies. 150 respondents were randomly sampled from 10 fishing communities from the study areas. The results indicated that there is significant correlations between climate change and fish yield. In conclusion. Global warming poses significant challenges to fish farming in Argungu and Yauri areas of Kebbi state.*

**Keywords: - Global warming, Angling, deforestation, Biosecurity**

### Introduction

Climate change is a change in climate that is directly or indirectly attributed to human activities. It affects the atmospheric conditions of the environment thereby leading to global warming''. Climate change is capable to change all natural systems thereby becoming a threat to human existence and socio- politically and economic survival (Ogunlade, I. 2007 & 2008). Climate change is a major obstacle to agricultural developing economies in Africa and the world at large. Ziervogel et al (2006) observed that climate change, which is attributable to natural climate cycle and human activities, has done a great damage to agricultural productivity in Africa. This is because African agriculture is predominantly dependent on seasonal rainfall and hence basically dependent on the elements of weather. Zoellick (2009) '' the planet warms, rain fall patterns change, and extreme events such as droughts, floods, and forest fires and desertification become more frequent. This results in poor and unpredictable yields, thereby making farmers more vulnerable, particularly in developing economies in Africa and Nigeria in particular.

The variability in climatic conditions has directly impacted fish yields in Argungu and Yauri. Fishermen have observed a decline in fish catches, particularly during periods of extreme weather events. The increased frequency of floods during the rainy season has been linked to lower fish catches, as turbulent waters make fishing more difficult and reduce fish availability (Lohana & Anka, 2016).

The decline in fish yields has significant socio-economic repercussions for the fishing communities in Argungu and Yauri. Fishing serves as a primary source of income and nutrition for these populations. Reduced fish catches have led to decreased earnings, affecting the livelihoods of fishermen and their families. This economic strain has prompted some community members to seek alternative employment, often in less sustainable sectors. Moreover, the scarcity of fish has led to increased prices, impacting local food security and accessibility (Lohana & Anka, 2016).

In response to these challenges, various adaptation strategies have been proposed and implemented. The Kebbi State government, in partnership with international organizations such as the World Fish Programme, has initiated efforts to revitalize fish production. These initiatives aim to enhance aquaculture practices, improve water management, and provide training to local fishermen on sustainable fishing techniques (NIPC, 2019). Additionally, there has been a focus on diversifying income sources for fishing communities to reduce their vulnerability to climate-induced shocks. For the fishing communities of Argungu and Yauri, reduced fish yields have direct socio-economic consequences. Fishing not only represents a primary income source but also a critical element of local food security. With decreasing fish stocks, local markets have experienced rising prices and reduced accessibility to this essential protein (Adebayo & Okeke, 2018). The economic strain is prompting shifts in occupational practices, with many community members exploring alternative, and sometimes less sustainable, livelihoods. This transition, coupled with the erosion of traditional fishing practices, raises concerns about long-term community resilience to climate-induced shocks (Nigerian Investment Promotion Commission [NIPC], 2019).

According to F.A.O (2009), Constraints to increased fish production in Nigeria include, among others, climate change effects (including sea level rise, coastal erosion and flooding, increase in environmental temperatures, and wind storms). (Nzeadike, Egbule, Chukwuone and Agu, 2011, Climate change requires the development of natural resources management strategies that ensures the sustainable use of soil and water, halt biodiversity decline and deal with emerging issues such as demand for renewable energy. Societies must therefore respond by both minimizing human activities that are contributing to global warming such as the greenhouse gases emission to atmosphere) and finding ways to adapt to the impacts that warming will bring, such as heavy rainfall, more frequent, extreme and unbearable weather conditions, and sea-level rise

Global warming poses significant challenges to fishing activities in the Argungu and Yauri areas of Kebbi State. Altered water levels, declining fish yields, and socio-economic disruptions underscore the urgent need for comprehensive adaptation strategies. Addressing these issues will require a multifaceted approach that integrates sustainable environmental management with community-based interventions, as well as continued research to monitor evolving climatic impacts (FAO, 2018; NIPC, 2019).

## Materials and Methods

### Sampling Procedure and Data Collection

These two local governments were selected because of their natural endowment for fish production, Fish farmers in these areas constituted the population for the study. Five fishing villages were selected from Yauri (Dabai, Makuku, Warra, Binji and Giro masa) and Argungu (Argungu town, Bagudo, Birnin Kebbi, Yelwa and Suru). Fifteen (15) farmers were selected from each fishing community through their associations making a total of 150 as the population.

Data for the study were collected through a structured questionnaire. Comprising of the respondents socio-economic status, educational level, fish farm experience, number of ponds owned, membership of social groups, household size and average annual income, were determined. Also, to ascertain respondents' knowledge of global warming and its effect on fish production, a four-point Likert-type scale with options of **strongly agree, agree, disagree and strongly disagree** with nominal values of **4,3,2,1** respectively was used to obtain responses from fish farmers. Data were analysed using both descriptive statistics. All objectives were analysed using frequency, mean scores and correlations.

## Method of Analysis

The responses were analysed using the frequency tables and standard deviation, which provided answers to the research questions. A mean score was used in analysing the data collected. The rating scale was given values as follows:

|                        |   |
|------------------------|---|
| SA (Strongly Agree)    | 4 |
| A (Agree)              | 3 |
| D (Disagree)           | 2 |
| SD (Strongly Disagree) | 1 |

Decision Rule: Any score that was 2.5 and above was accepted, while any score that was below 2.5 was rejected. Therefore, 2.5 was the bench mean score for decision taken

The respondents' perception (observation) of impacts of climate change were subjected to test of standard deviation. A higher standard deviation means there's more variation in the variable, while a lower standard deviation indicates more consistency in the variable. The deviation above 6 is considered high.

## Results

Socio-economic characteristics of respondents (n=150)

### Table 1A Gender Distribution

From the result 78.6.% of respondents are male while 24.4% are females

| Gender | PERCENTAGE |
|--------|------------|
| MALE   | 78.6       |
| FEMALE | 24.4       |

Source:- field survey, 2024

### Table 1B Age Group

From the table it would be observed that 52.8% of the respondents are within the ages of 20-39 which is the most active stage. This suggests that large number of them are new entrants and thus may not be fully aware of the changes in the fishing cycle 37.8% are within the ages of 40-59 and are in position to identify change in fishing cycle while, 9.4% are 60 years and above thus most vulnerable to the effects of climate change. They are neither active in fishing nor can they change their source of livelihood.

| AGE GROUP | PERCENTAGE |
|-----------|------------|
| 20-29     | 25.3       |
| 30-39     | 27.5       |
| 40-49     | 19.3       |
| 50-59     | 18.5       |
| 60-Above  | 9.4        |

Source:- field survey, 2024

**Table 1C : Marital Status**

From the table 74% are married while 26% are due to lack of marriage, death or divorced. The 6% are likely not to pay attention to climate change and its effect on fishing activities due to their social challenges confronting them.

| Marital Status | PERCENTAGE |
|----------------|------------|
| Single         | 20         |
| Married        | 74         |
| Divorced       | 3.3        |
| Widow/widower  | 2.7        |

Source:- field survey, 2024

**Table 1D: Level of Education**

From the table, 43.3% of the respondents 86.7% are educated and only 13.3% are not formally educated, this however may likely contribute to their level of awareness of climate change especially the 26.7% who are tertiary education graduates.

| Level of Education              | Percentage |
|---------------------------------|------------|
| Non-formal education only       | 13.3       |
| Primary and Islamic education   | 16.7       |
| Secondary education only        | 23.3       |
| Secondary and Islamic education | 20         |
| Tertiary education              | 26.7       |

Source:- field survey, 2024

From the table 2 below it would be observed that 44.6% of the respondents are experienced in fish farming for at least 10 years, this placed them in better position to identify effects of climate change in their fish farming experiences. However, 36.7% are new entrants so may lack proper understanding of the changes being experienced.

**Table 2: Fish farming experience**

| Year of experience | PERCENTAGE |
|--------------------|------------|
| 1-5                | 36.7       |
| 6-10               | 18.7       |
| 11-15              | 13.3       |
| 15 and above       | 31.3       |

Source:- field survey, 2024

**Table 3: Measuring Farmer's awareness and perception of climate change**

The Table below shows the awareness and unawareness are 50% each

| Level of awareness | Percentage |
|--------------------|------------|
| Very much aware    | 23.3       |
| Partially aware    | 26.7       |
| Not aware          | 50         |

Source:- field survey, 2024



**Table Four: Farmer's awareness of impacts of climate change on fishing activities.**

The table below indicated that at least 66.7 % of the respondents are aware of the impacts of climate change on fishing activities, 22.3 are not aware while, 20% are confused on matters relating to climate change.

| Level of awareness | Percentage |
|--------------------|------------|
| Very much aware    | 66.7       |
| Partially aware    | 20.0       |
| Not aware          | 22.3       |

Source:- field survey, 2024

**Table Five: Sources of awareness of climate change**

87.7% of the respondents got their awareness of climate change from various source, while 22.3% said they have no awareness of the climate change.

| Source of awareness         | Percentage |
|-----------------------------|------------|
| Agric. Extension worker     | 6.0        |
| National Orientation Agency | 2.0        |
| TV/Radio                    | 32.0       |
| Internet/social media       | 11.0       |
| News Paper                  | 17.0       |
| Friends/ relatives          | 9.7        |
| None                        | 22.3       |

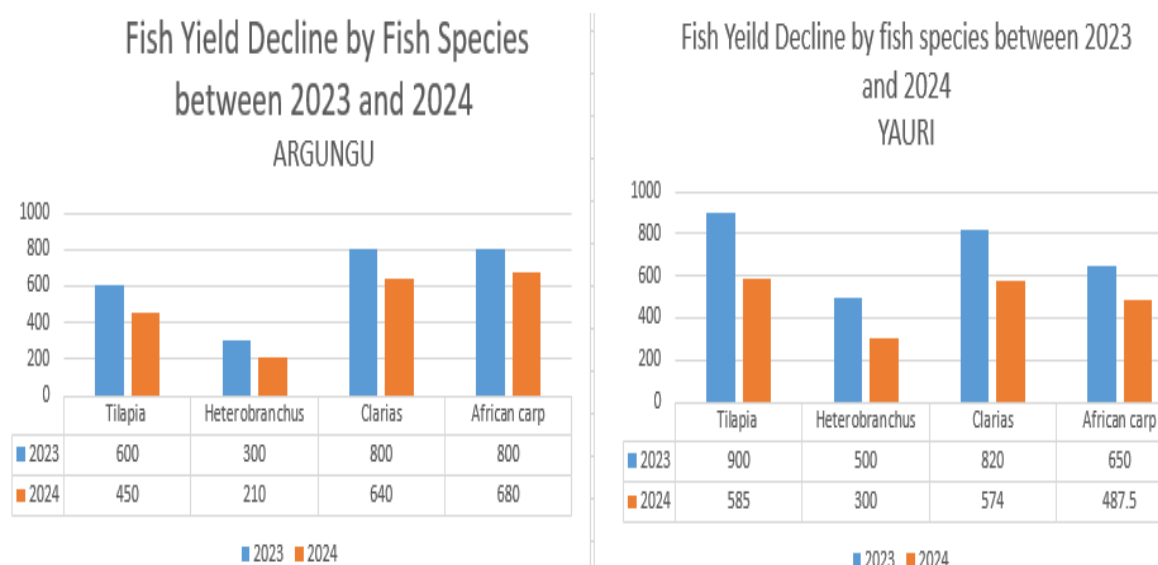
Source:- field survey, 2024

**Table six: Farmer's perception and impacts of climate change**

The table six shows there are more variation on fishing activities due to climate change in rainfall, drought, temperature, reduced in catch of marketable size and high cost of living. While there are more consistency in some variable meaning climate change has little or no effect on them

| Observations /Variable              | Mean | Standard Deviation | Remarks          |
|-------------------------------------|------|--------------------|------------------|
| Heavy rainfall(Flooding)            | 15   | 8.97               | More variation   |
| Low or reduced rainfall (drought)   | 15   | 8.05               | More variation   |
| High temperature                    | 15   | 9.61               | More variation   |
| Appearance of unfamiliar species    | 15   | 7.21               | More variation   |
| Reduced in catch of marketable size | 15   | 8.06               | More variation   |
| High cost of living                 | 15   | 7.38               | More variation   |
| Increased fishing time and effort   | 15   | 6.32               | More consistency |
| High perishability of fish          | 15   | 5.34               | More consistency |
| High cost of fishing gears          | 15   | 5.31               | More consistency |
| Low temperature                     | 15   | 4.74               | More consistency |
| Reduced catch of marketable species | 15   | 2.98               | More consistency |

Source:- field survey, 2024



**Figure 1:** Fish Yield Decline by Fish Species between 2023 and 2024 in metric tons. The chart below show the decline by fish species in 2023 and 2024 in Argungu and Yauri

Source:- Kebbi state ministry of Agriculture and rural development

#### Table Seven: Adaptation Strategies

Climate change has resulted into adopting different strategies for survival by respondents with construction of embankment, establishment of pond, stocking of fast growing species, non-selective and change in fishing time and effort pulling the most adopted strategies

| Strategies                                               | % Yes | % No |
|----------------------------------------------------------|-------|------|
| Migration from one fishing ground to another             | 55.5  | 45.5 |
| Change of fishing gears.                                 | 50    | 50   |
| Change in catch species.                                 | 70.2  | 29.8 |
| Non-selective fishing.                                   | 80.5  | 19.5 |
| Change in fishing time                                   | 70    | 30   |
| Change fishing baits and lures                           | 69    | 31   |
| Creating fish aggregating devices in the water body      | 20    | 80   |
| Following meteorological predictions                     | 25.8  | 74.2 |
| Procurement of weather monitoring kits                   | 0     | 100  |
| Establishment of ponds and fish farms                    | 78    | 22   |
| Construction of embankments and dykes to reduce flooding | 96    | 4    |
| Stocking of fast growing species.                        | 85    | 15   |
| Change from fishing to fish related businesses           | 65.8  | 34.2 |
| Quit fishing                                             | 30    | 70   |

**Table 8: Correlation Co-efficient**

The table below shows the correlation between some variable of the research as shown below

Significance level is at 5% ( $p < 0.05$ )

| Variable                                   | Correlation coefficient | p-Value | Inference       |
|--------------------------------------------|-------------------------|---------|-----------------|
| Rainfall and fish yield                    | 0.259                   | 0.020   | Significant     |
| Temperature and fish yield                 | -0.257                  | 0.023   | Significant     |
| Climate change and high cost of living     | -0.256                  | 0.024   | significant     |
| Level of awareness                         | -0.258                  | 0.022   | significant     |
| Other social variables and climate change. | -0.460                  | 0.685   | Not significant |

## Discussion

Climate change has led to significant alterations in water levels within the rivers and lakes of Kebbi State. Studies have reported a reduction in water volume during the dry season, attributed to increased temperatures and irregular rainfall patterns. This reduction has resulted in the contraction of aquatic habitats, adversely affecting fish populations and diversity (Lohana & Anka, 2016). Conversely, during the rainy season, heavy downpours have caused flooding, which disrupts fish breeding grounds and leads to the displacement of fish species. These fluctuations in water levels pose challenges to sustaining fish habitats and, consequently, fishing activities.

The variability in climatic conditions has directly impacted fish yields in Argungu and Yauri. Fishermen have observed a decline in fish catches, particularly during periods of extreme weather events. The increased frequency of floods during the rainy season has been linked to lower fish catches, as turbulent waters make fishing more difficult and reduce fish availability (Lohana & Anka, 2016). Additionally, the reduction in water volume during the dry season has led to decreased fish reproduction rates, further diminishing fish stocks. These trends suggest a strong correlation between climate-induced environmental changes and reduced fish productivity.

The decline in fish yields has significant socio-economic repercussions for the fishing communities in Argungu and Yauri. Fishing serves as a primary source of income and nutrition for these populations. Reduced fish catches have led to decreased earnings, affecting the livelihoods of fishermen and their families. This economic strain has prompted some community members to seek alternative employment, often in less sustainable sectors. Moreover, the scarcity of fish has led to increased prices, impacting local food security and accessibility (Lohana & Anka, 2016).

In response to these challenges, various adaptation strategies have been proposed and implemented. The Kebbi State government, in partnership with international organizations such as the World Fish Programme, has initiated efforts to revitalize fish production. These initiatives aim to enhance aquaculture practices, improve water management, and provide training to local fishermen on sustainable fishing techniques (NIPC, 2019). Additionally, there has been a focus on diversifying income sources for fishing communities to reduce their vulnerability to climate-induced shocks.

## Conclusion

Global warming poses substantial challenges to fishing activities in the Argungu and Yauri areas of Kebbi State. The resultant changes in water levels and climatic conditions have led to decreased fish yields, adversely affecting the socio-economic well-being of local communities. Addressing these issues requires a multifaceted approach, including environmental management, sustainable fishing practices, and socio-economic interventions to build resilience against the impacts of climate change.

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## ENERGY INSECURITY AND EFFECTIVENESS OF ADAPTIVE RESPONSES AMONG HOUSEHOLDS IN BIDA, NIGER STATE, NIGERIA

BY

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### Abstract

*This study investigated the dynamics of energy insecurity and adaptive responses among households in Bida, Niger State, Nigeria. Bida is a semi-urban town facing chronic electricity shortages, just like most urban areas in Nigeria. Using a structured questionnaire administered to 592 households, the study assessed patterns of energy use, access to alternative energy sources, and the effectiveness of the coping strategies. The outcome of descriptive statistics revealed that all respondents experience daily electricity outages, with limited hours of supply and high dependence on biomass for cooking. It also revealed that only 21.3% of the respondents reported effective coping mechanisms, primarily through solar lights/lamps. The inferential analysis, using multinomial logistic regression identified income, educational attainment, and household size as predictors of coping strategy effectiveness. The outcome of the analysis revealed that higher income and education levels are positively associated with the adoption of more effective alternatives, while larger households face greater challenges in managing energy insecurity. The study concluded that energy poverty in Bida is deeply linked to socioeconomic conditions and recommended the promotion of decentralised renewable energy solutions through the provision of subsidized solar home systems and community solar microgrids. The study also recommended the expansion of access to clean cooking energy as well as raising awareness on the health and environmental risks of firewood and charcoal use.*

**Keywords:** Energy insecurity, Adaptive responses, and Household resilience.

### Introduction

Access to reliable and affordable energy is a fundamental requirement for the sustainable development of any society (Usman, 2019). This is because it supports daily household activities, drives economic productivity, enhances learning and education, and improves the overall quality of life (Bridge *et al.*, 2016; and Zeng *et al.*, 2024). However, in many parts of sub-Saharan Africa, including Nigeria, energy insecurity remains a significant development challenge (Filho *et al.*, 2024; and Eduah, 2025). Energy insecurity, broadly defined as the inadequacy of reliable, affordable, and clean energy for basic needs, has far-reaching implications on household well-being, especially in urban and peri-urban areas (Onyekuru and Eboh, 2011; and Uzonwanne, 2015).

In Nigeria, the energy sector has been marred by decades of infrastructural deficits, corruption, mismanagement, and policy inconsistencies (Abdallah and Odeleke, 2023). Despite the country's vast natural gas and hydroelectric potentials, the national grid remains weak and epileptic, leading to frequent blackouts and unfulfilled energy demand (Jimoh and Raji, 2023). This situation has driven households to explore alternative but often expensive and environmentally unfriendly sources such as petrol-powered generators, charcoal, and firewood (Okoye and Achebe, 2019). According to the National Bureau of Statistics (NBS, 2022), more

than 60% of Nigerian households experience regular power outages, with rural and semi-urban areas facing the greatest disadvantages.

Bida, a fast-growing urban centre in Niger State, typifies this energy crisis. The town experiences recurrent power outages and unstable voltage, which adversely affect household livelihoods and social functions. Despite being located in a region with significant hydro and solar energy potentials, households often lack the financial capacity or awareness to invest in sustainable alternatives. As a result, households employ varied adaptive strategies such as reliance on generators, kerosene lamps, and behavioural adjustments like undertaking all electricity-dependent activities when there is electricity, even when it is not convenient. These responses reflect not only the severity of energy insecurity but also the socio-economic disparities that shape household resilience (Akinyele *et al.*, 2017). This is because households in the high-income class could afford to provide alternative energy sources.

The issue of energy insecurity similarly intersects with the broader issues of urban development, income inequality, and environmental sustainability. This is because inadequate electricity access can hinder home-based businesses, reduce students' study time, increase exposure to indoor pollution, and generally undermine the quality of life (Awojobi and Tetteh, 2017). Understanding how households in Bida navigate these energy challenges is critical for designing inclusive energy policies and community-based solutions. Therefore, this study set out to assess the nature and extent of energy insecurity in Bida and also investigate the adaptive strategies employed by households in response.

## **Literature Review**

### **Concept of energy insecurity**

Energy insecurity refers to the condition in which individuals or households are unable to access sufficient, reliable, affordable, and clean energy for their daily needs (Boateng *et al.*, 2022). It encompasses not only the absence of electricity but also issues related to affordability, quality, and sustainability of energy supply (Boateng *et al.*, 2020). In low and middle-income countries, including Nigeria, energy insecurity is often normalized due to the long-standing infrastructural weaknesses and governance failures (Brew-Hammond, 2010). In Nigeria, household access to reliable electricity remains limited despite government efforts to expand the grid and promote renewable alternatives. According to the International Energy Agency (IEA, 2021), over 85 million Nigerians lack access to electricity, while millions more rely on polluting and inefficient energy sources like firewood, kerosene, and petrol generators. This situation is more pronounced in semi-urban centres like Bida, where power supply is inconsistent and unreliable.

### **Household energy use in Nigeria**

The energy profile of Nigerian households is diverse and stratified along income, location, and education levels (Akeh *et al.*, 2023; and Abubakar *et al.*, 2024). Despite this, most urban and peri-urban households often rely on a combination of electricity from the national grid, generators, and traditional fuels like charcoal and kerosene (Nnaji *et al.*, 2012). In northern Nigeria however, solar energy potential remains underutilized due to high installation costs and limited technical knowledge (Akinyele *et al.*, 2017). This therefore affects the productivity and development of households and communities because studies have shown that access to modern energy sources enhances productivity, educational performance, and public health (Okoye and Achebe, 2019).

## **Adaptive responses to energy insecurity**

In response to the chronic energy shortages, households adopt a range of coping mechanisms. These include behavioural changes such as rationing usage during peak hours, switching to multiple energy sources, investing in backup generators or solar panels, and adjusting domestic schedules to match electricity availability (Awojobi and Tetteh, 2017). While high-income households can afford more resilient solutions, lower-income households often face greater vulnerability due to limited financial capacity (Denton *et al.*, 2020). Household-level adaptations, however, are not always sustainable. The use of generators, for example, contributes to noise pollution and increased greenhouse gas emissions. On the other hand, solar energy, though clean, is yet to be widely adopted due to upfront cost barriers (Akangbe and Sharifi, 2025).

## **Research Methodology**

This study employed the quantitative research approach and the rationale for this was to capture the measurable extent of energy insecurity among households in Bida. This approach also allowed for statistical analysis of household characteristics and energy use patterns to be performed. Furthermore, this approach allowed for the examination of household characteristics and how energy-related factors influence the perceived effectiveness of coping strategies during energy insecurity.

The research will be conducted on the whole of Bida town, a semi-urban town in Niger State, North central Nigeria. Bida is characterized by a blend of urban and peri-urban neighbourhoods and faces recurrent electricity supply challenges. It presents a relevant case for studying household-level energy insecurity due to its growing population, increasing energy demand, and limited infrastructure.

The study population comprised of households within Bida town, that is, households both at its core urban neighbourhoods and peri-urban extensions. For the sampling technique, a two-way sampling technique, made up of cluster and random sampling, was employed for the study. The cluster sampling technique divided the study area into 12 clusters (after Usman, 2019), and thereafter proportional samples were drawn from each cluster using the random sampling technique.

The sample size for this research was derived by first projecting the population of Bida town from Nigeria's 2006 census figure of 188,181 (as reported by the Niger State Department of Budget and Planning in the Niger State Bureau of Statistics, 2012) to the year 2025. This projection applied Nigeria's national annual population growth rate of 3.2% (UNFPA, 2011; and NPC, 2016), using the geometric growth model. Accordingly, Bida's projected population for 2025 stands at approximately 342,366. Household estimates per cluster (see Table 1) were calculated by dividing the projected population figures by the average household size of 7.8, based on Usman (2019). The Calculator.net online sample size calculator was then employed to determine the required sample size from each cluster. With a 4% margin of error and a 95% confidence level, a total of 592 respondents were selected. This figure was proportionately distributed across the various neighbourhoods, as detailed in Table 1.



**Table 1: Projected 2025 population; estimated number of households and sample sizes of neighbourhoods**

| S/No         | Neighbourhood    | Projected population | Estimated no. of households | Sample size |
|--------------|------------------|----------------------|-----------------------------|-------------|
| 1.           | Bangaie          | 35,990               | 4,614                       | 62          |
| 2.           | Bangbara         | 24,883               | 3,190                       | 43          |
| 3.           | Banma            | 47,985               | 6,152                       | 83          |
| 4.           | Banwuya          | 49,016               | 6,284                       | 85          |
| 5.           | Banyagi          | 43,957               | 5,636                       | 76          |
| 6.           | Dokodza          | 35,932               | 4,607                       | 62          |
| 7.           | Esso             | 55,871               | 7,163                       | 97          |
| 8.           | GRA              | 11,904               | 1,526                       | 21          |
| 9.           | Ndazabo          | 5,341                | 685                         | 9           |
| 10.          | Poly Area        | 17,344               | 2,224                       | 30          |
| 11.          | Project Quarters | 6,403                | 821                         | 11          |
| 12.          | Ramatu Dangana   | 7,450                | 955                         | 13          |
| <b>Total</b> |                  | <b>342,366</b>       | <b>43,857</b>               | <b>592</b>  |

Source: Calculated after Usman (2019)

Both the primary and secondary data sources were used in this study, while the primary data was collected directly from the 592 sampled households, the secondary data was obtained from relevant previous studies. The primary data was collected using structured questionnaires, and were basically on household energy sources and adaptive responses, while the secondary data were used in the introductory and literature review sections of the study.

The quantitative data collected from the field using the structured questionnaires were analysed using the SPSS Version 26. The outcome of these were presented in descriptive and inferential statistics (multinomial logistic regression). While the former summarised the dataset, the latter assessed the association/relationship between household characteristics and energy-related factors that influences the perceived effectiveness of coping strategies during energy insecurity.

## Results and Analysis

### Descriptive statistics: Socioeconomic characteristics

The outcome of the analysis showed that 54% of respondents are male, while 46% are female. This indicates a relatively balanced gender representation in the study. The outcome also indicated that the largest age group is 40-49 years (44.3%), while 66.4% of respondents are married, highlighting that family units dominate the household structure. The analysis similarly revealed that 35.6% of the respondents have secondary education, and 20.8% have no formal education. This reflects a moderate level of educational attainment and possible implications for awareness and adoption of alternative energy.

The outcome of the analysed data furthermore indicated that 54.2% of the respondents work in the informal sector, pointing to their economic vulnerability and potentially limited financial capacity to invest in alternative energy sources. While data on the monthly income of household heads revealed that the majority of the respondents (39%) earn between ₦20,000-₦49,999, suggesting a prevalence of low to middle-income households. The last data obtained on the socio-economic characteristics of the respondents showed that 48.5% of the households

have an average of 7-9 members, indicating relatively large household sizes which can influence energy demand and coping behaviours.

### **Household energy access and usage**

Data on household energy access and usage revealed that all the households in Bida rely on grid electricity, and this highlights a lack of energy source diversification. The data also indicated that the majority of households use traditional biomass - firewood (34.3%) and charcoal (28.5%)., while only 14.7% use cleaner Liquefied Petroleum Gas (LPG). All the respondents also confirmed that they experience daily electricity outages, indicating pervasive and chronic energy insecurity in Bida town. On the average number of hours electricity is received in Bida, the data obtained indicated that 72% of the households get between 2-8 hours of electricity daily, which is inadequate for most household activities. Data on the metering of households showed that 77% of the households are metered; although this may help regulate usage and expenditure, but it does not ensure constant electricity supply. The last data obtained on household energy access and usage revealed that 78.5% of the respondents spend ₦5,000 or less on monthly basis as their electricity expenditure, aligning with their income levels.

### **Adaptive strategies and impact**

Owing to the unstable nature of electricity supply in the study area, the respondents were asked on their coping methods, data on this indicated that rechargeable lamps are the most common (67.2%), followed by solar lights/lamps (21.3%) and generators (11.5%). The implication of this is that only 21.3% of the households in the study area invested in alternative source, indicating barriers to alternative energy uptake, which is primarily cost-related. Consequently, the coping strategies of the remaining 78.7% of the respondents are not effective, owing to the adoption of non-effective sources. On the other hand, data on the impacts of energy insecurity revealed that 39.7% of the households reported health problems due to fuel types used (kerosene, firewood and charcoal), 31.3% of the respondents stated that it affects children's study time, while 16.7% opined that it affects business productivity.

### **Perceptions on the state of energy**

Data on the perception of households on the energy situation in Bida showed that 62% of the respondents rated it as very poor, affirming dissatisfaction, while 87.3% of the respondents believe that government's efforts in addressing the energy insecurity are inadequate. The data also showed that 60% of the households opined that they believe their monthly electricity bills are not commensurate with the actual supply, while all the respondents claimed that the poor nature of the supply negatively affects their work, businesses or studies in one way or the other. Similarly, 58% of the respondents believe that formal neighbourhoods (such as GRA and Project Quarters) enjoy preferential treatment in terms of power restoration, while 25% stated that addressing their complaints are usually delayed or ignored. Finally, the analysed data revealed that 38% of the respondents said they had experience power surge that damaged appliances and in some instances, caused fire incidents or electric shock. It is discernible from the foregoing that the state of energy in Bida is perceived as severely inadequate, unreliable, inequitable, costly, and unsafe.

### **Inferential statistics: Multinomial logistic regression**

The essence of this analysis is to examine the nexus between household characteristics and energy-related factors that influences their perceptions. In other words, the regression analysis is to appraise how household characteristics and energy-related factors influence the perceived effectiveness or otherwise of the coping strategies during energy insecurity. The predictors are monthly income, household size, and education level, while the dependent variable, that is,

coping effectiveness was classified thus: 0 = not effective, 1 = effective, and 2 = very effective. The result the regression is presented in Table 2.

According to the model, the  $R^2$  value is equal to 0.1664. This in other words means that the model explains 16.6% of the variance in coping strategy effectiveness. The model also revealed that the Log-Likelihood Ratio (LLR) p-value is equal to 8.059e-26. The implication of this is that overall, the model is statistically significant. Similarly, according to the outcome of the multinomial regression analysis presented in Table 2, income is a strong and consistent predictor, that is, higher-income households are significantly more likely to adopt effective or very effective energy coping strategies like solar panels or inverters.

**Table 2: Relationship between household characteristics and energy-related factors**

| Comparison                          | Variable        | Coefficient | p-value | Interpretation                                                                                                                           |
|-------------------------------------|-----------------|-------------|---------|------------------------------------------------------------------------------------------------------------------------------------------|
| Effective (1) vs Not effective (0)  | Income          | 2.862       | 0.000   | Higher income significantly increases the likelihood of having effective coping strategies                                               |
|                                     | Education level | -1.182      | 0.008   | Surprisingly, higher education reduces the odds of having effective coping strategies. This could be due to expectations or energy needs |
|                                     | Household size  | -1.653      | 0.000   | Larger households are less likely to find their strategies effective                                                                     |
| Very effective (2) vs Not effective | Income          | 1.366       | 0.000   | Income also significantly boosts the chance of very effective strategies                                                                 |
|                                     | Education level | 1.100       | 0.003   | More educated households are more likely to adopt very effective strategies                                                              |
|                                     | Household size  | -2.571      | 0.000   | Larger households again show decreased likelihood of very effective responses.                                                           |

The Table also revealed that education showed mixed results for “effective” and “very effective”. For effective strategies, higher education seemed to correlate negatively - possibly because those respondents may have higher expectations of what constitutes “effective”, while for very effective strategies, higher education aligned positively with adaptive capacity, suggesting educated households may be more proactive. Analysis on the last predictor showed that household size negatively affects coping capacity, that is, larger households struggle more, likely due to higher energy demand and financial strain.

### Recommendations

The following recommendations have been put forward to enhance energy security in the study area:

1. The promotion of decentralised renewable energy solutions through the provision of subsidized solar home systems and community solar microgrids. This can be achieved in collaboration with private investors.
2. The expansion of access to clean cooking energy as well as raising awareness on the health and environmental risks of firewood and charcoal use.
3. The strengthening of energy governance and accountability through improved service delivery, and transparency in billing and metering practices.
4. The institutionalisation of resilience strategies by mainstreaming energy resilience planning into urban development strategies, and the provision of incentives for developers who integrate sustainable energy systems into new housing projects.

## Conclusion

The study revealed a deeply entrenched problem of energy insecurity among households in Bida, with every respondent reporting daily power outages and a majority receiving between 2-8 hours of electricity per day. This chronic shortage has led households to adopt various coping strategies, primarily low-cost options such as rechargeable lamps, with only a few investing in alternative energy systems like solar panels. Despite these efforts, 78.7% of the respondents found their coping strategies ineffective, reflecting the limited success of current responses. The outcome of the regression analysis underscored that income is the most influential factor in determining whether or not, a household can adopt effective energy coping strategies.

The study similarly showed that education plays a role, especially in enabling the most effective solutions, while larger households face greater challenges due to higher energy demands and limited resources. The energy crisis impacts not only daily living conditions but also health, educational outcomes, and economic productivity, especially for informal sector workers who dominate the town's labour force. The overwhelming dissatisfaction with government efforts (87.3% negative perception) further emphasizes the need for deliberateness in addressing the problem of energy insecurity.

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# ENTREPRENEURSHIP EDUCATION AS A CATALYST FOR EMPLOYMENT GENERATION FOR UNEMPLOYED YOUTHS IN KEBBI STATE NIGERIA

BY

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## Abstract

*The study investigated entrepreneurship education as a catalyst for employment generation for unemployed youths in Kebbi state Nigeria. The study is deemed necessary as a result of high level of unemployment rate widely spread among youths and inability of government to combat the problem was the motivating factor for this research. The study acknowledged the growing interest in entrepreneurship education as a tool for employment generation in recent times, but, however, noted that there are little or no empirical studies on the entrepreneurship education on employment generation in Kebbi state. The specific objectives of the study are basically to investigate among others, the effect of entrepreneurship education on employment generation for unemployed youths in Kebbi state Nigeria. This study employed descriptive survey research design. A descriptive survey design involves the collection of data from a small sample of a large population to enable the researcher to describe and interpret in a systematic manner, the characteristic features and facts about things that exist in the population without manipulation. The target population is 1525 youths and unemployed graduates in Kebbi state Nigeria. A sample of 306 respondents is drawn from the population using purposive and judgmental sampling techniques. The study use self-designed questionnaire titled: Entrepreneurship Education and Employment Generation for Unemployed Youths Questionnaire (EEEGUYQ). The study measure the response of the respondents on four Likert Rating scale with reliability of 0.71. The study obtain 0.81 reliability index using Cronbach Alpha. The data collected is analyzed using both descriptive and inferential statistical methods. The result of the analysis reveals that entrepreneurship education will lead to overall improvement in employment generation among youths in Kebbi State Nigeria. The study concludes that Entrepreneurship education is a necessary requirement to guarantee employment generation for the youths in Kebbi state Nigeria.*

**Keywords:** Entrepreneurship, Education, Employment Generation, Youth, Kebbi State.

## Introduction

The pertinence of education to every nation that desires to develop is hugely indispensable. The success of any nation is hinged on the quality and functionality of the education of her citizens. In fact education has come to be seen as an instrument per excellence for effecting national growth and development for a sustainable economy. Agi and Yellowe (2013) opines that the goal of wealth creation or generation, poverty reduction and value re-orientation, can only be attained and sustained through an efficient education system which impacts the relevant skills, knowledge, capacities, attitudes and values. Education has come to be seen as the major mechanism for the upliftment and integration of the youths and other citizens of a nation at large into the social, economic and political fabrics of the society. No wonder, one of the national educational goals is the “acquisition of appropriate skills and the development of mental, physical and social abilities, and competences as equipment for the individual to live and contribute to the development of the society” (FRN, 2013). Further, Ezeanya (2015) asserted that education is a veritable tool for the total emancipation and development of an

individual, the family and the nation at large.

The introduction of entrepreneurship education in institutions of higher learning is not just a welcome development but also a major step towards solving the economic problems through employment generation. This is largely due to entrepreneurial skills development inculcated in the learners (Okoye, 2016). In today's world, entrepreneurship is seen as a vital source for economic growth and competitiveness, job creation as well as wealth creation and providing societal interests. Given the critical nature of entrepreneurship, both academics and practitioners have increased their efforts in promoting an entrepreneurial mindset in the society. Education has been confirmed as a vital component in the creation and continuing development of entrepreneurship attitudes and successful firms. Entrepreneurship education seeks to prepare people; particularly youth, to be responsible, enterprising individuals who become entrepreneurial thinkers by immersing them in real life learning experiences where they can take risks, manage the results, and learn from the outcomes. It gives the students the opportunity to exercise leadership and develop interpersonal skills. They learn to communicate their ideas and influence others effectively through the development of self-advocacy and conflict resolution skills. Moreover, they learn how to become team players and to engage in problem solving and critical thinking – these are characteristics valued highly by employers in the competitive workplace of the 21<sup>st</sup> century. (Griffin, & Hammis, 2013). Entrepreneurship education will include at least one or more of the following elements:

- (a) Foster those personal attitudes and skills that form the basis of an entrepreneurial mindset and behavior (creativity, risk propensity, self-confidence, independence, etc.)
- (b) Raise awareness of students about self-employment and entrepreneurship as possible career options.
- (c) Use practice-based methods, where students are involved in project work and/or in activities outside the classroom (linking them with the business world or with the local community).
- (d) Provide basic business skills for self-employment, or self-management, and knowledge of how to start and develop a commercial or social venture successfully. (European Union, 2012).

Entrepreneurship education has shown to be the most visible alternative in the face of heightened unemployment occasioned by non-existence of jobs or the negligible quantity of available ones compared to the quantity of unemployed graduates roaming the streets. Entrepreneurship education provides training that imparts skills and abilities which can be positively directed to establishing businesses that will further foster job creation and thereby reducing the unemployment rate. Alabi, Alanana and Baha (2014) asserted that entrepreneurship education among graduates will lay a solid foundation for the emergence of a generation of innovators willing to apply necessary capital into the production process for new products, open and expand markets, explore new sources of materials and ensure the organization of new industries. Through this process, there would be an emergence of small units of businesses that would flourish into bigger industries in the future via the application of managerial skills learnt through entrepreneurship education. The economies of most Asian countries that can now comfortably compete with the economies of America, Germany, United Kingdom have attained their present level of development through the entrepreneurial activities of individuals and groups with the support of their government by providing the needed framework and enabling environment for such entrepreneurial ventures to thrive. In China for instance, the private businesses and organizations employ the majority of the nation's workforce. If effectively managed, entrepreneurship education will reduce general unemployment and even ensure a private sector driven economy. Entrepreneurship education can train graduates to gain extra skills that can engage them as competent plumbers,



electricians, auto mechanics, truck drivers, computer technicians, system programmers, web designer etc. This will not only make them self-employed, but further provides jobs for others, creates wealth, enlarge and fast track the economy to attain the status of one of the twenty most developed economies of the world. It is in view of the above background that this study deemed it necessary to assess the extent to which entrepreneurship education is a catalyst for employment generation for unemployed youths in Kebbi State Nigeria

### **Statement of the problem**

The high rate of unemployed graduates in Kebbi state and in Nigeria as a whole is worrisome and has become an issue of concern to stakeholders such as government, labor market and parents. Every year, universities in Nigeria turn out thousands of graduates into the labor market searching for non-available jobs. This challenge of lack of jobs is not only affecting the already sizeable unemployed graduates, but also of absorbing the new entrants into the labour market.

Unemployment and political instability in Nigeria is currently a national concern. Youths and graduates from various institutions looking for employment opportunity increase on daily basis. It is important to note that during the period of colonialism that lasted for several decades, Nigeria lost the culture of self-reliant and self-employment. It paid off initially as the few privileged Nigerians who went through the colonial system of education regarded and more importantly absorbed into enviable positions in the colonial administration and civil service as public servants. In those days, the Nigerian economy was large enough to absorb the educated into the prestigious “White collar jobs ”(Oguz & Aydin, 2012). It is pertinent also to mention that, age – long formal education inherited from the imperialist turned out graduates with job-searching mindsets as opposed to job – creators. These graduates lacked entrepreneurial traits like self –motivation, drive and innovation needed by the world of work and employers of labour (Raimi and Towobola, 2011). However, with the population growing at geometric proportion relative to job placements that are growing at arithmetic progression, it became obvious that the nation`s formal education is fueling unemployment, crime and cycle of poverty as graduates could not be absorbed, hence the introduction of entrepreneurship in our schools.

Graduate unemployment is caused by countless of factors some of which include a mismatch between aspirations, skills and self-concept of graduates and employment opportunities available to them. Ageing, declining and dysfunctional educational system; that is inconsistent with present realities, inadequate effort by the government in the areas of policies and programs targeted at increasing and attaining economic growth and full employment among others have also accounted for it (Akpan, 2005). A research conducted by National Board for Technical Education (NBTE, 2005) reveals that most graduates were not well equipped with skills necessary to perform certain job functions required of them in the labour market, and about 85 percent of Nigerian graduates fall in this category. The question of whether entrepreneurship can be taught is no longer an issue today, but the major problem today is what should be taught and how it should be taught. It is becoming very clear today that entrepreneurship, or certain facets of it, can be taught. In the light of these, the study investigates how entrepreneurship education can be a catalyst for employment generation for unemployed youths in Kebbi State Nigeria.

### **Objectives of the Study**

The main objective of this study is to investigate entrepreneurship education as a catalyst for employment generation for unemployed youth in Kebbi state Nigeria. Therefore, the following are the specific objectives;

1. To examine the extent of entrepreneurial skills acquisition on employment generation for unemployed youths in Kebbi state Nigeria
2. To ascertain the extent of entrepreneurial training and training facilities on employment generation for unemployed youths in Kebbi state Nigeria
3. To assess the extent of managerial skills on employment generation for unemployed youths in Kebbi state Nigeria

### Research Questions

This study is guided by the following research questions

1. What is the extent of entrepreneurial skills acquisition on employment generation for unemployed youths in Kebbi state Nigeria?
2. What is the extent of entrepreneurial training and training facilities on employment generation for unemployed youths in Kebbi state Nigeria?
3. What is the extent of managerial skills on employment generation for unemployed youths in Kebbi state Nigeria?

### Research Hypotheses

Based on research questions and objectives, the study formulated and tested the following hypotheses at 0.05 level of significance

1. **H<sub>01</sub>:** Entrepreneurial skills acquisition has no significant effects on employment generation for unemployed youths in Kebbi state Nigeria.
2. **H<sub>02</sub>:** Entrepreneurial training and training facilities have no significant effect on employment generation for unemployed youths in Kebbi state Nigeria.
3. **H<sub>03</sub>:** Managerial skills acquisition has no significant effect on employment generation for unemployed youths in Kebbi state Nigeria

### Literature Review

#### Conceptual Framework

This section explicitly presented conceptual framework of this study for better understanding

#### Concept of Entrepreneurship

Entrepreneurship has been defined differently by different people. Akinawo (2013) Defined entrepreneurship as the ability to develop a new venture or apply a new approach to an old business. The new approach can be in terms of marketing, packaging or production by way of using resources in a new way. Mba (2018) is of the view that entrepreneurship is the process of using private initiative to transform a business concept into a new venture or to grow and diversify an existing venture with high growth potential. Olagunju (2004) defines entrepreneurship as an undertaking which one is involved in the task of creating and managing an enterprise for a purpose. (The purpose may be personal, social or developmental). Furthermore, Entrepreneurship can be defined as the process of identifying opportunities in the market place, marshalling the resources required to pursue these opportunities and investing the resources to exploit the opportunities for long term gains. It involves creating wealth by bringing together resources in new ways to start and operate an enterprise. Kareem (2015) define entrepreneurship as the attempt to create value recognition of business opportunity, the management of risk-taking appropriate to the opportunity and through the communicative and management skills to mobilize human, financial and material resources necessary to bring a project to function. Entrepreneurship is the set of activities performed by an entrepreneur.

## **Concept of Entrepreneurship Education**

Entrepreneurship education comprises the totality of all the training processes designed to equip its recipients with necessary skills, values, experience and orientations needed to be self-reliant and contribute to a nation's development. Akinboye (2015) sees entrepreneurship education as a kind of education that attempts to inject values of creativity, innovation, entrepreneurship, emotion, character, needed skills, competence, knowledge, attitude and heart. According to Tamuno and Ogiji (2019), entrepreneurship education is the education that has the ability to impact on the growth and development of an enterprise through technical and vocational training. Nwosu and Ohia (2009) sees entrepreneurship education as that aspect of education which equips an individual and creates in the person the mindset to undertake the risk of venturing into something new by applying the knowledge and skills acquired in school. One salient point noticeably present in the definitions given so far is empowerment, in other words, entrepreneurship education empowers the recipients with skills and abilities for self-development and contribution to the nation's general development. Entrepreneurship education is the process of fostering or developing entrepreneurial capacities and mind-sets of students through education and learning. According to Enu (2012) entrepreneurship education is made up of all kinds of experiences that give students the ability and vision of how to access and transform opportunities differently. Entrepreneurship education offer to the students the tools that will enable them think creatively, analyze a business idea objectively, solve problems effectively and evaluate a given project optimally

## **Concept of Unemployment**

Bogoro (2015) defined unemployment as a situation where people who are willing and capable of working are unable to find suitable paid employment. Unemployment is a situation which capable persons willing to work are unable to get suitable paid employment (Asogwa et al, 2016). Unemployment, a direct contrast is a chronic situation where competent persons within workable ages, ready and qualified to take up job positions are not given the opportunity nor find befitting places to work. Saptakee (2001) defined graduate unemployment as a kind of unemployment amongst people with academic degrees. In other words, graduate unemployment could be seen as a condition in which graduate job seekers are without a job. Fajana (2020) describes graduate unemployment as a state of joblessness experienced by persons who are members of the labor force, who perceive themselves and are perceived by others as capable of working.

## **Theoretical Framework**

This work anchored on Schumpeter's Theory of Entrepreneurship. Propounded by Schumpeter in his book – The Theory of Economic. He emphasized that entrepreneurship is a vital force in the economic system as a whole. A situation where the entrepreneur is a catalytic agent in the economic development process. According to him the following are the main features of an entrepreneur. The entrepreneur is a social deviant. He is that individual who does things differently. That is, in a new way. He does not follow the existing conventions or traditions, for the purpose of bringing about new ideas or changes. This implies that, the entrepreneur is an innovator. The entrepreneur is a destroyer of old customs. That is, he is always breaking up old traditions and creating new traditions to replace the old. The entrepreneur is egocentric, untraditional and ambitious. According to Schumpeter, the entrepreneur is a self-centered person. This is due to the fact that, he does not rely on tradition or customs as the rest of the members of the society does. The entrepreneur is also characterized by the dream and the will to find a private kingdom. The entrepreneur is characterized by the will to conquer, the impulse to fight, to prove oneself to others, to succeed for the sake of success itself and not for the fruit

of success. In effect the economic actions of the entrepreneur are as a result of his desire to succeed just for the sake of success only and nothing more. The entrepreneur is that person who is out to derive joy from just creating things and getting things done. He is out to simply exercise his superiority over others by simply doing things differently. The entrepreneur engages in the co-ordination of all factors of production for the benefits of individuals and the entire economy. The entrepreneur is the intermediary between the forces of demand and supply. He sees and calculates what the society wants to make of its scarce resources and organizes the resources in order to service the users. (Mba. ,2018). This work is based on Schumpeter 's theory of entrepreneurship because the entrepreneur is a social deviant, that individual who does things differently, that is, in a new way, he does not follow the existing conventions or traditions for the purpose of bringing about new ideas or changes. This impels that, the entrepreneur is an innovator. The entrepreneurship is an innovative function as it involves doing things in a new and better way.

### **Methodology**

This study employed descriptive survey research design. The study adopts descriptive survey design. The descriptive survey design is one of the methods used in education to verify knowledge that will help educationists in making valid decisions and policies (Oso & Onen, 2008). A descriptive survey design involves the collection of data from a small sample of a large population to enable the researcher to describe and interpret in a systematic manner, the characteristic features and facts about things that exist in the population without manipulation. The population of the study comprised 1525 participants in the study area; the study used Research Advisor (2006) to select 306 out of 1525 participants. To arrive at this sample size multi-stage sampling technique was used. The instrument used for data collection for the conduct of this research was questionnaire titled: Entrepreneurship Education and Employment Generation for the Youth Questionnaire (EEEGYQ). The questionnaire had sections 'A' which dealt with the instruction for respondents. Section 'B' contained questionnaire items of Entrepreneurship Education and Employment Generation for the Youth in Kebbi state Nigeria' based on four Likert type scales of Strongly Agree (SA) = 4, Agree (A )= 3 Disagree (D) = 2 and Strongly Disagree (SD) =1. The content validity of the questionnaire was done by experts in the department of Business Administration Usmanu Danfodiyo University Sokoto Nigeria, as well as, other experts in Entrepreneurship in the tertiary institutions located in the study area. To determine reliability of the research instrument the study used Cronbach alpha Statistical formula, which yielded a reliability index of 0.71 and this shows that the instrument is reliable for data collection. The study used descriptive statistics to answer research questions, while T-test was used to test the null hypotheses at the 0.05 level of significance.

### **Analysis and Results**

This section presented research hypotheses that were tested using t -test at 0.05 significant levels.

#### **Hypothesis One**

**H<sub>01</sub>:** Entrepreneurial skills acquisition has no significant effects on employment generation for unemployed youths in Kebbi state Nigeria.

**Table 1: T-test and Product Moment Correlation Analyses for ESA and EG**

| Variables | N   | Mean | Std Dev. | t-test |         | Product Moment Correlation |         | Decision               |
|-----------|-----|------|----------|--------|---------|----------------------------|---------|------------------------|
|           |     |      |          | T      | P-value | R                          | P-value |                        |
| ESA       | 300 | 3.68 | 0.28     |        |         |                            |         |                        |
| EG        | 300 | 3.87 | 0.69     | 4.564  | 0.000   | 0.519                      | 0.000   | Reject Ho <sub>1</sub> |

\*ESA= *Entrepreneurship Skill Acquisition*, EG = *Employment Generations*

Table 1 shows the statistical analyses to test null hypothesis H<sub>01</sub> using two independent samples t-test and product moment correlation techniques. The result of t-test  $t=4.564$  with  $p\text{-value}=0.000 < 0.05$  revealed that there is significance difference in the opinions of the participants on effect of Entrepreneurial skills acquisition on employment generation for unemployed youths in Kebbi state Nigeria at 5% level of significance. The result correlation analysis  $r=0.519$  with  $p\text{-value} = 0.000 < 0.05$  shows strong and positive correlation. This result implies that Entrepreneurial skills acquisition has contributed to the employment generation for unemployed youths in Kebbi state there is significant positive relationship between the opinions of the respondents on Entrepreneurial skills acquisition and employment generation for unemployed youths in Kebbi state. Therefore, the null hypothesis which stated that Entrepreneurial skills acquisition has no significant effects on employment generation for unemployed youths in Kebbi state Nigeria was rejected.

### Hypothesis Two

**H<sub>02</sub>:** Entrepreneurial training and training facilities have no significant effect on employment generation for unemployed youths in Kebbi state Nigeria.

**Table 2: T-test and Product Moment Correlation Analyses for ETTF and EG**

| Variables | N   | Mean | Std Dev. | t-test |         | Product Moment Correlation |         | Decision               |
|-----------|-----|------|----------|--------|---------|----------------------------|---------|------------------------|
|           |     |      |          | T      | P-value | R                          | P-value |                        |
| ETTF      | 300 | 3.68 | 0.29     |        |         |                            |         |                        |
| EG        | 300 | 3.87 | 0.69     | 4.222  | 0.024   | 0.314                      | 0.013   | reject Ho <sub>2</sub> |

\*ETTF=*Entrepreneurial Training and Training Facilities*, EG = *Employment Generation*

Table 2 shows the statistical analyses to test null hypothesis H<sub>02</sub> using two independent samples t-test and product moment correlation techniques. The result of t-test  $t=4.222$  with  $p\text{-value}=0.024 < 0.05$  revealed that there is significant effect of Entrepreneurial training and training facilities on employment generation for unemployed youths in Kebbi state Nigeria. The result correlation analysis  $r=0.314$  with  $p\text{-value} = 0.013 < 0.05$  shows moderate and positive correlation. This result implies that Entrepreneurial training and training facilities is a key determinant of employment generation for unemployed youths in Kebbi state Nigeria. Therefore, the null hypothesis which stated that Entrepreneurial training and training facilities have no significant effect on employment generation for unemployed youths in Kebbi state Nigeria was rejected.

### Hypothesis Three

**H<sub>03</sub>:** Managerial skills acquisition has no significant effect on employment generation for unemployed youths in Kebbi state Nigeria

**Table 3: T-test and Product Moment Correlation Analyses for MSA and EG**

| Variables | N   | Mean | Std Dev. | t-test |         | Product Moment Correlation |         | Decision               |
|-----------|-----|------|----------|--------|---------|----------------------------|---------|------------------------|
|           |     |      |          | T      | P-value | R                          | P-value |                        |
| MS        | 300 | 3.67 | 0.29     |        |         |                            |         |                        |
| EG        | 300 | 3.87 | 0.69     | 2.669  | 0.008   | 0.321                      | 0.000   | Reject Ho <sub>3</sub> |

\*MSA = Managerial skills acquisition, EG = Employment Generation

Table 3 shows the statistical analyses to test null hypothesis H<sub>03</sub> using two independent samples t-test and product moment correlation techniques. The result of t-test  $t=2.669$  with  $p\text{-value}=0.008 < 0.05$  revealed that there is significant effect of Managerial skills acquisition on employment generation for unemployed youths in Kebbi state Nigeria. The result correlation analysis  $r=0.519$  with  $p\text{-value}=0.000 < 0.05$  shows strong and positive correlation. This result implies Managerial skills acquisition is a catalyst for employment generation for unemployed youths in Kebbi state Nigeria. Therefore, the null hypothesis which stated that Managerial skills acquisition has no significant effect on employment generation for unemployed youths in Kebbi state Nigeria was rejected.

### Summary of the Major Findings

The following are the summary of the major findings emanated from this study

1. The study found that Entrepreneurial skills acquisition has contributed to the employment generation for unemployed youths in Kebbi state
2. The study also found that Entrepreneurial training and training facilities is a key determinant of employment generation for unemployed youths in Kebbi state Nigeria.
3. The study found that Managerial skills acquisition is a catalyst for employment generation for unemployed youths in Kebbi state Nigeria

### Discussion of the Major Findings

This section further discussed major findings of this study

First finding indicated that Entrepreneurial skills acquisition has contributed to the employment generation for unemployed youths in Kebbi state. This finding collaborated with Idoko (2014) who found that skill acquisition programs as a means of youth empowerment is to prepare and equip the youths that can be beneficial to the society. He maintained that the ideal skill acquisition is capable of ensuring value re-orientation among the youths and transforming them into creators of wealth and employment instead of seekers. The finding also agreed with Olagunju (2020) who found that entrepreneurial skill acquisition enhances employment generation among youth, this is because it gives ability to exploit an idea and create enterprise (small or big) not only for personal gain but also for social and development gain. He further stated that entrepreneurship skill acquisition correlates significantly with youth empowerment and self-reliance.

Second finding indicated that Entrepreneurial training and training facilities is a key determinant of employment generation for unemployed youths in Kebbi state Nigeria. The finding was in consonance with Dandago and Muhammad, (2014) he submitted that training has positive co-efficient with employment generation or otherwise, unemployment reduction, implying that training has the potentials of increasing the propensity for entrepreneurship other things being equal. The finding also in tandem with Okoye, Iloanya and Udunze, (2014) who

found that entrepreneurship training has significantly contributed to the employment generation and empowerment of youth in the country.

Third finding indicated that Managerial skills acquisition is a catalyst for employment generation for unemployed youths in Kebbi state Nigeria. This finding concurred with Uche and Adesope (2019) who found that managerial skill has help to build a culture of entrepreneurship among the youth which is essential for the reduction of unemployment rate in the country. The finding agreed with Makinde (2013) who found that managerial skills have a positive and significant effect on employment generation for the youth in Nigeria. This thus means that managerial skills are a significant predictor of employment generation among the youth in Nigeria. The study also corroborated with Alabi, Alanana and Bahal, (2014) who found that managerial skills help youth to manage finances and resources, develop and maintain relationships with customers and stakeholders, and understand and apply relevant laws and regulations.

### **Recommendations**

The following are the recommendations of this study

1. There is need for the government to provide adequate funds to ensure continuity in entrepreneurial skills acquisition which is considered to be necessary to empower unemployed youth to be self-employed and self-reliance without depending on government jobs or greener pasture and this would reduce unemployed youths' syndrome in Nigeria
2. Since entrepreneurship training and training facility have positive and significant effect on employment generation for the youth. therefore, there is need for the government through its relevant agencies to continue the training program and adequate provision of training facilities to ensure continuous and constant training of the youth in entrepreneurship to reduce the gap of unemployment rate
3. There is need for the government to encourage managerial skills acquisition which is essential for the youth to become job creators after graduation instead of looking for jobs and this would contribute to employment generation for unemployed youths in Nigeria

### **Conclusion**

Based on the findings of this study, the study concluded that,

1. Continuous entrepreneurial skills acquisition is necessary to empower unemployed youth to be self-employed and self-reliance without depending on government jobs or greener pasture and this would reduce unemployed youths' syndrome in Nigeria.
2. Entrepreneurship training and training facility have positive and significant effect on employment generation for the youth. Therefore, it is necessary that government and relevant agencies to continue the training program and adequate provision of training facilities to ensure continuous and constant training of the youth in entrepreneurship.
3. Managerial skills acquisition is essential for the youth to become job creators after graduation instead of looking for jobs and this would contribute to employment generation for unemployed youths in Kebbi State, Nigeria

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## EXPERIMENTAL MODELING OF THE FUEL CHARACTERISTICS OF CASTOR OIL: A BLEND OF KEROSENE AND ETHANOL AS A SUBSTITUTE FOR PETROLEUM DIESEL

BY

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### Abstract

*This research work is aimed to develop Castor oil, kerosene and ethanol blend as alternative to petrodiesel. Castor oil was blended with kerosene and ethanol at different proportions according to extreme vertices mixture design. Density, Sulphur content, kinematic viscosity, flash point and fire point of the blends were determined and then statistically analyzed and optimized. The results obtained showed that the density for Castor blends was found to be 0.86, which indicated that the blends have values within the approved ASTM range value for density. The sulphur content for Castor blends (0.023) were within the accepted range for diesel oil. The kinematic viscosity for Castor blends was found to be 27.20cst, which indicated that the blends have values near the approved ASTM value for kinematic viscosity. The flash points of Castor blends 61.18°F, which implies that, the value of Castor blend is close to the ASTM D 93 standard value for flash point on diesel. When measurements of fire point on castor blends (77.00) were made, they fell within the accepted range set by motor vehicle manufacturers. Therefore, the castor blends in this research work have diesel characteristic.*

**Keywords:** Castor oil, Diesel, Kerosene, Ethanol

### Introduction

Today, 80% of the world energy consumption and almost 100% of energy needed in the transportation sector is met by fossil fuels (Ahmad *et al.*, 2011). As the population increases the demand for energy to meet the different lifestyles requirements also increases as well. Although fossils fuels are the major energy resources, production and consumption of fossil fuels have caused a lot of environmental damage by increasing the Carbon dioxide (CO<sub>2</sub>) concentration in the atmosphere (Tutunea *et al.*, 2013). The world is presently confronted with twin crises of fossil fuels depletion and pollution which will lead to the scarcity of the oil and environmental degradation (Naveen, K. & Sharma, P. B., 2005).. Gasoline and diesel-driven automobiles are the major source of greenhouse gases (GHG) emission. Due to gradual depletion of the world oil reserves (Azad *et al* 2013), increasing demand for diesels and uncertainty in their availability (Deshpande *et al.*, 2012), recent increase in crude oil prices and the dwindling petroleum reserves (Ebenezer, 2010) and the environmental pollution there is an urgent need for alternative and suitable fuels. Alternative fuels promise a harmonious correlation with sustainable development, energy conservation efficiency and environmental preservation (Wakil, M. A., *et al.*, 2015). According Azad *et al* (2013), the European Biodiesel Board, countries like Austria, Belgium, Finland, Italy, Netherlands, Poland and Spain produced approximately 9 million metric tons of biodiesel in 2009 and about 65 percent of the world's biodiesel in 2013. The U.S. uses 62 billion gallons of diesel fuel each year. As the world turned to an alternative, it makes approximately 650 million gallons of soybean oil per year and the production is expected to increase gradually (Wagner *et al.*, 2013). Castor oil is extracted from

seeds of Palma Christi, the annual plant *Ricinus communis* and its other versions belonging to Euphorbiaceae family and cultivated almost in all tropical and subtropical countries. The seed contains up to 55% of the oil, when released from a peel it contains up to 69%. This oil is highly viscous, its coloration ranges from a pale yellow to colorless, and it has a soft and faint odor and a highly unpleasant taste. Castor oil has been used in isocyanate reactions to make poly urethane elastomer, millables, castable, adhesives and coatings, and polyurethane foams (Ogunniyi *et al.*, 1998). The automotive industry uses castor oil for the production of high performance motor oil and braking fluids (Carmen, 2006). However, castor oil and its derivatives are used in the production of paints, varnishes, lacquers, and other protective coatings, lubricants and grease, hydraulic fluids, soaps, printing inks, linoleum, oil cloth and also as a raw material in the manufacturing of various chemicals *sebacic acid* and *undecylenic acid* (Akpan *et al.*, 2006).

This paper aimed to develop castor oil, kerosene and ethanol blend as an alternative to petrodiesel for use in diesel engines. This will be achieved through the realization of the following specific objectives:

1. To prepare kerosene-castor oil blend with similar fuel properties as petro diesel.
2. To compare the fuel properties of the blends with those of petro diesel
3. To determine the effect of the different proportions of the components on the various fuels properties.
4. To evaluate how different castor oils affect the proportions of components in the optimal blends.

This study modeled the characteristics of castor oil, kerosene and ethanol using a blend to produce a fuel with equivalent characteristics of diesel as substitute for petroleum diesel. This substitute will provide friendly environment that will cause no harm to the people unlike petroleum diesel which caused a lot of environmental damage in the atmosphere.

## Literature Review

Several studies have been done to investigate the physical and chemical properties of biodiesel and its blends with petroleum products within and outside Nigeria. In the course of this research work topic 'experimental modeling of fuel characteristic of castor oil: a blend of kerosene and ethanol as substitute for to petro diesel', many journals were consulted, which are review here.

Deshpande D. P. et al., (2012) Production of Biodiesel from Castor Oil using acid and Base catalysts aim at producing Biodiesel from Castor Oil using acid ( $H_2SO_4$ ) and Base (NaOH) catalysts. It was observed that using acid, the viscosity decreases with increasing temperature while using base, the viscosity increases with increasing temp. The effect of various parameters like temp, residence time, catalyst concentration investigated on yield of biodiesel and physical properties like Viscosity, Specific gravity and Acid value.

Chalatlon, (2011) reported biodiesel production from *Jatropha* fruits by mechanical cracking machine and screw pressing. The optimized blends of the biodiesel obtained with petrodiesel showed improved performance in accordance with ASTM standard when compared with the pure oil. Thus, recommended further studies on blending *Jatropha* oil with Kerosene.

Azad *et al.*, (2012) prepared by transesterification reaction and without trans-esterification by blending in different proportion with diesel and study the physicochemical parameters of the blends. The result indicated that the biodiesel produced can be run in diesel engine and increase the diesel engine performance.

Lamba *et al.*, (2013) used prepared biodiesel to constituted the biodiesel-diesel blends and investigated their physico-chemical behavior with and without antioxidant. The study displayed that the properties of the biodiesel blends increases due to the presence of the presence oxidized product and were observed within the range by ASTM standard.

Azad *et al.*, (2013) conducted an experimental investigation which offers a comprehensive study of DI diesel engine performance using biodiesel from mustard oil blends with kerosene. The vegetable oil without trans-esterification reaction has been blended with kerosene oil by volume in some percentage like 20%, 30%, 40% and 50%. The properties have been tested with maintaining different ASTM standards. A comparison has been made for engine performance of different bio-diesel blends with kerosene with the engine performance of diesel fuel.

Silitonga *et al.*, (2013) critically reviewed a paper on Characteristic of the potential biodiesel and biodiesel blend with diesel and its fuel properties and biodiesel blends were covered. The fuel properties of biodiesel blends fuel were very close to diesel fuels and satisfied ASTM 6751 and EN 14214 standards.

Above all the mentioned studies, none of these uses petrokerosene and ethanol. With this, the study proposed experimental modeling of fuel characteristic of castor oil, a blend of kerosene and ethanol as substitute to petro diesel.' This involved blending of three components at different proportion using extreme vertices mixture design on MINITAB 16 statistical software platform.

## Materials and Method

### Apparatus

The apparatus used in this research papper are listed in Table 1 below

Table 1: List of Apparatus that are used in this research paper

| APPARATUS                                  | MODEL      | MANUFACTURER               |
|--------------------------------------------|------------|----------------------------|
| Disponsable sample container               |            | Horiba Scientific          |
| Flash point tester                         | K14670     | Koehler instrument Co.     |
| Flash point tester                         | 13730-0    | Stanhope-Seta England      |
| Flash point close cup                      |            |                            |
| Hydrometer                                 | S60/60°F   | Stevenson UK               |
| Hydrometer                                 | SGT60/60°F | T \$A UK                   |
| KV-8 Viscometer bath (40°C)                | 84000-op   | Stanhope-Seta UK           |
| Magnetic stirrer                           | ERC-1000H  | Tokyo Co. Ltd Japan        |
| Thermometer                                | 102°C      | Seta                       |
| Viscometer                                 | 150DM      | Koehler instrument Co.     |
| Viscometer                                 | 200DM      | Koehler Instrument Company |
| Viscometer                                 | 150DM      | Analisis                   |
| X-ray fluorescence sulphur-in-oil analyzer |            | Horiba Scientific          |

### Solvents

The solvents used in this research paper were purchased from local vendors and used without further purification. The solvents are listed in table 2 below

**Table 2: List of chemicals/reagents employed for the research.**

| REAGENTS            | FORMULA                                       | %PURITY  | MANUFACTURER |
|---------------------|-----------------------------------------------|----------|--------------|
| Aniline             | C <sub>6</sub> H <sub>5</sub> NH <sub>2</sub> | Absolute | Merck        |
| Ethanol             | C <sub>2</sub> H <sub>5</sub> OH              | Absolute | JHD          |
| Methanol            | CH <sub>3</sub> OH                            | Absolute | JHD          |
| Patassium hydroxide | KOH                                           |          |              |
| Phenolphthalein     |                                               |          | BDH          |
| Sodium hydroxide    | NaOH                                          |          | BDH          |

### Sample Collection

Sample of Castor oil (*Ricinus Commuris*) was collected from National Research Institute for Chemical Technology (NARICT) Zaria, Nigeria. Samples of kerosene and diesel were collected from NNPC approved oil filling stations namely A. A. Rano, U Gostu and S A K Nigeria Limited, Sokoto, Nigeria, in cleaned containers. The physicochemical parameters of the oils and their blends were determined at Nigerian National Petroleum Co-operation (NNPC) Laboratory Kaduna.

### Experimental Design and Blending

This involved blending of three components, namely castor oil, kerosene and ethanol at different proportion using extreme vertices mixture design on MINITAB 16 statistical software platform in upper and lower levels to investigate, optimize and obtain the best blends with similar fuel properties as petrodiesel.

**Table 3: Upper and Lower Values of the Blends**

| Components    | Code          | Lower levels | Upper levels |
|---------------|---------------|--------------|--------------|
| Vegetable oil | Vegetable oil | 5            | 95           |
| Kerosene      | Petrokero     | 5            | 95           |
| Ethanol       | Ethanol       | 0            | 40           |

## PHYSICOCHEMICAL ANALYSES

The parameters studied in this work and their procedures of determinations are shortlisted below.

- Determination of Density ASTM D 1298
- Determination of Sulphur Content ASTM D 4294
- Determination of Kinematic Viscosity ASTM D 445
- Determination of Flash Point ASTM D 93
- Determination of Fire Point ASTM D 93
- Results and Discussion

### Effect of Density on the Blends

From Table 4: analysis of variance at  $\alpha = 0.5$ , the p values for linear and quadratic (0.000 and 0.000) are significant related to density which indicated that all of the separate components and combine components are less than the 0.05 and there is significant interaction between the components. Table 5: Describes about 99.8% which indicated that the model fit data. The analysis further shows that, A\*B is statistically significant because the p value (0.000) is less than alpha value. A\*C is also significant because the p value (0.025) is less than alpha value. B\*C is significant because the p value (0.005) is less than alpha value.

**Table 4: Analysis of Variance for Castor Blends on density**

| Source            | DF | Seq SS   | Adj SS   | Adj MS   | F       | P     |
|-------------------|----|----------|----------|----------|---------|-------|
| Regression        | 5  | 0.097682 | 0.097682 | 0.019536 | 3628.2  | 0     |
| Linear            | 2  | 0.097403 | 0.0518   | 0.0259   | 4809.97 | 0     |
| Quadratic         | 3  | 0.000279 | 0.000279 | 0.000093 | 17.25   | 0     |
| Castor (*PetroKer | 1  | 0.000225 | 0.000193 | 0.000193 | 35.81   | 0     |
| Castor (*Ethanol  | 1  | 0.000004 | 0.00003  | 0.00003  | 5.54    | 0.025 |
| PetroKer*Ethanol  | 1  | 0.00005  | 0.00005  | 0.00005  | 9.29    | 0.005 |
| Residual Error    | 33 | 0.000178 | 0.000178 | 0.000005 |         |       |
| Lack-of-Fit       | 7  | 0.000174 | 0.000174 | 0.000025 | 184.86  | 0     |
| Pure Error        | 26 | 0.000004 | 0.000004 | 0        |         |       |
| Total             | 38 | 0.09786  |          |          |         |       |

**Table 5: Estimated Regression Coefficients for Castor Blends on Density**

| Term(cm <sup>3</sup> ) | Coef    | SE Coef | T    | P     | VIF    |
|------------------------|---------|---------|------|-------|--------|
| Castor                 | 0.95819 | 0.00143 | *    | *     | 3.48   |
| PetroKero              | 0.77098 | 0.00143 | *    | *     | 3.48   |
| Ethanol                | 0.76624 | 0.0135  | *    | *     | 81.176 |
| Castor *PetroKero      | 0.03751 | 0.00627 | 5.98 | 0     | 3.809  |
| Castor *Ethanol        | 0.05194 | 0.02206 | 2.35 | 0.025 | 33.119 |
| PetroKero *Ethanol     | 0.06726 | 0.02206 | 3.05 | 0.005 | 33.119 |

S = 0.00232048 PRESS = 0.000215176

R-Sq = 99.82% R-Sq (pred) = 99.78% R-Sq(adj) = 99.79%

Key: Castor = A, Petrokero = B and Ethanol = C

Figure 1(a): Response plots showing relative proportion of the figure 1(a) shows that as the relative proportion of the castor oil increases, and other components decrease, from the reference blend, the density increases linearly rapidly and decrease in proportion of the castor oil from the reference blend results in decrease in the density of the blend. On the other hand, increase in the proportion of the petrokerosene from the reference blend decreases the density of the blend and decrease in proportion of petrokerosene results in increase in the density. Ethanol shows similar, the density decrease slowly and its decrease result in slow increase in density.

Figure 1(a): Cox Plot Response Trace showing Effect of Components on Density and Figure 1(b): Contour Plots showing Effect of Relative Proportions of the Three Components on the Blends.

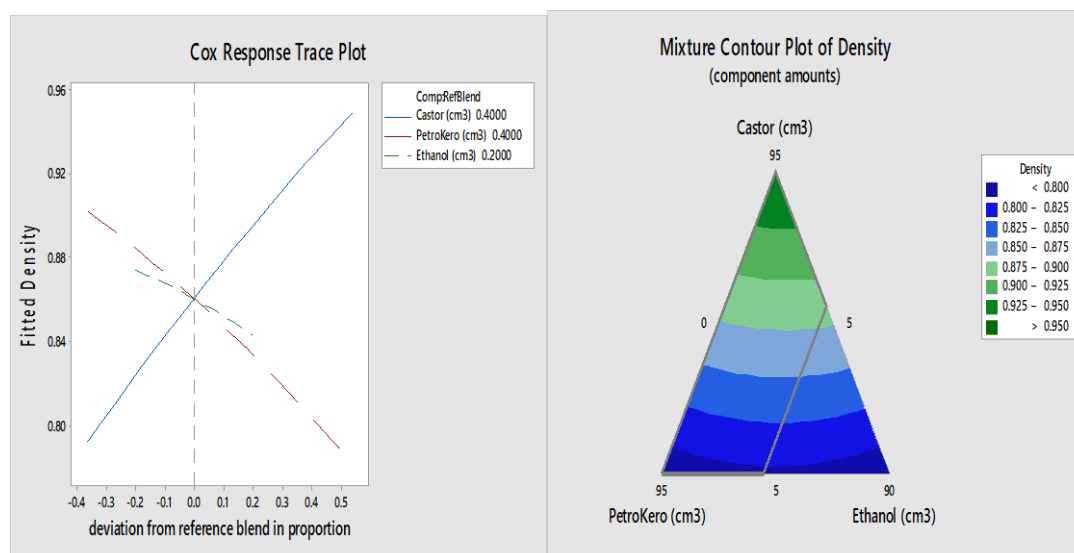


Figure 1(b) explains that the density is high at high proportion of castor which is greater than 0.950 and also the low density is observed at high proportion of ethanol and petrokerosene. The standard density (0.857) is observed at low proportion of ethanol and petrokero.

### Effect of Sulphur Content on the blends

From the table 6 analysis of variance at  $\alpha = 0.5$ , the linear regression is statistically significant because the p value (0.000) is less than the alpha value while the quadratic regression (0.149) is not significant which show that the mix components are greater than the common alpha value. However, table 7 shows that, A\*B is statistically not significant since the p value (0.612) is greater than the common alpha value. On the other hand, A\*C is statistically significant because the p value (0.030) is less than the common alpha value. However, the B\*C is not significant because the p value (0.095) is greater than the alpha value.

Table 6: Analysis of Variance for Castor Blends on Sulphur

| Source            | DF | Seq SS  | Adj SS  | Adj MS  | F       | P     |
|-------------------|----|---------|---------|---------|---------|-------|
| Regression        | 5  | 0.00045 | 0.00045 | 8.9E-05 | 21.05   | 0     |
| Linear            | 2  | 0.00042 | 0.00028 | 0.00014 | 32.96   | 0     |
| Quadratic         | 3  | 2.4E-05 | 2.4E-05 | 8E-06   | 1.9     | 0.149 |
| Castor (*PetroKer | 1  | 0       | 1E-06   | 1E-06   | 0.26    | 0.612 |
| Castor (*Ethanol  | 1  | 1.1E-05 | 2.2E-05 | 2.2E-05 | 5.13    | 0.03  |
| PetroKer*Ethanol  | 1  | 1.3E-05 | 1.3E-05 | 1.3E-05 | 2.95    | 0.095 |
| Residual Error    | 33 | 0.00014 | 0.00014 | 4E-06   |         |       |
| Lack-of-Fit       | 7  | 0.00014 | 0.00014 | 0.00002 | 3896.36 | 0     |
| Pure Error        | 26 | 0       | 0       | 0       |         |       |
| Total             | 38 | 0.00059 |         |         |         |       |

Table 7: Estimated Regression Coefficients for Castor Blends on Sulphur

Estimated Regression Coefficients for Sulphur (component proportions)

| Term(cm <sup>3</sup> ) | Coef    | SE Coef | T | P | VIF    |
|------------------------|---------|---------|---|---|--------|
| Castor                 | 0.02798 | 0.00127 | * | * | 3.48   |
| PetroKero              | 0.01498 | 0.00127 | * | * | 3.48   |
| Ethanol                | 0.05351 | 0.01198 | * | * | 81.176 |

|                    |         |         |       |       |        |
|--------------------|---------|---------|-------|-------|--------|
| Castor *PetroKero  | 0.00285 | 0.00556 | 0.51  | 0.612 | 3.809  |
| Castor *Ethanol    | -0.0444 | 0.01958 | -2.27 | 0.03  | 33.119 |
| PetroKero *Ethanol | -0.0336 | 0.01958 | -1.72 | 0.095 | 33.119 |

S = 0.00205973 PRESS = 0.000182910

R-Sq = 76.13% R-Sq(pred) = 68.81% R-Sq(adj) = 72.51%

Key: Castor = A, Petrokero = B and Ethanol = C

Figure 2(a) shows that as the castor oil increase in proportion, the sulphur content increase and its decreases in proportion result in decrease in sulphur content. Sulphur content decrease with increase in petrokerosene proportion and increase with decrease in petrokerosene proportion. As ethanol increase in proportion, the sulphur content increase slowly and when ethanol decrease in proportion the sulphur content nearly remain constant.

Figure 2(a): Cox Plot Response Trace showing effect of Components on Sulphur and Figure 2(b): Contour plots showing Effect of Relative Proportions of the Three Components on Sulphur Content

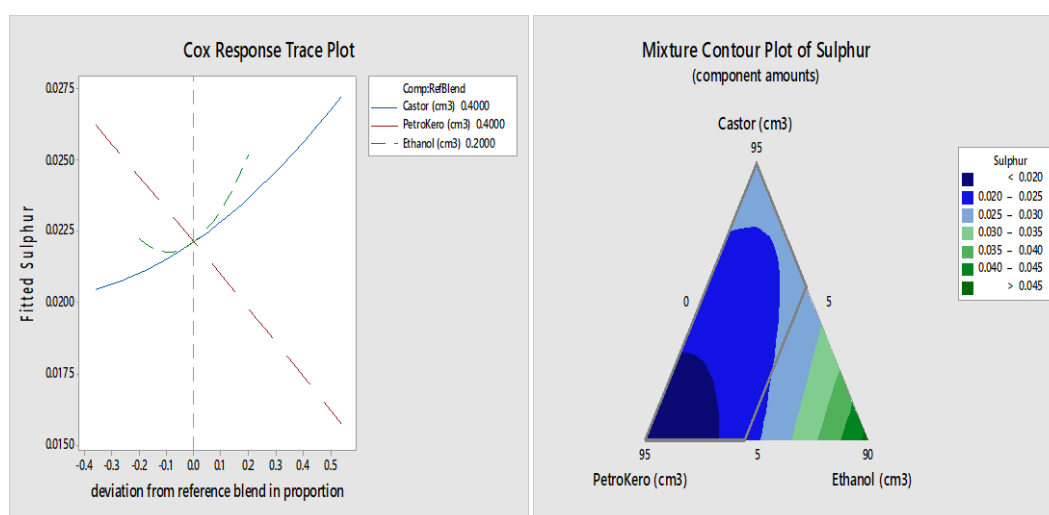


Figure 2(b) shows that the sulphur is found to be high at very high proportion of ethanol which is greater than 0.045 and also it is low is observed at high proportion of petrokero which is less than 0.020.

### Effect of Kinematic Viscosity Content on the Blends

Table 8 shows that, the p values for both linear and quadratic (0.000 and 0.000) are significant which indicated that all of the separate components and mix components are less than the common alpha 0.05 and there is significant interaction between the components. Nevertheless, table 9 describes that the model is good to fit the data with 94.68%. it also shows that A\*B, A\*C and B\*C are all statistically significant which show that their values (0.000, 0.000 and 0.011) are less than the common alpha level.

**Table 8: Analysis of Variance for Castor Blends on KV**

| Source            | DF | Seq SS  | Adj SS  | Adj MS  | F      | P |
|-------------------|----|---------|---------|---------|--------|---|
| Regression        | 5  | 74393.6 | 74393.6 | 14878.7 | 117.53 | 0 |
| Linear            | 2  | 52349.6 | 43939.1 | 21969.5 | 173.54 | 0 |
| Quadratic         | 3  | 22044   | 22044   | 7348    | 58.04  | 0 |
| Castor (*PetroKer | 1  | 7423.3  | 5944    | 5944    | 46.95  | 0 |



|                  |    |         |        |        |        |       |
|------------------|----|---------|--------|--------|--------|-------|
| Castor (*Ethanol | 1  | 13711.2 | 6164.4 | 6164.4 | 48.69  | 0     |
| PetroKer*Ethanol | 1  | 909.5   | 909.5  | 909.5  | 7.18   | 0.011 |
| Residual Error   | 33 | 4177.6  | 4177.6 | 126.6  |        |       |
| Lack-of-Fit      | 7  | 4101.7  | 4101.7 | 586    | 200.89 | 0     |
| Pure Error       | 26 | 75.8    | 75.8   | 2.9    |        |       |
| Total            | 38 | 78571.1 |        |        |        |       |

**Table 9: Estimated Regression Coefficients for Castor Blends on KV**

| Term(cm <sup>3</sup> ) | Coef   | SE Coef | T     | P     | VIF    |
|------------------------|--------|---------|-------|-------|--------|
| Castor                 | 179.4  | 6.93    | *     | *     | 3.48   |
| PetroKero              | 7.4    | 6.93    | *     | *     | 3.48   |
| Ethanol                | 219.6  | 65.435  | *     | *     | 81.176 |
| Castor *PetroKero      | -208.2 | 30.39   | -6.85 | 0     | 3.809  |
| Castor *Ethanol        | -746.5 | 106.975 | -6.98 | 0     | 33.119 |
| PetroKero *Ethanol     | -286.7 | 106.975 | -2.68 | 0.011 | 33.119 |

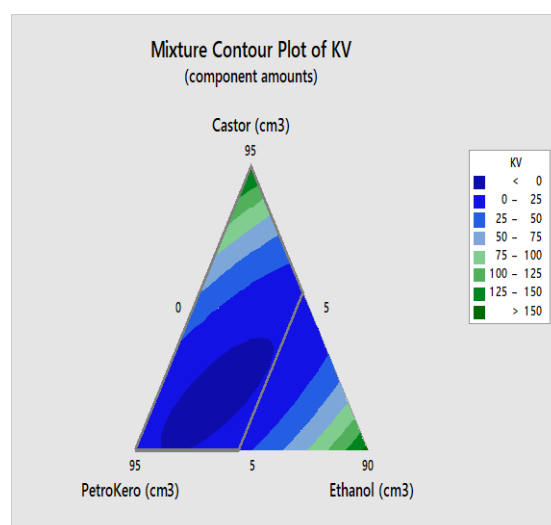
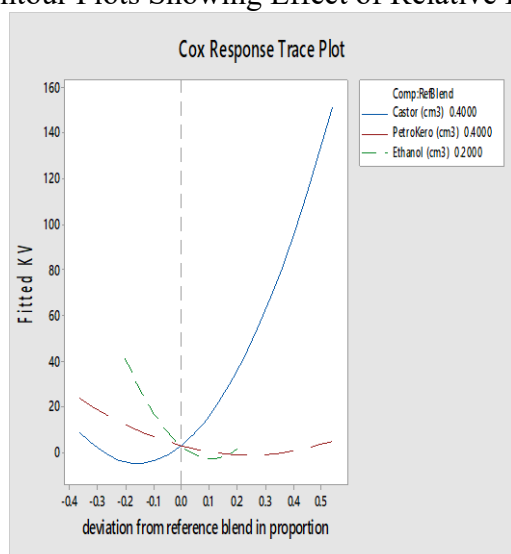
S = 11.2514 PRESS = 5955.33

R-Sq = 94.68% R-Sq(pred) = 92.42% R-Sq(adj) = 93.88%

Key: Castor = A, Petrokero = B and Ethanol = C

Figure 3(a): From the plot shows that, from the reference blend there is rapid increase in kinematic viscosity when the proportion of castor oil increases and decrease to a minimum before it slowly increase when the castor oil decreases in proportion. As the proportion of the petrokerosene increases, the KV remains almost constant and its decreases results in slow increase in KV. The KV remains nearly constant with increase in ethanol and increases with decrease in ethanol proportion.

Figure 3(a): Cox Plot Response Trace showing Effect of Components on KV and Figure 3(b): Contour Plots Showing Effect of Relative Proportions of the Three Components on KV



From the table 3(b) the KV is observed to be high at high proportion of both ethanol and castor which is greater than 150 and also it is low is observed at moderate proportion of petrokero which is less than 0.

### Effect of Flash Point Content on the blends

From the table 10 for linear and quadratic, their p values (0.000 and 0.000) are significant which indicated that all of the separate components and mix components are less than the common alpha 0.05. However, table 11 describes 69.13% which is good indicated that the model fit data. It further explains that, A\*B is statistically not significant because the p value (0.964) is greater than the alpha value. However, the p value for A\*C and B\*C (0.000 and 0.000) are less than the common alpha level, which indicated that they are statistically significant.

**Table 10: Analysis of Variance for Castor Blends on Flash Point**

| Source            | DF | Seq SS  | Adj SS  | Adj MS  | F      | P     |
|-------------------|----|---------|---------|---------|--------|-------|
| Regression        | 5  | 9220.3  | 9220.35 | 1844.07 | 14.78  | 0     |
| Linear            | 2  | 4246.6  | 6343.94 | 3171.97 | 25.42  | 0     |
| Quadratic         | 3  | 4973.8  | 4973.77 | 1657.92 | 13.29  | 0     |
| Castor (*PetroKer | 1  | 81.9    | 0.26    | 0.26    | 0      | 0.964 |
| Castor (*Ethanol  | 1  | 1604.1  | 4775.08 | 4775.08 | 38.27  | 0     |
| PetroKer*Ethanol  | 1  | 3287.7  | 3287.68 | 3287.68 | 26.35  | 0     |
| Residual Error    | 33 | 4117.4  | 4117.39 | 124.77  |        |       |
| Lack-of-Fit       | 7  | 4024.1  | 4024.06 | 574.87  | 160.14 | 0     |
| Pure Error        | 26 | 93.3    |         | 93.33   | 3.59   |       |
| Total             | 38 | 13337.7 |         |         |        |       |

**Table 11: Estimated Regression Coefficients for Castor Blends on Flash Point**

| Term (cm <sup>3</sup> ) | Coef   | SE Coef | T     | P     | VIF    |
|-------------------------|--------|---------|-------|-------|--------|
| Castor                  | 103.7  | 6.88    | *     | *     | 3.48   |
| PetroKero               | 56.7   | 6.88    | *     | *     | 3.48   |
| Ethanol                 | 400.4  | 64.962  | *     | *     | 81.176 |
| Castor *PetroKero       | 1.4    | 30.17   | 0.05  | 0.964 | 3.809  |
| Castor *Ethanol         | -657   | 106.202 | -6.19 | 0     | 33.119 |
| PetroKero *Ethanol      | -545.2 | 106.202 | -5.13 | 0     | 33.119 |

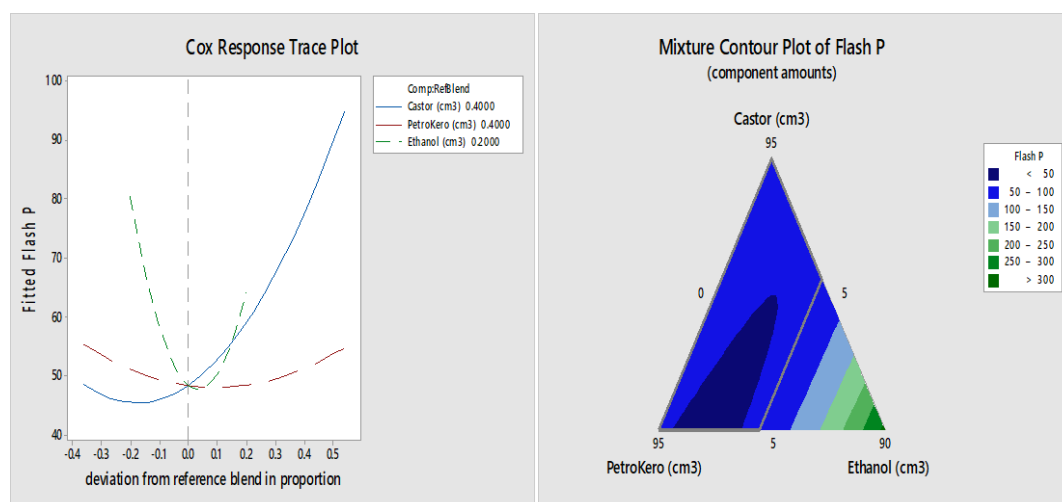
S = 11.1700 PRESS = 5324.67

R-Sq = 69.13% R-Sq(pred) = 60.08% R-Sq(adj) = 64.45%

Key: Castor = A, Petrokero = B and Ethanol = C

Figure 4(a) shows that from the reference blend there is rapid increase in flash point when castor oil increase in proportion and slow decrease when castor oil decrease. As the petrokerosene increase the flash point nearly remain constant before it start to increase and same to same with decrease in petrokerosene. The flash point increases slowly with increase in ethanol proportion and increase rapidly with decrease in ethanol proportion.

Figure 4(a): Cox Plot Response Trace showing Effect of Components on Flash Point and Figure 4(b): Contour Plots Showing Effect of Relative Proportions of the Three components on Flash Point



From the figure 4(b) above the flash point is observed to be high at high proportion of ethanol which is greater than 300 and also it is low is observed at low and high proportion of petrokero which is less than 50.

### Effect of Fire Point Content on the blends

Table 12 shows that, the p values for linear and quadratic (0.000 and 0.000) are statistically significant which indicated that all of the separate components and mix components are less than the common alpha 0.05 and there is significant interaction between the components. Again table 13 describes 74.93% which is statistically good and also indicated that the model fit the data. It also displays that, A\*B is statistically not significant because the p value (0.304) is greater than the alpha value. However, the p value for A\*C and B\*C (0.000 and 0.000) are less than the common alpha level, which indicated that they are statistically significant.

**Table 12: Analysis of Variance for Castor Blends on Fire Point**

| Source            | DF | Seq SS  | Adj SS  | Adj MS  | F     | P     |
|-------------------|----|---------|---------|---------|-------|-------|
| Regression        | 5  | 10007.9 | 10007.9 | 2001.57 | 19.73 | 0     |
| Linear            | 2  | 790.1   | 7311.4  | 3655.72 | 36.03 | 0     |
| Quadratic         | 3  | 4217.8  | 4217.8  | 1405.93 | 13.86 | 0     |
| Castor (*PetroKer | 1  | 4.5     | 110.7   | 110.71  | 1.09  | 0.304 |
| Castor (*Ethanol  | 1  | 1755.3  | 3961.4  | 3961.42 | 39.04 | 0     |
| PetroKer*Ethanol  | 1  | 2457.9  | 2457.9  | 2457.95 | 24.23 | 0     |
| Residual Error    | 33 | 3348.1  | 3348.1  | 101.46  |       |       |
| Lack-of-Fit       | 7  | 3224.8  | 3224.8  | 460.69  | 97.12 | 0     |
| Pure Error        | 26 | 123.3   | 123.3   | 4.74    |       |       |
| Total             | 38 | 13356   |         |         |       |       |

**Table 13: Estimated Regression Coefficients for Castor Blends on Fire Point**

| Term                    | Coef   | SE Coef | T     | P     | VIF    |
|-------------------------|--------|---------|-------|-------|--------|
| Castor (cm3)            | 119.6  | 6.204   | *     | *     | 3.48   |
| PetroKero (cm3)         | 62.3   | 6.204   | *     | *     | 3.48   |
| Ethanol (cm3)           | 377.8  | 58.58   | *     | *     | 81.176 |
| Castor (cm3)*PetroKero  | 28.4   | 27.206  | 1.04  | 0.304 | 3.809  |
| Castor (cm3)*Ethanol    | -598.4 | 95.769  | 6.25  | 0     | 33.119 |
| PetroKero (cm3)*Ethanol | -471.4 | 95.769  | -4.92 | 0     | 33.119 |

S = 10.0727 PRESS = 4356.28

R-Sq = 74.93% R-Sq(pred) = 67.38% R-Sq(adj) = 71.13%

Key: Castor = A, Petrokero = B and Ethanol = C

Figure 5(a) shows that as the jatropha oil increase in the blend, the fire point increase sharply and when the proportion of jatropha oil decreases the fire point also decrease. When the proportion of petrokerosene increases in proportion the fire point decreases gradually and its decrease in proportion result in gradual increase in fire point. The fire point increases slowly with increase in ethanol and increase rapidly with decrease in ethanol proportion.

Figure 5(a): Cox Plot Response Trace showing Effect of Components on Fire Point and Figure 5(b): Contour Plots showing Effect of Relative Proportions of the Three Components on Fire Point

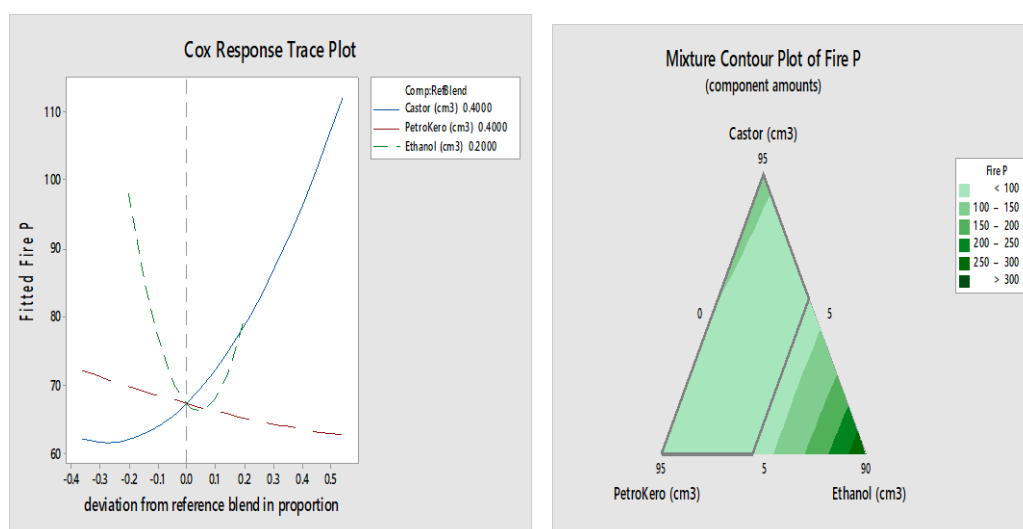


Figure 5(b) describes that the fire point is observed to be high at high proportion of ethanol which is greater than 300 and also it is low is observed at low and high proportion of petrokerosene which is less than 100.

## Conclusions and Recommendations

From the result obtained, it can be concluded that castor oil if appropriately blended can serve as good alternative to petrodiesel. Castor oil, ethanol and kerosene are characterized to be used in the preparation of fuel similar to petrodiesel by blending. However, in the modeling experiment that was statistically analysed and optimized, castor oil blends were found to have similar properties with petrodiesel. Considering results obtained from the Castor oil blend with kerosene and ethanol being analysed, the following recommendations are put forward:

- I. The samples that fall within the ranges should be further analyzed using engine test for confirmation.
- II. The samples that do not fall within the ranges should not be used in the blending for further analysis.
- III. Government and private sector should invest and assist on the cultivation of the castor to encourage petrodiesel production by blending.
- IV. Further research should be done on castor blend with different petroleum products and different alcohol.
- V. Water content by distillation should be carried out for further investigation

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### Appendix

#### Density for references

| S/N | Name of sample | SG    | T°C  | CSG(g/cm <sup>3</sup> ) |
|-----|----------------|-------|------|-------------------------|
| 1   | Castor oil     | 0.946 | 29   | 0.9549                  |
| 2   | Petrokerosene  | 0.771 | 29   | 0.7813                  |
| 3   | Ethanol        | 0.865 | 26.5 | 0.8725                  |
| 4   | AA Rano        | 0.850 | 29   | 0.8592                  |
| 5   | U Gostu        | 0.853 | 28.5 | 0.8618                  |
| 6   | SAK            | 0.840 | 28.5 | 0.8489                  |

#### Kinematic viscosity for references

| S/N | Samples            | Viscosity      | Reading | Sec     | D | Mean    | Constant | KV@40°Cst |
|-----|--------------------|----------------|---------|---------|---|---------|----------|-----------|
| 1   | Castor oil         | 200dm<br>1335  | 28.1329 | 1693.29 | 3 | 1713.22 | 0.10628  | 182.08    |
|     |                    |                | 28.4934 | 1729.34 |   |         |          |           |
|     |                    |                | 28.3703 | 1717.03 |   |         |          |           |
| 2   | Petrokero          | 150dm<br>11258 | 0.4528  | 45.28   | 3 | 45.23   | 0.03883  | 1.76      |
|     |                    |                | 0.4507  | 45.07   |   |         |          |           |
|     |                    |                | 0.4534  | 45.34   |   |         |          |           |
| 3   | Ethanol            | 150dm<br>F882  | 0.4024  | 40.24   | 3 | 39.7    | 0.03772  | 1.49      |
|     |                    |                | 0.3938  | 39.38   |   |         |          |           |
|     |                    |                | 0.3947  | 39.47   |   |         |          |           |
| 4   | Diesel A<br>A Rano | 150dm<br>F882  | 2.1074  | 130.74  | 3 | 134.14  | 0.03772  | 5.05      |
|     |                    |                | 2.1504  | 135.04  |   |         |          |           |
|     |                    |                | 2.1664  | 136.64  |   |         |          |           |
| 5   | Diesel U<br>Gostu  | 150dm<br>1383  | 4.2183  | 261.83  | 3 | 263.12  | 0.03894  | 10.25     |
|     |                    |                | 4.2488  | 264.88  |   |         |          |           |
|     |                    |                | 4.2266  | 262.66  |   |         |          |           |
| 6   | Diesel<br>SAK      | 150dm<br>11255 | 13.0439 | 784.39  | 3 | 740.51  | 0.03875  | 28.69     |
|     |                    |                | 11.5811 | 718.11  |   |         |          |           |
|     |                    |                | 11.5904 | 719.04  |   |         |          |           |

| S/N | Parameter                   | Standard      | Blends        |
|-----|-----------------------------|---------------|---------------|
| 1   | Density(g/cm <sup>3</sup> ) | 0.840-0.853   | 0.781-0.951   |
| 2   | Sulphur content             | 0.2406-0.2493 | 0.0153-0.0293 |
| 3   | Kinematic Viscosity(cSt)    | 5.05-28.69    | 2.084-176.44  |
| 4   | Flash point(°F)             | 54-82         | 32-107        |
| 5   | Fire point(°F)              | 84-182        | 46-123        |



## FISH QUALITY LOSSES EVALUATION IN TAGWAI LAKE, NIGER STATE, NIGERIA

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### Abstract

The research was made to evaluate the sensory and quality losses of fish in Tagwai Lake from the point of capture to time of storage and consumption. Twenty four Tilapia fish (*Oreochromis niloticus*) samples were preserved in a Refrigerator during assessment of quality losses. Four fish were randomly sampled on 0, 3, 6, 9, 12 and 15 days respectively for sensory Evaluation and Biochemical Analysis using pH and TVB-N. One – way analysis of Variance and correlation analysis revealed that there were changes in the correlation and sensory evaluation scores of all fish sensory parameters which significantly increased ( $p > 0.05$ ) as a result of increase in number of days and time of storage meaning that fish spoilage and quality losses increased with the length of fish storage. There were also significant difference ( $p > 0.05$ ) in the mean pH and TVB-N of the fish sold around Tagwai Lake. The fish quality losses had been attributed to poor storage facilities, bad handling and inadequate refrigeration. Good fishery policy to improve declining fishery resources of Tagwai Lake was therefore recommended.

**Keywords:** Tilapia fish, Evaluation, Sensory & quality losses, Biochemical analysis, Tagwai Lake

### 1.0 INTRODUCTION

Freshness is one of the most significant things to look for in fish of good quality. Sensory methods (e.g. quality index method) and instrumental methods (e.g. chemical, physical and bacteriological analysis) are usually employed to measure the degree of fish quality (Lillian, 2010). Sensory analysis is suitable and indeed inevitable for enhancement of fish product. Fish is often considered to be a good supplier of protein needed for normal body growth and maintenance of good health (Asma, 2015). However the fact remains that it is easily spoiled, very susceptible to oxidation and often developing off-flavours due to wrong handling or poor storage. The preservation of fish high nutritional quality is usually affected by several parameters such as the fish diet, handling and storage. Quality losses can take place in fresh fish. Fish processing is no exclusion and in conventional techniques, the losses may be severe (Mgawe, 2008; Kumolu-Johnson and Jimoh, 1997). As fish spoils, it will result to a loss in its quality value. The bacterial responsible for the spoilage destructively feasts on the fish protein content expected to be the major human food and produce nitrogenous substances with unpleasant odours. The level of acceptability and attractiveness of the affected fish will significantly decline because there is too much quality damage. It could be more noteworthy in freshwater fish, when less violent ammoniacal odours are produced than in marine fish, where Trimethylamine and its breakdown products rapidly impart strong odours (Ames et al., 1991) cited by (Oyero and Oladele, 2016). Bacterial spoilage in fresh fish can generate toxins which cause food poisoning. Pathogenic bacterial contamination of fresh fish caused by poor handling and washing the fish in polluted water can also cause food poisoning. The objective

of this research study is to evaluate fish sensory and quality losses in *Oreochromis niloticus* obtained from Tagwai Lake, Minna, Niger State.

## 2.0 Materials and Method

### 2.1 Description of the Study Area

The samples for the research study were collected from Tagwai Lake, located in Chanchaga Local Government Area; South West Zone of Minna. It is the major source of water supply to Minna metropolis. The Lake lies on Latitude  $9^{\circ}9'33.55''$  to  $9^{\circ}9'36.07''$ N and longitude  $6^{\circ}6'39.20''$  to  $6^{\circ}6'39.58''$  E (Muhammed, A.K. et al., 2014). The Lake is east of Tunga Goro about 10km south-east of Mobil Market and North-East of Paiko.

Other Communities around Tagwai Lake include Tunga-Goro, Kadna, Gidan Mangoro, Tunga Boka, Tunga Waya and Kasabo, which is the closest to the Lake. The activities of people within the Lake environment are mainly farming and fishing. The Lake is under the care of Niger State Water Board, which serves as a primary reservoir for the city of Minna, the largest metropolis in Niger State.

### 2.2 Fish Sampling and Preparation

Twenty four fresh Tilapia were procured from fishermen around 3.p.m at Tagwai Lake area of Niger State and was immediately conveyed in Polythene Bag filled with water to the Laboratory belonging to the Department of Water Resources, Aquaculture and Fisheries Technology, Minna. Upon arrival at the laboratory, the fish were stored in a refrigerated chamber ( $0-2^{\circ}2^{\circ}$ C) for 15 days. During storage, draining and addition of ice were conducted every 24 hours. Four fish were removed for sampling at 0, 3, 6, 9 12, and 15 days of storage and used for chemical and sensory analyses. Sensory analyses were performed by a panel of ten experienced assessors, as samples were obtained at selected time intervals. Organoleptic assessment was carried out using the Quality Index Method (QIM) by Massa *et al.*, (2005). The scheme employed the main three quality parameters which include general appearance (skin colour, stiffness, belly, and smell), eyes (clarity/colour, shape) and gills (gill colour and smell) respectively. The excellent freshness quality fish ranked with Quality Index demerit score between 0 – 1, fish of good quality 1 – 2 and deteriorated fish would have the scores of 2 -3. The scores of the separate characteristics were added to give an overall sensory score (Total QIM score). For biochemical analyses, the pH and Total Volatile Based Nitrogen test (TBV-N) were experimented using the procedures described by Goulas and Kontominas (2005).

### 2.3 Results

Table 2.1 showed that the demerit score of the fish skin colour, stiffness, belly, smell, eye clarity/colour, shape, gill colour and gill smell significantly increased in the time (in days) order:  $0 > 3 > 6 > 9 > 12 > 15$ . The correlation between the time in days and the QIM score for all the fish sensory parameters were strong, highly significant and positive which implied that as the time increased, the demerit score significantly increased. Figure 2.1, 2.2 and 2.3 respectively showed the changes in the score of general appearance, eyes and gills of Tilapia obtained from Tagwai Lake. During the 15 days of post mortem storage, the fish underwent noticeable changes in general appearance (skin colour, stiffness, belly, and smell), eyes (clarity/colour, shape) and gills (gill colour and smell). Table 2.1 showed that after 9 days of storage, the total QIM score was above 2 point, with this value, the fish was considered unacceptable by the members of the panel. At the end of storage, all fish showed eyes completely sunken with gray pupil and milky cornea and brownish-yellowish gills with very unpleasant odour.

Table 2.2a revealed that there were significant differences in the mean pH and TVB – N of the fish sold around Tagwai Lake ( $p < 0.05$ ). Table 2.2b showed that the pH and TVB – N of the fish had strong, highly significant and positive correlation with time of storage which implied that the pH and TVB – N increased as the time after catching the fish increased from 0 to 15 days. From Table 2.2a, ANOVA revealed that the pH of fish at days 9, 6 and 3 were not significantly different from each other but were significantly higher than that of the fresh fish. The TVB – N of the fish significantly increased as the test time increased except those of the fresh and 3<sup>rd</sup> day which were not significantly different from each other.

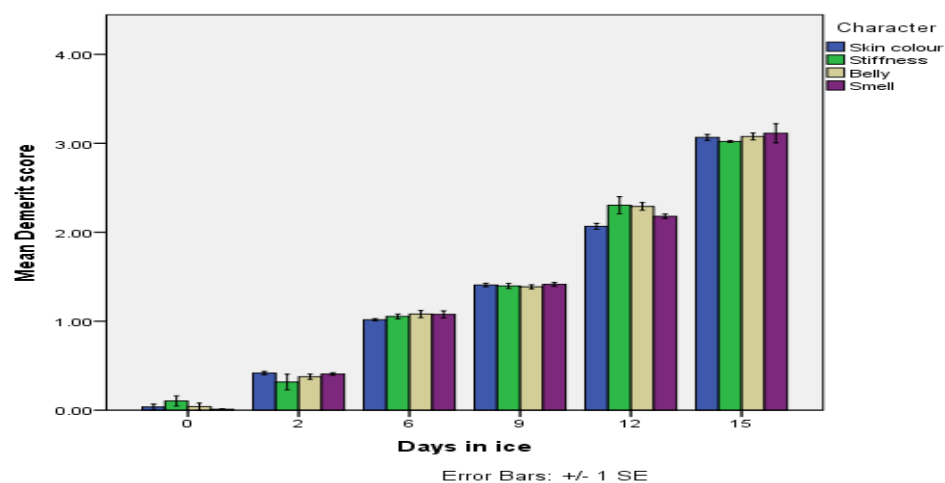
**Table 2.1: Demerit score of fish stored for 15 days (Sensory Evaluation)**

| Days                                                                    | Skin colour       | Stiffness         | Belly             | Smell             | Eye clarity<br>/ colour | Shape             | Gill colour       | Smell             | Significance<br>at 95% CI |
|-------------------------------------------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------------|-------------------|-------------------|-------------------|---------------------------|
| 0                                                                       | 0.04 <sup>f</sup> | 0.10 <sup>f</sup> | 0.04 <sup>f</sup> | 0.01 <sup>f</sup> | 0.01 <sup>f</sup>       | 0.05 <sup>f</sup> | 0.01 <sup>f</sup> | 0.05 <sup>f</sup> | *                         |
| 3                                                                       | 0.42 <sup>e</sup> | 0.32 <sup>e</sup> | 0.38 <sup>e</sup> | 0.41 <sup>e</sup> | 0.32 <sup>e</sup>       | 0.39 <sup>e</sup> | 0.38 <sup>e</sup> | 0.25 <sup>e</sup> | *                         |
| 6                                                                       | 1.02 <sup>d</sup> | 1.05 <sup>d</sup> | 1.08 <sup>d</sup> | 1.08 <sup>d</sup> | 1.09 <sup>d</sup>       | 1.07 <sup>d</sup> | 1.08 <sup>d</sup> | 1.09 <sup>d</sup> | *                         |
| 9                                                                       | 1.41 <sup>c</sup> | 1.40 <sup>c</sup> | 1.39 <sup>c</sup> | 1.41 <sup>c</sup> | 1.39 <sup>c</sup>       | 1.40 <sup>c</sup> | 1.36 <sup>c</sup> | 1.39 <sup>c</sup> | *                         |
| 12                                                                      | 2.07 <sup>b</sup> | 2.03 <sup>b</sup> | 2.29 <sup>b</sup> | 2.18 <sup>b</sup> | 2.32 <sup>b</sup>       | 2.28 <sup>b</sup> | 2.34 <sup>b</sup> | 2.14              | *                         |
| 15                                                                      | 3.07 <sup>a</sup> | 3.02 <sup>a</sup> | 3.08 <sup>a</sup> | 3.11 <sup>a</sup> | 3.09 <sup>a</sup>       | 3.14 <sup>a</sup> | 3.07 <sup>a</sup> | 3.07 <sup>a</sup> | *                         |
| Correlation coefficient<br>(with days)                                  | 0.984**           | 0.985**           | 0.987**           | 0.985**           | 0.988**                 | 0.984**           | 0.986**           | 0.985**           |                           |
| Correlation coefficient<br>(Days vs. QIM scores for<br>sensory quality) | 0.985**           | 0.984**           | 0.986**           | 0.987**           | 0.989**                 | 0.986**           | 0.988**           | 0.986**           |                           |

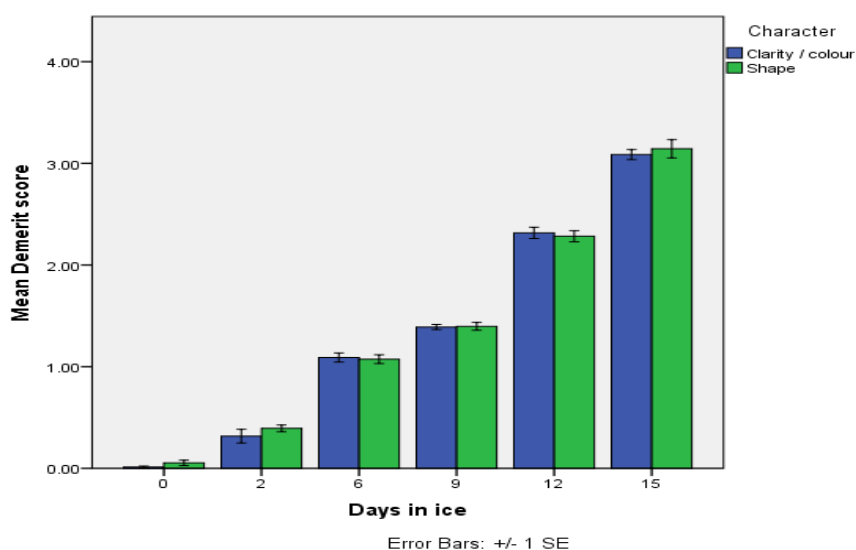
Means on the same column with different superscript are significantly different ( $p < 0.05$ )

\*Significant at 5% level

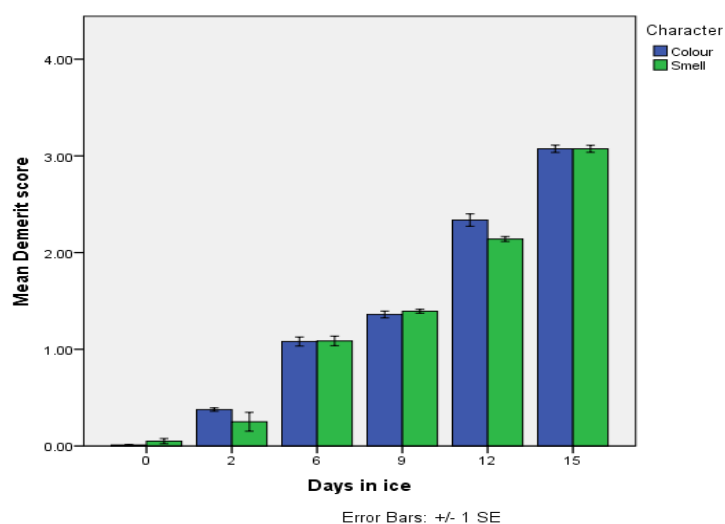
\*\*Correlation is significant at 1% level



**Figure 2.1: Demerit Score for the General Appearance of Fish**



**Figure 2.2: Demerit Score for the Eye of Fish**



**Figure 2.3: Demerit Score for the Gill of Fish**

**Table 2.2: pH and TVB – N of fish for the period of 15 days**

| Days | pH                 | TVB – N            |
|------|--------------------|--------------------|
| 0    | 6.53 <sup>d</sup>  | 6.95 <sup>e</sup>  |
| 3    | 6.82 <sup>c</sup>  | 8.41 <sup>d</sup>  |
| 6    | 6.85 <sup>bc</sup> | 8.55 <sup>d</sup>  |
| 9    | 6.87 <sup>bc</sup> | 11.43 <sup>c</sup> |
| 12   | 6.9 <sup>ab</sup>  | 13.60 <sup>b</sup> |
| 15   | 6.94 <sup>a</sup>  | 15.40 <sup>a</sup> |

Means on the same column with different superscript are significantly different ( $p < 0.05$ )

## Discussion

During the 15 days of post mortem storage, the fish had gone through series of obvious changes in general appearance (skin colour, stiffness, belly, and smell), eyes (clarity/colour, shape) and Gills (gill colour and smell). After 9 days of storage, the total QIM score was above 2 point, with this value, the fish was considered unacceptable by the panel. According to Martindottir et al. (2001), the increase in the scores for the sensory parameters considered in the QIM scheme shows loss of freshness hence deterioration in fish quality. According to the results of study there is an increase at pH content because of nitrogenous substances that fish include depends on storage duration. According to the literature, the pH is about 6.0–6.5 for fresh fish, and it increases during storage. The limit of acceptability is usually 6.8–7.0. Increase may also be due to an increase in volatile bases from the decomposition of nitrogenous compounds by endogenous or microbial enzymes (Erkan and Ozden, 2008). However, post-mortem pH can vary considerably depending on the season, the species, and other factors (Yunus et al. 2011). The initial lower levels of TVBN observed could be attributed to lower levels of endogenous ammonia due to slower microbial breakdown of proteins during the first 9 and 12 days of storage in ice (Pacheco-Aguilar et al. 2000). The formation of TVBN is associated with the activity of micro-organisms and tends to be high at high microbial populations as observed by (Benjakul et al., 2004) and (Chytiri et al., 2004). There were significant differences in the mean pH and TVB-N of fish sold around Tagwai Lake ( $p < 0.05$ ) as the storage days increased. Therefore to significantly curtail nutritional losses in and around Tagwai Lake, Fish should be effectively handled on board by gutting, washing and storing in clean boxes or containers. Fish should be wrapped in wet jute bags to prevent flies capable of spoiling the fish and to facilitate evaporative cooling. Fish sellers buying fish from fishermen in Tagwai Lake should use ice block to preserve the quality of the harvested fish before reaching their shops or markets and even before further fish preservation and processing. There should be training of fisher folks on suitable procedures for fish handling, processing and marketing. This will considerably lessen fish spoilage on the Lake.

#### 4. Appendices

##### APPENDIX A

##### DEMERIT (QIM) SCORES OF FISH FOR 15 DAYS

| DAY       |                  | 0        | 3        | 6        | 9        | 12       | 15       |
|-----------|------------------|----------|----------|----------|----------|----------|----------|
| DATE      |                  | 14/08/14 | 16/08/14 | 19/08/14 | 22/08/14 | 25/08/14 | 28/08/14 |
| REPLICATE | XY(1)            | XY(2)    | XY(3)    | XY(4)    | XY(5)    | XY(6)    |          |
| GENERAL   | GA Skin Colour   | 0.06     | 0.42     | 1.02     | 1.41     | 2.07     | 3.07     |
| APPEA-    | GA Stiffness     | 0.16     | 0.32     | 1.05     | 1.40     | 2.30     | 3.14     |
| RANCE     | GA Belly         | 0.12     | 0.38     | 1.08     | 1.39     | 2.29     | 3.08     |
| (G.A)     | GA Smell         | 0.02     | 0.41     | 1.08     | 1.41     | 2.18     | 3.11     |
| EYES      | E Clarity/Colour | 0.02     | 0.32     | 1.09     | 1.39     | 2.32     | 3.09     |
| (E)       | E Shape          | 0.08     | 0.39     | 1.07     | 1.40     | 2.28     | 3.14     |
| GILLS     | Gill Colour      | 0.02     | 0.38     | 1.08     | 1.36     | 2.34     | 3.07     |
|           | Gill Smell       | 0.08     | 0.25     | 1.09     | 1.39     | 2.14     | 3.07     |
| QIM       | QIM Scores       | 0.56     | 2.87     | 8.56     | 11.15    | 17.92    | 24.77    |
|           | Mean(X)          | 0.07     | 0.36     | 1.07     | 1.39     | 2.24     | 3.10     |

## APPENDIX B

## pH AND TVB-N FOR THE PERIOD OF 15 DAYS

| DAY             | DATE              | REPLICATE(XY) | pH   | TVB-N (MgN/100g) |
|-----------------|-------------------|---------------|------|------------------|
| <b>0</b>        | <b>14/08/2014</b> | x1y1          | 6.50 | 6.40             |
| “               | “                 | x1y2          | 6.49 | 6.94             |
| “               | “                 | x1y3          | 6.61 | 7.52             |
| <b>MEAN(XY)</b> |                   | <b>XY(1)</b>  | 6.53 | 6.95             |
| <b>2</b>        | <b>16/08/2014</b> | x2y1          | 6.80 | 8.40             |
| “               | “                 | x2y2          | 6.81 | 8.42             |
| “               | “                 | x2y3          | 6.84 | 8.40             |
| <b>XY</b>       | “                 | <b>XY(2)</b>  | 6.82 | 8.40             |
| <b>6</b>        | <b>19/08/2014</b> | x3y1          | 6.85 | 8.42             |
| “               | “                 | x3y2          | 6.83 | 8.63             |
| “               | “                 | x3y3          | 6.87 | 8.59             |
| <b>XY</b>       | “                 | <b>XY(3)</b>  | 6.85 | 8.55             |
| <b>9</b>        | <b>22/08/2014</b> | x4y1          | 6.85 | 11.20            |
| “               | “                 | x4y2          | 6.89 | 11.60            |
| “               | “                 | x4y3          | 6.86 | 11.50            |
| <b>XY</b>       | “                 | <b>XY(4)</b>  | 6.87 | 11.43            |
| <b>12</b>       | <b>25/08/2014</b> | x5y1          | 6.88 | 12.60            |
| “               | “                 | x5y2          | 6.95 | 15.40            |
| “               | “                 | x5y3          | 6.86 | 12.80            |
| <b>XY</b>       | “                 | <b>XY(5)</b>  | 6.90 | 13.60            |
| <b>15</b>       | <b>28/08/2014</b> | x6y1          | 6.93 | 14.15            |
| “               | “                 | x6y2          | 6.95 | 16.56            |
| “               | “                 | x6y3          | 6.94 | 15.50            |
| <b>XY</b>       | “                 | <b>XY(6)</b>  | 6.94 | 15.40            |



## APPENDIX C

**Freshness Ratings using the Quality Assessment Scheme to identify the  
Quality Index Demerit Score (Massa *et al.* 2005).**

**SENSORY CHARACTERISTICS AND SCORES USED IN THE PANEL SCORE SHEET**

| General    |                |                                  |   |
|------------|----------------|----------------------------------|---|
| Appearance | Skin colour    | Bright, iridescent pigmentation  | 0 |
|            |                | Bright but not lustrous          | 1 |
|            |                | Dull, becoming discolored        | 2 |
|            |                | Dull and discolored pigmentation | 3 |
|            | Mucus          | Clear, not clotted               | 0 |
|            |                | Slightly milky                   | 1 |
|            |                | Milky, opaque                    | 2 |
|            |                | Yellowish gray and clotted       | 3 |
|            | Stiffness      | Rigid (fish still in rigor.)     | 0 |
|            |                | Firm and elastic                 | 1 |
|            |                | Slightly soft, less elastic      | 2 |
|            |                | Very soft                        | 3 |
|            | Belly          | Firm elastic, normal burged      | 0 |
|            |                | Firm/flat concave                | 1 |
|            |                | Soft                             | 2 |
|            |                | Belly burst                      | 3 |
| Eyes       | Colour/Clarity | Black, bright pupil              | 0 |
|            |                | Dull, black pupil                | 1 |
|            |                | Mat Cornea, opaque pupil         | 2 |
|            |                | Milky cornea, grey pupil         | 3 |
|            | Shape          | Convex                           | 0 |
|            |                | Convex but slightly sunken       | 1 |
|            |                | Flat                             | 2 |
|            |                | Sunken                           | 3 |

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|       |        |                                    |   |
|-------|--------|------------------------------------|---|
| Gills | Colour | Bright/red                         | 0 |
|       |        | Faded, less discoloured            | 1 |
|       |        | Discoloured opaque                 | 2 |
|       |        | Brown, yellowish, gray             | 3 |
|       | Odour  | Fresh marine and seaweed-like      | 0 |
|       |        | Neutral                            | 1 |
|       |        | Slight rancid, unpleasant smell    | 2 |
|       |        | Very unpleasant smell/stale        | 3 |
|       | Mucus  | Not mucus                          | 0 |
|       |        | Slight traces of milk mucus        | 1 |
|       |        | Yellowish, brown, slightly clotted | 2 |

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## IMPACT OF PUBLIC REALATIONS ON UNIVERSITY LIBRARY SERVICES: A CASE STUDY OF FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA LIBRARY

BY

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### Abstract

*This research work was carried out to find out the Impact of Public Relations on University Library Services a case study of Federal University of Technology, Minna Library. The research work tends to find out what impact public relations have on FUT, Minna Library Services. The objectives of this research work amongst others includes; to find out the Impact of Public Relations on FUT, Minna Library Services, to find out the Role of Exhibition of Library Resources in Public Relations. The research design used for this study was the descriptive survey design. A questionnaire was used as an instrument for data collection for the study. A total of 340 copies of questionnaire were distributed, out of these, 313 copies of the questionnaire were retrieved and analyzed. The findings from the data collected shows that the library staff and undergraduate students agreed that public relations have impact on FUT, Minna Library Services, library staff and undergraduate students agreed that exhibition of library resources play a very vital role in public relations, from this study, it shows that the library lacks adequate public relations methods and tools such as billboards, posters and flyers etc. The study also show that both library staff and undergraduate students agreed that circulation and reference units play important role in public relations activities. It was therefore recommended that the management of the library should ensure that relevant information resources are made available and be updated regularly to encourage users in coming to the library to utilize those resources; the library should try and organize in-house workshop and seminars on public relations for the library staff to further improve the quality of their services; and library staff should show positive attitude, better interpersonal communication, better patron's orientation, efficiency and smile whenever they are approached by the patrons for complaints among other.*

**Keyword:** Impact, Public, Public Relations, University, Library, Library Services

### 1. Introduction

The economic growth of any nation depends on the adequate manpower in various sectors within such nation. It is therefore paramount to provide adequate manpower in various sectors of the economy to boost economic growth of any nation. To be able to provide such manpower, universities are established in a nation to train people in various fields of study who will in turn work in various sectors of the economy.

The importance of universities in any nation cannot be overemphasized as they provide not only the high-level skills necessary for every labor market but also training essential for teachers, doctors, nurses, civil servants, engineers, humanists, social scientists, and other personnel.

However, for any university to exist there must be a library established alongside with such university to cater for the information resources relevant for the research and development of staff, students and members of the community. Such library is called an academic library that

is defined as that type of library established in the institutions of higher learning such as universities, polytechnics and colleges of education. The academic library is seen as the heart of the learning community, providing a place for students and faculty to do their research and advance their knowledge. Academic library in any institution is charged with the responsibility of providing services to its patrons. Some of these services include reference services, current awareness services, indexing and abstracting services and etc.

Aina (2014) stated that “the main purpose of academic library is to support the objectives of an academic environment in the areas of learning, teaching, research and service. A library has been defined by various authorities. For instance, it is regarded as a collection of information resources which had been gathered, processed and organized for effective accessibility. This shows that various effort have been put in place in the course of selection, acquisition, processing, preservation, conservation, cataloguing and classification etc. These efforts are likely to be in waste if the relevant materials gathered in the library or information centers are not adequately patronized or utilized. This is because human, financial and material resources have actually being devoted towards a good collection rather than the use of those collections and this is pointing to a waste. To withstand the challenges of non- use or ineffective utilization of the information resources, public relations become very imperative. This entails that the resources and services of the library required to be adequately promoted, projected, stimulated, facilitated, etc. for effective accessibility and utilization. To meet the target goal, it is mandatory to any library especially a university library to devote much time or effort towards public relations.

The term public relations can be defined as a way of creating the awareness of the resources, functions and services of the library to the users and by so doing, the image of the library is being promoted or projected. Reitz (2014) defined public relations “as publicity designed to create public opinion and boost awareness of library services, resources, and programs and promotes the interest of libraries in society”

The practice of public relations has been on since the dawn of recorded history. Public relations is essential to human existence and communal living. Although modern public relations evolved in the 20th century it has ancient roots. In virtually every great society through history, the leaders understood the importance of influencing public opinion through persuasion.

Seitel (2011) recalls that archeologists found a farm bulletin in Iraq that told farmers of 1800 B.C. the latest techniques of harvesting, sowing and irrigating. The aim of the persuasion was that the more food farmers grew, the better the citizenry are and the wealthier the country became. This was planned persuasion to reach a specific public for a particular purpose, in other words, public relations. As Edward Bernays has observed, ‘the three main elements of public relations which are informing people, persuading people and integrating people with people are practically as old as society. The force of public relations was visible in ancient Rome. This can be deduced from the common phrase, *Vox Populi, Vox Dei* (the voice of the people is the voice of God). Julius Caesar, one of the greatest of the Roman emperors, is said to be a particularly master in the persuasive technique. When faced with an upcoming battle, Caesar would rally public support through assorted publications and staged events (typical of modern public relations techniques).

In ancient Greece, a high premium was placed on communication skills. The best speakers were generally elected to leadership positions. Greek politicians enlisted the aid of sophists (individuals with rhetorical prowess) to help fight verbal wars. This can be likened to the lobbyists of today who attempt to influence legislation through effective communication techniques. Cutlip, Centre and Broom state that rudimentary elements of public relations

appear in descriptions of the king's spies in India. Apart from espionage the duties of the Spies included keeping the king in touch with public opinion, championing the king in public and spreading rumors favorable to the government. Equally, public relations was used many centuries ago in England where the kings maintained Lords Chancellor as "keepers of the king's conscience", as there was an acknowledge need for a third party to facilitate communication and adjustment between the government and the people. The spread of Christianity in the middle ages could be likened to the use of public relations in modern times. Under the leadership of Pope Gregory XV, the Catholic Church established a college of propaganda to help propagate the faith. The committee of cardinals knew as congregation de Propaganda Fide (the congregation for the propagation of faith). The church simply wanted to inform the public about the advantages of Catholicism. This was the origin of propaganda and it has been suggested that the roots of public relations lie in the development of propaganda. Efforts to communicate with the force of public opinion go back to antiquity, only the tools, degree of specialization breadth of knowledge, and intensity of effort are relatively new. In the words of Cutlip, Centre and Broom public relations has existed since the dawn of mankind. From crude methods in primitive society, PR has followed trends in civilization advancement in culture has resulted in more sophisticated method of PR. Public relations have been in existence in Nigeria since the creation of man. It was practiced in rudimentary forms by traditional rulers through town criers who disseminated information from the traditional authority to the people. Even during the colonial era, the colonial government resorted to liaising with traditional rulers so as to maintain touch with the people. Daramola (2013) has suggested, the indirect rule system employed by the colonial government in Nigeria was a crude or primitive form of public relations practice. Formal public relations was said to have been introduced in Nigeria in 1924 when Major Lawrence Thorp planned and staged Nigeria's exhibition during the Empire day. He was said to have used propaganda and information to publicize Nigeria's involvement as well as mobilize Londoners to visit its stand.

### **Statement of the Problem**

The impact of public relations on university library services cannot be overemphasized as it helps in the creation of awareness of the library resources and services to the users. Public relations activities are very important in any academic library. It is the only way through which the image of the library can be promoted or projected. Unfortunately there are factors affecting public relations activities in most university libraries in Nigeria. Such as lack of proper public relations tools, inadequate relevant information resources etc. Therefore, this research is aimed at finding out the impact of public relations on university library services using FUT, Minna as the case study and the techniques to be used to ensure proper public relations activities in university libraries.

### **Objective of the Study**

The main objective of the study is to find out the impact of public relations on university library services. Specifically the objectives are:

1. To find out the impact of public relations on FUT, Minna library services.
2. To find out the role of exhibition of library resources in public relations activities
3. To find out Methods and Tools of Public Relations used in FUT, Minna Library

### **Research Questions**

The following research questions are set out to guide the study

1. What impact does Public Relations has on FUT, Minna library services?

2. What role does library exhibition play in Public Relations activities in FUT Minna library services?
3. What are the Methods and Tools of Public Relations used in FUT, Minna Library?

### **Significance of the Study**

The study is very important to both students and staff of library and information technology department, the university and the society at large. It impacts useful knowledge on the impact of public relations on university library services to the undergraduates which could be useful to them now and in the future.

### **Scope and Limitation of the Study**

The scope of the study is limited to the impact of public relations on university library services with Federal University of Technology, Minna library as the case study.

## **2. Related Literature**

### **Concept of Public Relations**

Public Relations can be defined as an interaction between the library staff and their patrons. It is a way of promoting or advertising the resources and services of the library to the users. Public relations is the practice of managing the spread of information between an individual or an organization and the public. Public relations may include an organization or individual gaining exposure to their audiences using topics of public interest and news items that do not require direct payment (wiki, 2014). Namara (2010) defines public relations includes ongoing activities to ensure the overall organizations has a strong image. Namara (2010) opined that public relations are conducted through the media e.g. newspapers, television and radio etc. the target audiences in public relations activities according to Kunaka (2018) are policy makers, library users, potential library users and professional associations. Gurel (2018) says parallel with the developing importance given to visitors and their experience in the library, library public relations has developed from a communication function to an image or perception function.

According to Paul Christ (2019), public relations involves the cultivation of favorable relations for organizations and products with its key public through the use of a variety of communication channels and tools such as media relations, media tours, newsletters, special events and sponsorships. PR building awareness and a favorable image for a company or client within stories and articles found in relevant media outlets and closely monitoring numerous media channels for public comments about a company and its products. Further, PR supports marketing by managing crisis that threaten company or product image and by building goodwill among an organization's target market through community, philanthropic and special programs and events.

Inazu (2019) viewed public relations as a major component of marketing. It is a channel of creating a personal relationship between the potential patrons and the library or librarian. In order to successfully promote the value of products and services the librarian should engage in personal advocacy.

Murray (2018) defined public relations as the practice of creating, promoting, or maintaining goodwill and a favorable image among the public toward an institution.

According to Gupta, (2014) the objectives of public relations programs to library are:

- Creating library consciousness among the people of the community;



- Spotlighting the existence of libraries, where they are located, what do they contain, and identify the services they can render to help the people in their informal self-education;
- Enriching and further develop the subjects on which individual are undertaking formal education to help people remain informed;
- Assisting client in constructive use of leisure hour;
- Helping client to become good citizens;
- Helping people to be well informed;
- Helping clients to appreciate the value of democracy and human rights and
- Increasing the theoretical knowledge of their vocations.

### **Importance of Public Relations to Libraries**

The importance of public relations to university libraries cannot be overemphasized as it is the best way through which university libraries can inform their users about their services, resources and policies of the library. In this context, Odede (2012) stated the importance of public relations to libraries to include the followings:

- Public relations influences and create confidence for library services in the public in various ways, such as making public aware of the services and policies of the library. At the same time assist the public to develop knowledge and understanding of a new reorganization or new initiative introduced by the library.
- Public relations help in opening the worlds of books and knowledge better and more completely than would otherwise be possible by bringing together client, collections and services. It helps to make better contact between the library staff and the public so that what is known can be enlarged upon and used more fully.
- Public relations bring about cooperation among professional colleagues creating a sense of oneness thereby improving relationship. This relationship can lead to mutual collaboration when one library receives and extends service help from and to another library.
- Public relations helps to make better contact between the librarians and the public, this gives the librarian opportunity to create good image of the library which can lead to an increase in the utilization of library services.
- In libraries, there is a tendency for users especially students to be stuck in grooves and become dull and lazy about their academic work. A public relations program that is well conceived and carried out can help correct such negative tendencies and become a means of engaging people to creating better harmony.
- Public relations help to keep tab on the external environment so as to gather outside opinion/comments and pass on this information to the library management for consideration and necessary action.
- Public relation practices in libraries will help to keep various public informed about the policy, functions, and services of the library as well as increase the staff knowledge and understanding.
- Good public relations program will help the library get support from the government, the parent organization and the public in terms of personnel, budgets and equipment. It is believed that improving librarians living and working conditions depends to a great extent on librarians themselves persuading, explaining and bargaining.
- Quite a number of new client do not know what a library is? What services it provides? Or what benefits they can gain from it, public relations will help publicize and market the function and services of the library.

- Most libraries' social image is not very possible. Public relations as the art of portraying an image should change what people formally thought of the library by improving our services and communicating with the readers in order to enlarge the library's influence with the society.

### **Library Resources Exhibition roles in Public Relations**

History has it that as early as 1876, librarians introduced marketing techniques in the library profession (Kumar, 2015). Librarians were innovative, goal getters and serious about library and information service business at that time, different strategies were adopted in wooing library users. Some of the strategies deployed include banners, streetcar signs, direct mail, telephone solicitation and exhibition. Though all these were not formerly introduced until 1970s when formal marketing started taking place. Advertising surfaced only in public library articles in 1896 (Gupta and Savard, 2010), because libraries must develop new promotional strategies to reach out to current and potential users (Schmidt, 2007) exhibition became the instrument of promotional and marketing communication in libraries. Exhibition is defined as a public display of books, artifacts, objects, and other materials. Exhibitions can be online, physical or a combination of the two and of any scale or duration, within the literature it is obvious that library exhibitions fall into two major types: physical and online. The exhibition construct has been chosen over display, as exhibition is more encompassing; the word is inclusive of both large scale exhibitions as well as small displays (Williams, 2011). Velarde (2001) averred that regardless of the category or purpose, all exhibitions deal with the same elements: information, people, objects and space. Exhibition is part of marketing or advertisement strategies library and information centers adopt to promote their services and resources. Brochures containing information, flyers, pamphlets, posters are displayed in designated areas within the libraries. Williams (2011) citing Schaeffer (1991) posited that exhibitions are adjudged to be a major promotional instrument within a library's marketing strategy, as exhibitions are one of the most visual means of showcasing what the library can offer.

The exhibition of materials from their holdings is a common technique adopted by libraries to advertise their collections and services. On few occasions, mostly during workshops, seminars and book launch, vendors or publishers are requested to exhibit their products. There are policies guiding display and exhibition. Exhibition and display are programs designed to get reader's attention and stimulate their interest and quest for information. Libraries need to enhance the marketing strategies of the services and collections in order to remain relevant in the 21st century (Giuliano, 2010). Libraries have been exploring different strategies to market their services such as newsletters, orientation programs, notice board, meetings and university gatherings to sensitize members, training programs, flyers, poster, in-house newsletters, local press, billboards, posters, on-screen announcements, radio, cinema advertisements, Television commercials, and networks. In-house information services are commonly used through leaflets and brochures, which are aimed at a target user group. However, in modern times, exhibition is not limited to the walls of the library. It is also done on the street, through flyers or through conventional mass media. In the 21st century, libraries employ digital or online display such as news flash on library website, RSS feeds, weblogs, sending of emails and messages through the social networking for marketing library and information services. The emergence of Information Communication Technology (ICT) since 1980s revolutionized every facet of operation and services of libraries. It became expedient for libraries to deploy ICT for display and exhibition of their collections and services. The adoption of ICT has made it possible for libraries to cover a wider range in their exhibition and display activities. Unlike the traditional

method which was limited to within the library building, exhibition and display are carried out online through the Internet on library websites, social networking sites and RSS.

### 3. Research Methodology

#### Research Design

The descriptive survey design was used for this study, which involves the gathering of people's opinion on a particular issue or problem. It was considered as the most suitable and most appropriate to gather relevant data within the given period of time. It also allows only a sample population to be used to represent the entire population. Descriptive survey research design according to Kothari (2011) is concerned with describing, recording, analyzing and interpreting conditions that either exist or existed.

#### Population of the Study

The study population consists of library staff and undergraduate students of Federal University of Technology Minna.

| <b>Federal University of Technology Minna</b> | <b>Population</b> |
|-----------------------------------------------|-------------------|
| Library Staff                                 | 104               |
| Undergraduate Students                        | 15 000            |

#### Sampling procedure and Sample size

A total number of 25 library staff and 315 undergraduate students of Federal university of Technology Minna were selected randomly for the study. The library staff and undergraduate students who visited and used the library within the period of research were selected randomly.

#### Instrument for Data Collection

Questionnaire was the instrument used for data collection; structured questionnaire and observations were used to collect data in order to make the answers easier to retrieve from the respondents. The questionnaire consisted of two sections, one for personal data and the other for the research questions.

#### Validity of the instrument

Kumar, (2015) noted that validity means that correct procedure have been applied to find the answers to a question and reliability refers to the quality of measurement procedure that provide repeatability and accuracy. Ofo (2011) also noted that validity of an instrument is the degree to which a test measures what it is supposed to measure, while reliability of a test is the degree to which a test consistent measures what is intended to measure.

In order to ensure the content validity of the instrument, the questionnaire covered all the aspects of the research questions, and was also given to the project supervisor for proper correction and editing. This correction and editing gave room for necessary amendments in the questionnaire, prior to the final administration to the respondents.

#### Method of Data Collection

A total number of 340 copies of questionnaire were self-administered to the respondents personally. Copies of the questionnaire were administered to library staff and undergraduate students of Federal University of Technology, Minna. The questionnaire were filled and returned back to me within a short period of time.

## Analysis of Data

The data obtained will be analyzed using statistical method showing frequency rates and percentages of raw data collected. The end results of the analysis will be discussed extensively in relation to the objectives of the study.

### 4. Result

#### Demographic Data of the Respondents

**Table 1: Questionnaire Return Rate**

| Respondent    | No. of questionnaire distributed | No. of questionnaire returned | No. of questionnaire not returned |
|---------------|----------------------------------|-------------------------------|-----------------------------------|
| Student       | 315                              | 292                           | 23                                |
| Library staff | 25                               | 21                            | 4                                 |
| <b>Total</b>  | <b>340</b>                       | <b>313</b>                    | <b>27</b>                         |

For the analysis of students and library staff's data, the researcher will be making use of the number of questionnaire returned which are 313.

**Table 2: Distribution of undergraduate students and library staff by age**

| Age          | Student s  |                | Library staff |                |
|--------------|------------|----------------|---------------|----------------|
|              | Frequency  | Percentage (%) | Frequency     | Percentage (%) |
| Below 20yrs  | 126        | 43.2           | 0             | 0              |
| 20-29yrs     | 154        | 52.7           | 0             | 0              |
| 30-39yrs     | 12         | 4.1            | 11            | 52.4           |
| 40-49yrs     | 0          | 0              | 5             | 23.8           |
| 50-59yrs     | 0          | 0              | 3             | 14.3           |
| 60 and above | 0          | 0              | 2             | 9.5            |
| <b>Total</b> | <b>292</b> | <b>100</b>     | <b>21</b>     | <b>100</b>     |

Table 2 shows that 43.2% of the respondents are below 20yrs, 52.7% are between the ages of 20-29yrs, while 4.1% are between the ages of 30-39yrs. Similarly the ages of library staff shows that 52.4% of the respondents are between the ages of 30-39yrs, 23.8% are between the ages of 40-49yrs, 14.3% are between the ages of 50-59yrs while 9.5% are between the ages of 60yrs and above.

**Table 3: Gender Distribution of Respondents**

| Gender       | students   |             | Library staff |            |
|--------------|------------|-------------|---------------|------------|
|              | Frequency  | Percentages | Frequency     | Percentage |
| Male         | 229        | 78.4        | 17            | 81         |
| Female       | 63         | 21.6        | 4             | 19         |
| <b>Total</b> | <b>292</b> | <b>100</b>  | <b>21</b>     | <b>100</b> |

Table 3 shows that out of 100% undergraduate students who used the library, 78.4% are males while 21.6% are females. Similarly 81% of the library staff are males and 19% are females. This shows that more male undergraduate students use the library than the female undergraduate students while male library staff are the dominant.

**Table 4: Distribution of undergraduate students by level**

| Level        | Frequency  | Percentages |
|--------------|------------|-------------|
| 100          | 117        | 40.1        |
| 200          | 43         | 14.7        |
| 300          | 60         | 20.5        |
| 400          | 14         | 4.8         |
| 500          | 58         | 19.9        |
| <b>Total</b> | <b>292</b> | <b>100</b>  |

Table 4 revealed that out of 100% undergraduate students who used the library 40.1% are in 100 Level, 14.7% are in 200 Level, 20.5% are in 300 Level, 4.8% are in 400 Level and 19.9% are in 500 Level.

**Research Question 1:** What impact does Public Relations (PR) has on FUT, Minna Library Services?

**Table 5: Impact of Public Relations on FUT, Minna library services**

- i. **Public Relations help in publicizing and marketing the functions and resources of the library**

| Answer       | Students   |             | Library staff |            |
|--------------|------------|-------------|---------------|------------|
|              | Frequency  | Percentages | Frequency     | Percentage |
| Yes          | 249        | 85.3        | 19            | 90.5       |
| No           | 42         | 14.4        | 2             | 9.5        |
| Undecided    | 1          | 0.3         | 0             | 0          |
| <b>Total</b> | <b>292</b> | <b>100</b>  | <b>21</b>     | <b>100</b> |

Table 5(i) shows that 250(85.6%) of the students agreed that public relations helps in publicizing and marketing the functions and resources of the library, 42(14.4%) disagreed and 1(0.3%) did not decide. Similarly, 19(90.5%) of library staff agreed while 2(9.5%) disagreed

- i. **Public Relations make patrons aware of the services and policies of the library**

| Answers      | Students   |            | Library staff |            |
|--------------|------------|------------|---------------|------------|
|              | Frequency  | Percentage | Frequency     | Percentage |
| Yes          | 274        | 93.8       | 21            | 100        |
| No           | 18         | 6.2        | 0             | 0          |
| Undecided    | 0          | 0          | 0             | 0          |
| <b>Total</b> | <b>292</b> | <b>100</b> | <b>21</b>     | <b>100</b> |

Table 5(ii) shows that 274(93.8%) of the students agreed that Public Relations make patrons aware of the services and policies of the library while 18(6.2%) disagreed. Similarly, 21(100%) of library staff agreed while 0(0%) disagreed.

**Public Relations bring about cooperation among professional colleagues creating a sense of oneness thereby improving relationships**

| Answers   | Students  |             | Library staff |            |
|-----------|-----------|-------------|---------------|------------|
|           | Frequency | Percentages | Frequency     | Percentage |
| Yes       | 195       | 66.8        | 16            | 76.2       |
| No        | 94        | 32.2        | 3             | 14.3       |
| Undecided | 3         | 1           | 2             | 9.5        |

|              |            |            |           |            |
|--------------|------------|------------|-----------|------------|
| <b>Total</b> | <b>292</b> | <b>100</b> | <b>21</b> | <b>100</b> |
|--------------|------------|------------|-----------|------------|

Table 5(iii) shows that 195(66.8%) of the students agreed that public relations brings about cooperation among professional colleagues creating a sense of oneness thereby improving relationships, 94(32.2%) disagreed and 3(1%) did not decide. Similarly, 16(76.2%) of library staff agreed, 3(14.3%) disagreed and 2(9.5%) did not decide.

ii. **Public Relations helps to make better contact between the librarians and the library users**

| <b>Answer</b> | <b>Students</b>  |                    | <b>Library staff</b> |                   |
|---------------|------------------|--------------------|----------------------|-------------------|
|               | <b>Frequency</b> | <b>Percentages</b> | <b>Frequency</b>     | <b>Percentage</b> |
| Yes           | 285              | 97.6               | 18                   | 85.7              |
| No            | 7                | 2.4                | 3                    | 14.3              |
| Undecided     | 0                | 0                  | 0                    | 0                 |
| <b>Total</b>  | <b>292</b>       | <b>100</b>         | <b>21</b>            | <b>100</b>        |

Table 5(iv) shows that 285(97.6%) of the students agreed that public relations helps to make better contact between the librarians and the library users while 7(2.4%) disagreed.

iii. **Public Relations help in promoting the image of the library**

| <b>Answer</b> | <b>Students</b>  |                    | <b>Library staff</b> |                   |
|---------------|------------------|--------------------|----------------------|-------------------|
|               | <b>Frequency</b> | <b>Percentages</b> | <b>Frequency</b>     | <b>Percentage</b> |
| Yes           | 262              | 89.7               | 19                   | 90.5              |
| No            | 26               | 8.9                | 2                    | 9.5               |
| Undecided     | 4                | 1.4                | 0                    | 0                 |
| <b>Total</b>  | <b>292</b>       | <b>100</b>         | <b>21</b>            | <b>100</b>        |

Table 5(v) shows that 262(89.7%) of the students agreed that public relations help in promoting the image of the library, 26(8.9%) disagreed and 4(1.4%) did not decide. Similarly, 19(90.5%) of the library staff agreed while 2(9.5%) disagreed.

**Research Question 2:** What are the roles of library resources exhibition in Public Relations activities of FUT Minna library?

**Table 6: Roles of library resources exhibition in Public Relations activities of FUT Minna library**

**Helps users to know about new resources a library has**

| <b>Answers</b> | <b>Students</b>  |                    | <b>Library staff</b> |                   |
|----------------|------------------|--------------------|----------------------|-------------------|
|                | <b>Frequency</b> | <b>Percentages</b> | <b>Frequency</b>     | <b>Percentage</b> |
| Yes            | 273              | 93.5               | 20                   | 95.2              |
| No             | 16               | 5.5                | 1                    | 4.8               |
| Undecided      | 3                | 1                  | 0                    | 0                 |
| <b>Total</b>   | <b>292</b>       | <b>100</b>         | <b>21</b>            | <b>100</b>        |

Table 6(i) shows that 273(93.5%) of the students agreed that library resources exhibition as a public relations strategy helps users to know about new resources a library has, 16(5.5%) disagreed and 3(%) did not decide. Similarly, 20(95.2%) of the library staff agreed while 1(4.8%).

**i. Helps the library to advertise its collections and services**

| Answers      | Students   |             | Library staff |            |
|--------------|------------|-------------|---------------|------------|
|              | Frequency  | Percentages | Frequency     | Percentage |
| Yes          | 287        | 98.3        | 15            | 71.4       |
| No           | 3          | 1           | 6             | 28.6       |
| Undecided    | 2          | 0.7         | 0             | 0          |
| <b>Total</b> | <b>292</b> | <b>100</b>  | <b>21</b>     | <b>100</b> |

Table 6(ii) shows that 287(98.3%) of the students agreed that library resources exhibition help the library to advertise their collections and services, 3(1%) disagreed and 2(0.7%) did not decide. Similarly, 15(71.4%) of the library staff agreed while 6(28.6%) disagreed.

**ii. Helps the library to identify the information needs of the users**

| Answers      | Students   |             | Library staff |            |
|--------------|------------|-------------|---------------|------------|
|              | Frequency  | Percentages | Frequency     | Percentage |
| Yes          | 240        | 82.2        | 14            | 66.7       |
| No           | 47         | 16.1        | 5             | 23.8       |
| Undecided    | 5          | 1.7         | 2             | 9.5        |
| <b>Total</b> | <b>292</b> | <b>100</b>  | <b>21</b>     | <b>100</b> |

Table 6(iii) shows that 240(82.2%) of the students agreed that library resources exhibition help the library to identify the information needs of the users, 47(16.1%) disagreed and 5(1.7%) did not decide. Similarly, 14(66.7%) of the library staff agreed, 5(23.8%) disagreed and 2(9.5%) did not decide.

**iii. Helps to get reader's attention and stimulate their interest and quest for information**

| Answer       | Students   |             | Library staff |            |
|--------------|------------|-------------|---------------|------------|
|              | Frequency  | Percentages | Frequency     | Percentage |
| Yes          | 279        | 95.5        | 11            | 52.4       |
| No           | 13         | 4.5         | 10            | 47.6       |
| Undecided    | 0          | 0           | 0             | 0          |
| <b>Total</b> | <b>292</b> | <b>100</b>  | <b>21</b>     | <b>100</b> |

Table 6(iv) shows that 279(95.5%) of the students agreed that library resources exhibition helps to get reader's attention and stimulate their interest and quest for information while 13(4.5%) disagreed. Similarly, 11(52.4%) of the library staff agreed while 10(47.6%) disagreed

**Research Question 3:** What are the methods and tools of public relations used in FUT, Minna library?

**Table 7: Methods and Tools of Public Relations used in FUT, Minna Library****i. Posters and Flyers**

| Answer       | Students   |             | Library staff |            |
|--------------|------------|-------------|---------------|------------|
|              | Frequency  | Percentages | Frequency     | Percentage |
| Yes          | 27         | 9.2         | 2             | 9.5        |
| No           | 261        | 89.4        | 17            | 81         |
| Undecided    | 4          | 1.4         | 2             | 9.5        |
| <b>Total</b> | <b>292</b> | <b>100</b>  | <b>21</b>     | <b>100</b> |

Table 7(i) shows that 27(9.2%) of the students agreed that posters and flyers are among methods and tools of public relations used in FUT, Minna, 261(89.4%) disagreed and 4(1.4%) did not decide. Similarly, 2(9.5%) of the library staff agreed, 17(81%) disagreed and 2(9.5%) did not decide.

**ii. Social Network Media**

| Answer       | Students   |             | Library staff |            |
|--------------|------------|-------------|---------------|------------|
|              | Frequency  | Percentages | Frequency     | Percentage |
| Yes          | 17         | 5.8         | 2             | 9.5        |
| No           | 273        | 93.5        | 16            | 76.2       |
| Undecided    | 2          | 0.7         | 3             | 14.3       |
| <b>Total</b> | <b>292</b> | <b>100</b>  | <b>21</b>     | <b>100</b> |

Table 7(ii) shows that 17(5.8%) of the students agreed that social network is among the methods and tools of public relation used in FUT, Minna library, 273(93.5%) disagreed and 2(0.7%) did not decide. Similarly, 2(9.5%) of the library staff agreed, 16(76.2%) disagreed and 3(14.3%) did not decide.

**iii. Newsletters**

| Answer       | Students   |             | Library staff |            |
|--------------|------------|-------------|---------------|------------|
|              | Frequency  | Percentages | Frequency     | Percentage |
| Yes          | 142        | 48.6        | 11            | 52.4       |
| No           | 143        | 49          | 10            | 47.6       |
| Undecided    | 7          | 2.4         | 0             | 0          |
| <b>Total</b> | <b>292</b> | <b>100</b>  | <b>21</b>     | <b>100</b> |

Table 7(iii) shows that 142(48.6%) of the students agreed that newsletters are used in FUT, Minna library as one of the public relations tools and methods, 143(49%) disagreed and 7(7%) disagreed. Similarly, 11(52.4%) of the library staff agreed, 10(47.6%) disagreed.

**iii. Brochures and Catalogues**

| Answer       | Students   |             | Library staff |            |
|--------------|------------|-------------|---------------|------------|
|              | Frequency  | Percentages | Frequency     | Percentage |
| Yes          | 222        | 76          | 13            | 61.9       |
| No           | 67         | 23          | 8             | 38.1       |
| Undecided    | 3          | 1           | 0             | 0          |
| <b>Total</b> | <b>292</b> | <b>100</b>  | <b>21</b>     | <b>100</b> |

Table 7(iv) shows that 222(76%) of the students agreed that brochures and catalogues are used in FUT, Minna library as one of the public relations methods and tools, 67(23%) disagreed and 3(1%) did not decide. Similarly, 13(61.9%) of the library staff agreed, 8(38.1%) disagreed



**iv. Billboard**

| Answer       | Students   |             | Library staff |            |
|--------------|------------|-------------|---------------|------------|
|              | Frequency  | Percentages | Frequency     | Percentage |
| Yes          | 13         | 4.5         | 0             | 0          |
| No           | 271        | 92.8        | 18            | 85.7       |
| Undecided    | 8          | 2.7         | 3             | 14.3       |
| <b>Total</b> | <b>292</b> | <b>100</b>  | <b>21</b>     | <b>100</b> |

Table 7(v) shows that 13(4.5%) of the students agreed that billboard is among methods and tools of public relations used in FUT, Minna library, 271(92.8%) disagreed and 8(2.7%) did not decide. Similarly, 18(85.7) of the library staff disagreed while 3(14.3%) did not decide.

**v. Workshop and Seminar on Public Relations**

| Answer       | Students   |             | Library staff |            |
|--------------|------------|-------------|---------------|------------|
|              | Frequency  | Percentages | Frequency     | Percentage |
| Yes          | 17         | 5.8         | 0             | 0          |
| No           | 269        | 92.1        | 21            | 100        |
| Undecided    | 6          | 2.1         | 0             | 0          |
| <b>Total</b> | <b>292</b> | <b>100</b>  | <b>21</b>     | <b>100</b> |

Table 7(vi) shows that 17(5.8%) of the students agreed that workshop and seminar are among methods and tools of public relations used in FUT, Minna library, 269(92.1%) disagreed and 6(2.1%) did not decide. Similarly, all the library staff disagreed with workshop and seminar on public relations as among the methods and tools of public information resources affect public relations in FUT, Minna library, 19(6.5%) disagreed. Similarly, 13(61.9%) of the library staff agreed, 6(28.6%) disagreed and 2(9.5%) did not decide.

**Summary of the findings**

1. The study revealed that the undergraduate students and the library staff agreed that public relations have impact on FUT, Minna library services.
2. The study revealed that both undergraduate students and the library staff agreed that exhibition of library resources play a very vital role in public relations.
3. The study revealed that FUT, Minna library lack adequate public relations methods and tools as both undergraduate students and the library staff disagreed with most of the methods and tools of public relations listed in this research. Only few public relations methods and tools are being used presently in FUT, Minna Library such as brochures/catalogues and newsletters.
4. The study revealed that undergraduate students and library staff agreed that circulation and reference units play a very important role in public relations in FUT, Minna Library.
5. The study also revealed that both undergraduate students and library staff agreed that there factors affecting effective public relations in FUT, Minna Library except that library staff disagreed with one of the factors which is poor attitude of library staff towards their patrons. They perceived that poor attitude of library staff towards the patrons does not affect public relations.

**Recommendations**

Based on the findings of the study the following recommendations are provided:

1. The management of Federal University of Technology, Minna Library should ensure that updated and relevant information resources are made available in the library and

be updated regularly to encourage users in visiting the library and utilizing the library resources.

2. The management of Federal University of Technology Minna library should organize in-house seminar and workshop on public relations for staff to further improve the quality of their services.
3. Library staff should show a positive attitude; better interpersonal communication, better patrons' orientation, competence and efficiency, smile whenever they are approached for assistance and library staff should equally be fast when attending to users.
4. The management of Federal University of Technology Minna library should endeavor to include public relations unit among the units of the library to enhance effective public relations activities
5. The authority should provide enough funds for the university library management so that the library could acquire adequate public relations tools and thereby enhance public relations activities.
6. The library should improve creation of awareness about their resources, services and policies by adopting the use of various public relations tools such as posters/flyers, newsletters, brochures/Catalogues, billboards, etc.
7. The library should use the influence of FUT, Minna search FM to organize radio programs that will educate library users about their services and resources.

## Conclusion

Based on the findings of this study, it is observed that undergraduate students and library staff of Federal University of Technology Minna Library agreed that public relations have impact on FUT, Minna library services as it creates awareness about the services, resources and policies of the library. They also agreed that exhibition of library resources play a very vital role in public relations, including circulation and reference units. However, there is need for provision and also improvement in some of the public relations methods and tools such as billboards, newsletter, brochure and catalogues, posters/flyers, social media network. It is believed that if university management and library management of Federal University of Technology Minna should endeavor to eliminate or minimize all the factors hindering effective public relations activities in the library, the undergraduate students would perceive library services, its resources and policies from a more positive perceptive.

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## INFORMATION DISSEMINATION BY PUBLIC LIBRARIES FOR SUSTAINABLE MENTAL HEALTH LITERACY AMONG YOUTHS IN KEBBI STATE, NIGERIA.

BY

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### Abstract

*This paper assessed Information Dissemination for Sustainable Mental Health Literacy among Youths in Kebbi State, Nigeria. The study was guided by two objectives and two corresponding research questions. Survey research design method was adopted. The total population of the youths under study was 108,737. The sample size of the youth's population was 383 drawn using Gill et al. (2010) sample size table for determining the sample size of a population. Purposive method of sampling was employed to sample 6 participants from the public libraries. Questionnaire, interview schedule and focus group discussion were used as instruments for data collection. Out of 383 copies of questionnaire administered, three hundred and fifty-two (352) copies were filled, returned and used for the analysis. Interview responses and focus group discussion involving 6 librarians and 72 rural youths were also analysed for the study. Descriptive statistical tool involving frequency counts and percentages, mean and standard deviation, and narrative analysis were used to analyse the data. The findings of the study indicated that mental health literacy among the rural youths of North-central Nigeria is very low. The study revealed further that inadequate library resources in the library is a factor contributing to poor mental health literacy of the youths. The study recommended there should be an intentional effort by information professionals and other stakeholders in creating massive awareness to the rural youths on mental health disorders, the types, symptoms and possible solution. Additionally, the Public Library Board in North-central Nigeria should endeavour to equip the public libraries with adequate information resources on mental health, and should put in place a quality assurance system for the evaluation of information services to the communities they serve.*

**Keywords:** Information dissemination, Mental health literacy, public librarians, Youths in rural areas.

### 1. Introduction

Information is a backbone to any meaningful development in all spheres of life. Hence, great effort has been made to raise awareness on physical health diseases such as polio, measles, meningitis, chicken pox, malaria, HIV/AIDS, Ebola, monkey pox and very recently, the Corona virus. However, public awareness on mental health diseases seems to be quite low in comparison to that of the physical diseases.

Mental health literacy (MHL) helps with early detection of mental health issues and promotes early help-seeking, resulting to early intervention and improved long-term outcomes (Clarke et al., 2016). Definitions of mental health literacy vary, but it essentially involves the access, communication, comprehension and evaluation of information about mental health which leads to the improvement, maintenance and promotion of mental health. As put by National Network of Libraries of Medicines (2017), health literacy is the ability to access and use health information while Mental health literacy is the Knowledge and beliefs about mental disorders which aid its recognition, management or prevention.

It was observed by Onyemelukwe (2016) that for too long, mental disorders have been largely overlooked as part of strengthening primary care. This is despite the fact that mental disorders are found in all countries, in women and men, at all stages of life, among the rich and poor, and in both rural and urban settings. One report suggested that about half of serious mental illness cases in developed countries, and about four-fifths of cases in less developed countries, were either not recognized or received no treatment in the year prior to the survey (Demyttenaere et al, 2014).

Various scholarly examinations of Mental Health Literacy (MHL) have typically found that the general public of developing countries have a poorer understanding of mental health when compared to the cases in developed countries (Goldney et al, 2011). In Nigeria today, attitude towards mental illnesses is gravely colored with prejudice and misconceptions. It is estimated that over 20% – 30% of the population suffers from mental illnesses, but regrettably, the level of awareness on mental health issues amongst the Nigerian youths is considerably dismal (Salau, 2018). The rural youths in particular continue to trace the origin of mental health disorders to social and supernatural causes, such as possession by evil spirits, or ghosts (Bener & Ghuloum, 2014).

To address the long-standing problem of mental health illiteracy of rural youths, information dissemination is therefore considered very crucial. Similarly, Lawless, Toronto and Grammatica (2016), discussed the complexity of defining health literacy and compared and contrasted it with definitions of information literacy which the librarians may be more familiar. In view of this, librarians as custodians of knowledge should be more proactive in effectively bridging the communication gap between the mental health practitioner and the public. This could be rephrased to stating that although the health practitioners have the required knowledge of mental health illnesses, but are not efficient in providing health literacy skills – a skill possessed by librarians (Ha and Longnecker, 2015).

The librarians possess skill and tools required to interact with their users to study their needs and provide feedback. Nigeria is currently witnessing an increased rate of suicidal attempts and actions, yet, they cannot recognize specific disorders, to mention how to manage such situation when confronted with it. This therefore calls for a need to study ways through which librarians, being information professionals can step in to enhance mental health literacy which is a known barrier to mental health sustenance. This will greatly enhance the ability to gain access to, understand and use information in ways that promote and maintain good mental health.

### **Statement of the Research Problem**

Over the past few decades, much attention has been given to health literacy by health organizations, health practitioners, health policy makers and health information professionals. The World Health Organization (WHO) (2018) also endorsed mental health as a universal human right and a fundamental goal for health care systems of all countries. However, in spite of the rising research on the mental health literacy of adults, there is yet to be a parallel interest in how to ensure a sustainable mental health literacy of youths in rural areas of Nigeria. Some of the policies on mental health and development in Nigeria such as the Mental Health Policy formulated in 1991, National Adolescent Health Policy (NAHP), and National Youth Policy (NYP) do not earnestly address the issues of mental health literacy among youths.

Several researches conducted in Nigeria have recorded mental health literacy to be very low. It has also been observed that the individuals with mental and behavioral disorders are predominantly, the rural youths of developing countries where mental health literacy remains a neglected matter (Salau, 2018). Hence, librarians, as custodians of information become key players in improving mental health literacy skills through information dissemination. The

WHO conceptualizes optimal actions for improved mental health literacy as services for mental disorders in primary care, ensuring accessibility to essential medication, promoting public education, and to promote and support relevant research (WHO, 2016).

This study, therefore, seeks to assess information dissemination for sustainable mental health literacy among youths in rural areas of North-central, Nigeria.

### **Objectives of the Study**

The objectives of the study are to:

1. Ascertain the level of mental health literacy of the youths in Kebbi State.
2. determine the types of information resources and services on mental health literacy available in the library for the youths in Kebbi State, Nigeria

### **Research Questions**

The study was guided by the following questions:

1. What is the mental health literacy level of the youths in Kebbi State?
2. What are the types of information resources and services on mental health literacy available in the library to the youths in rural areas of Kebbi State?

## **2. Literature Review**

Health literacy (MHL) is a term that was introduced by Jorm et al, in 1997. Jorm et al (1997) initially defined mental health literacy as the knowledge and beliefs about mental disorders which aid their recognition, management or prevention. A more current definition of mental health literacy also includes: understanding how to prevent mental disorders, recognizing symptoms of a developing mental disorder, knowing about help-seeking interventions and self-help strategies, and mental health first aid skills to help others experiencing a mental health crisis (Jorm et al, 2015). Additionally, the researchers opined that understanding public opinions and views about mental health can guide and shape how to their practices to meet the needs of a person with mental illness.

Since health literacy was introduced as a field in 1997, growing numbers of studies have been conducted on it throughout the world. Areas of studies include, but not limited to assessing of the public health literacy, exploring factors associated with mental health disorders, help-seeking, and the ability to improve mental health literacy and concerns. Current literature reports that people in the developed countries tend to have mental health notions that are similar to mental health practitioners' perspectives, compared to people in developing and underdeveloped countries (Furnham & Igboaka, 2017).

With increasing attention to research and availability of mental health education and training resources, recent studies suggested that awareness has been improved, particularly about depression. Yet, people are not familiar with many other mental disorders and lower-level mental health literacy is reported amongst people in developing countries (Swami & Furnham, 2018). Existing literature suggested that people with a higher level of mental health awareness are likely to have positive attitudes toward seeking professional help, more confidence in helping others with mental health issues, and less stigmatizing beliefs and attitudes toward mental health issues (Kutcher, Wei, & Coniglio, 2016).

According to an exploratory study conducted by Wickstead & Furnham (2017), mental health disorders were identified as the fourth highest ranking rural health concern among 28 functional areas identified. The prevalence of recent mental disorders appears to be similar in rural and

urban areas. However, rural residents with mental illness may be less likely than their urban counterparts to define. Further to this, Iwhiwhu & Okorodudu (2012) posited that library staff are valued as information experts and community health advocates, with a high level of community knowledge and expertise.

Public libraries are the information centers of the rural areas. They bring promotion and outreach skills, and have experience of a broad range of activities relevant to health information and promotion, creativity and community activity and learning and skills development. The case studies and survey findings of Stringer (2020), suggest that involvement in health and well-being service delivery also benefits the library sector by helping librarians to hone existing skills, both through the provision of designated training in areas such as mental health awareness, health information provision and health and well-being referral.

### **3. Methodology**

The study adopted survey research design method. This is because survey research design method has the advantage of wider application as it allows data to be collected on a large population. The survey research design is relevant for this study because it is relatively cheap and serves as a fast way of collecting information and data on the computer self-efficacy and information searching skills for research output of postgraduate students. Questionnaire, interview schedule and focus group discussion were used as instruments for data collection.

#### 4. Result

**Table 1: Level of Mental Health Literacy of the Youths in Kebbi State**

| S/N |                                                                                    | VL  |      | L   |      | H   |      | VH |      | N   | FX  | $\bar{x}$ | STD  | Decision |
|-----|------------------------------------------------------------------------------------|-----|------|-----|------|-----|------|----|------|-----|-----|-----------|------|----------|
|     |                                                                                    | 1   | %    | 2   | %    | 3   | %    | 4  | %    |     |     |           |      |          |
| 1.  | I am aware that mums-to-be or new mum can develop certain mental disorders         | 129 | 36.6 | 143 | 40.6 | 67  | 19.0 | 13 | 3.7  | 352 | 668 | 1.90      | 0.83 | Low      |
| 2.  | I am aware that loss of job, loved one or properties can trigger mental disorder   | 105 | 29.8 | 120 | 34.1 | 82  | 23.3 | 45 | 12.8 | 352 | 770 | 2.19      | 1.01 | Low      |
| 3.  | I am aware that drug abuse can cause mental disorders                              | 81  | 23.0 | 109 | 31.0 | 100 | 28.4 | 62 | 17.6 | 352 | 848 | 2.41      | 1.03 | Low      |
| 4.  | I am aware that watching pornographic contents can cause a mental disorder         | 102 | 29.0 | 147 | 41.8 | 74  | 21.0 | 29 | 8.2  | 352 | 735 | 2.09      | 0.91 | Low      |
| 5.  | I am aware that unregulated use of social media can cause certain mental disorders | 139 | 39.5 | 135 | 38.4 | 57  | 16.2 | 21 | 6.0  | 352 | 665 | 1.89      | 0.89 | Low      |
| 6.  | I am aware that drinking alcohol                                                   | 88  | 25.0 | 97  | 27.6 | 98  | 27.8 | 69 | 19.6 | 352 | 851 | 2.42      | 1.07 | Low      |



|                    |                                                                                             |     |      |     |      |    |      |    |      |     |     |      |      |      |
|--------------------|---------------------------------------------------------------------------------------------|-----|------|-----|------|----|------|----|------|-----|-----|------|------|------|
|                    | can cause mental disorders                                                                  |     |      |     |      |    |      |    |      |     |     |      |      |      |
| 7.                 | I am aware that smoking cigarettes and other damaging substances can cause mental disorders | 82  | 23.3 | 88  | 25.0 | 97 | 27.6 | 85 | 24.1 | 352 | 890 | 2.53 | 1.09 | High |
| 8.                 | I am aware that pandemic, economic meltdown can cause mental disorders                      | 112 | 31.8 | 123 | 34.9 | 81 | 23.0 | 36 | 10.2 | 352 | 746 | 2.12 | 0.97 | Low  |
| Overall mean value |                                                                                             |     |      |     |      |    |      |    |      |     |     | 2.18 | 0.98 |      |

**Table 2: Percentage Distribution of Situation(s) Youths in Rural North-central Nigeria Consider a Mental Disorder**

| Item                                                                 | Scale                                                                                 | Frequency | Percent |
|----------------------------------------------------------------------|---------------------------------------------------------------------------------------|-----------|---------|
| Which of the following situations do you consider a mental disorder? | Madness only                                                                          | 163       | 46.3%   |
|                                                                      | Madness and anxiety                                                                   | 13        | 3.7%    |
|                                                                      | Madness, Anxiety, Depression & Obsessive Character Disorder (OCD)/Addiction           | 4         | 1.1%    |
|                                                                      | Madness, Anxiety, Depression, Obsessive Character Disorder (OCD)/Addiction & Insomnia | 21        | 6.0%    |
|                                                                      | Madness & Depression                                                                  | 93        | 26.4%   |
|                                                                      | Madness, Anxiety & Depression                                                         | 10        | 2.8%    |

|  |                                                                              |            |              |
|--|------------------------------------------------------------------------------|------------|--------------|
|  | Madness, Depression, Obsessive Character Disorder (OCD)/Addiction & Insomnia | 4          | 1.1%         |
|  | Madness, Depression & Obsessive Character Disorder (OCD)/Addiction           | 34         | 9.7%         |
|  | Madness, Anxiety & Obsessive Character Disorder (OCD)/Addiction              | 8          | 2.3%         |
|  | Madness and Obsessive Character Disorder (OCD)/addiction                     | 2          | 0.6%         |
|  | <b>Total</b>                                                                 | <b>352</b> | <b>100.0</b> |

The result in Table 1 showed that the mental health literacy level of the youths in the rural areas of North-central Nigeria is low, as the responses from the respondents have an overall mean score ( $\bar{x}$ ) lesser than the benchmark score (2.50). Although most of the items had low, the least three items are; I am aware that unregulated use of social media can cause certain mental disorders with ( $\bar{x} = 1.89$ ;  $SD = 0.89$ ); I am aware that mums-to-be or new mum can develop certain mental disorders with ( $\bar{x} = 1.90$ ;  $SD = 0.83$ ); I am aware that watching pornographic contents can cause a mental disorder with ( $\bar{x} = 2.09$ ;  $SD = 0.91$ ).

Table 2 shows the youths' responses when asked which situation(s) they consider a mental disorder. 163 youths, or 46.3% of the total 352 youths sampled in rural North-central Nigeria, say they only consider madness to be a mental disorder. 3.7% stated that they consider madness and anxiety only as mental disorders, while 1.1% said they consider madness, anxiety, depression, and Obsessive Character Disorder (OCD)/addiction as mental disorders. 6.0% say they consider madness, anxiety, depression, Obsessive Character Disorder (OCD)/addiction and insomnia as mental disorders. 26.4 % says they consider madness and depression only as a mental disorder, 2.8% says they consider madness, anxiety and depression as a mental disorder, 1.1% says they consider madness, depression, Obsessive Character Disorder (OCD)/addiction and Insomnia as a mental disorder, 9.7% (34) says they consider madness, depression and Obsessive Character Disorder (OCD) / addiction as mental disorder, 2.3% says they consider madness, anxiety and Obsessive Character Disorder (OCD)/addiction as mental disorder and 0.6% says they consider madness and Obsessive Character Disorder (OCD)/addiction only as mental disorder.

**Table 3: Percentage distribution of types of Information Resources and Services**

| S/N                          | Types of Information Resources                                               | Available | Not Available |
|------------------------------|------------------------------------------------------------------------------|-----------|---------------|
| <b>Information Resources</b> |                                                                              |           |               |
| 1                            | Journals                                                                     | 6 (100%)  | 0             |
| 2                            | Newspapers                                                                   | 6(100%)   | 0             |
| 3                            | Posters/handbills                                                            | 1(16.7%)  | 5(83.3%)      |
| 4                            | Magazines                                                                    | 2(33.3%)  | 4(66.7%)      |
| 5                            | Monographs                                                                   | 3(50%)    | 3(50%)        |
| 6                            | Medicine Online (MOL)                                                        | 1(16.7%)  | 5(83.3%)      |
| 7                            | Medical Text Online                                                          | 1(16.7%)  | 5(83.3%)      |
| <b>Information Services</b>  |                                                                              |           |               |
| 9                            | Current Awareness Service (CAS)                                              | 3(50%)    | 3(50%)        |
| 10                           | Selective Dissemination of Information (SDI)                                 | 2(33.3%)  | 4(66.7%)      |
| 11                           | Mobile phone call services                                                   | 1(16.7%)  | 5(83.3%)      |
| 12                           | Short Messages Services (SMS)                                                | 0         | 6(100%)       |
| 13                           | Library orientation services                                                 | 6(100%)   | 0             |
| 14                           | Provision of mental health information through radio and television services | 0         | 6(100%)       |
| 15                           | Internet and web technologies services                                       | 3(50%)    | 3(50%)        |
| 16                           | E-mail alert services                                                        | 2(33.3%)  | 4(66.7%)      |
| 17                           | Use of social networking                                                     | 0         | 6(100%)       |
| 18                           | Medical research services                                                    | 4(66.7%)  | 2(33.3%)      |
| 19                           | Mobile book services                                                         | 3(50%)    | 3(50%)        |
| 20                           | Film shows                                                                   | 0         | 6(100%)       |
| 21                           | Discussions                                                                  | 5(83.3%)  | 1(16.7%)      |

Table 3 shows the librarians responses when asked the types of information resources and services available in the library. Journals, newspapers and library orientation service were available in 6 (100%) out of the six (6) libraries under study. However, 1 (16.7%) of the libraries have posters/handbills, Medicine Online (MOL), medical text online, and render mobile phone call services. Furthermore, no library provides film shows service, Short Message Services (SMS), use of social networking, and provision of mental health information through radio. Selective Dissemination of Information (SDI), Magazines, and Email alert

services are available in 2 (33.3%) of the libraries, whereas mobile book services, internet and web technology services, Current Awareness Services (CAS) and monographs are available in 3 (50%) of the libraries. Additionally, medical research services and discussions are rendered by 4(66.7%) and 5(83.3%)

### **Discussion of the Findings**

From the findings of this study, it was discovered that there is a low mental health literacy level among youths in Kebbi State. As the responses from the respondents indicate a low level of mental health literacy among the youths. This is captured in Table 1 This study finding is also consistent with the study conducted by Aluh, Anyachebelu, Anosike, and Anizoba (2017), which concluded that mental health literacy is quite low in Nigeria and requires urgent attention. Also, a significant number of rural youths indicated that they consider madness only as a mental health disorder and are not really aware of the other situations that can be considered mental disorders. It also supports the findings of Reavley, Morgan, and Jorm (2014) which revealed that youths have a low level of knowledge and recognition of depression and other situations associated with mental disorders.

Findings from this study revealed that the libraries in Kebbi State do not have available most of the information resources and services on mental health literacy that could help the rural youths. Most of the libraries only had newspapers and journals available as information resources and library orientation services as information services readily available to rural youths. Some libraries also indicated they provide other informational services such as current awareness services (CAS), selective dissemination of information (SDI), mobile phone call services, Internet and web technology services, e-mail alert services, medical research services, mobile book services, and discussions, but their numbers are limited. The overall findings of the study therefore requires an urgent attention be paid to the improving of the information resources in the public libraries of North-central Nigeria, and improved services to the communities they serve.

### **Recommendations**

Based on the findings, this study offers the following recommendations:

1. There should be an intentional effort by information professionals and other stakeholders in creating massive awareness to the rural youths on mental health, the types, symptoms and possible solution.
2. The Public Library Board in North-central Nigeria should endeavour to equip the public libraries with adequate information resources on mental health disorders, and should put in place a quality assurance system for the evaluation of information services to the communities they serve.

### **Conclusion**

The conclusion, based on the findings of the study is that mental health literacy is abysmally low amongst youths in the rural area of North-central Nigeria. It was also revealed that the role of public librarians in improving mental health literacy of rural youths is core, the poor mental health literacy is also faced with poor library resources and inadequate awareness programs. Hence, there is a significant relationship between information dissemination and mental health literacy. The study further revealed that Focus Group Discussion as an instrument of data collection is more effective when studying a population of predominantly, illiterates or basic schooled people.

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## OPTICAL PROPERTIES CHARACTERIZATION OF SAWDUST WASTE FOR SUSTAINABLE OPTICAL APPLICATIONS

BY

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### Abstract

*This research investigates the optical properties of fermented liquid derived from sawdust waste, utilizing UV-Vis spectrophotometry and refractometer. Sawdust waste was chosen as the substrate due to its abundance, low cost, and potential for sustainable material development. The study aims to characterize the absorption and transmission spectra of the fermented liquid and determine its refractive index, thereby exploring its potential for sustainable material development. The employed reagents in this study, including fermentation agents and solvents, were used to facilitate the breakdown of sawdust waste and extract the fermented liquid. These reagents were essential for ensuring the effective fermentation process and accurate measurement of optical properties. Findings indicated significant absorption and transmission characteristics, with a stable refractive index across the visible spectrum (380-780 nm). At 380 nm it shows high absorbance in ultra-violet range and lower transmittance, whereas 780 nm recorded the highest transmittance and minimal absorbance as compared to 380 nm. Furthermore, the refractive index was measured using refractometer at different temperatures from 30 – 70 °C, the results revealed that, as the temperature increases the refractive indices decreases. These findings suggest that the fermented liquid could serve as a viable alternative to conventional materials in various optical applications, such as in the development of eco-friendly optical coatings and sensors. Further research is recommended to explore additional optical properties and practical applications of this innovative material, potentially contributing to advancements in sustainable material science and technology.*

**Keywords:** Sawdust Waste, Optical Properties, Fermentation, Absorbance, Transmittance, Refractive index.

### 1.0 Introduction

The increasing demand for sustainable and eco-friendly materials has driven significant research into the utilization of agricultural and industrial waste products (Alabduljabbar *et al.*, 2020). Sawdust, a byproduct of the timber industry, represents a substantial portion of this waste, often discarded or used in low-value applications (Al-Dhabaan, 2022). However, sawdust contains valuable lignocellulosic components that can be transformed into high-value products through appropriate processing techniques (Phonphuak *et al.*, 2020; Eliche-Quesada *et al.*, 2012; Horisawa *et al.*, 1999).

The disposal and management of sawdust waste pose significant environmental challenges as also reported by (Al-Fakih *et al.*, 2019; Kazmi *et al.*, 2016; Zhang, 2013; Eliche-Quesada *et al.*, 2012; Phonphuak *et al.*, 2012). Sawdust, a byproduct of the timber industry, is often discarded or used in low-value applications, leading to environmental pollution and inefficient resource utilization (Alabduljabbar *et al.*, 2020). The demands for wood into different applications like furniture, building construction and interior decorations has increased rapidly

in Nigeria, which led to numerous growth in sawmills industries in the country (Udokpoh & Nnaji, 2023). The amount of sawdust generated per annum in Nigeria is estimated to be around 1.8 million tonnes (Kolo *et al.*, 2021; Tilak *et al.*, 2018; Rominiyi *et al.*, 2017; Tilak *et al.*, 2017). Those sawmills accumulate large amount of sawdust waste, up to 93% (Peter *et al.*, 2017). About 5.2 million tonnes per year of wood residue is also being generated in Nigeria (Ogunwusi, 2014; Sambo, 2009). Despite its abundance, the potential of sawdust as a valuable resource remains largely untapped.

This research project aims to explore the potential of sawdust waste as a substrate for fermentation, focusing on the characterization of its optical properties. By leveraging a combination of chemical pretreatment for fermentation, this study seeks to convert sawdust into a fermented liquid with applications in renewable energy, environmental sustainability, and material science.

The pretreatment process involves the use of sodium hydroxide to break down the complex lignocellulosic structure of sawdust, enhancing the accessibility of cellulose for microbial action (Suresh *et al.*, 2018). Subsequent fermentation with yeast, supplemented with essential nutrients such as ammonium sulphate and magnesium sulfate, facilitates the conversion of fermentable sugars into ethanol and other metabolites. The optical properties of the resulting fermented liquid will be analyzed using UV-Visible spectrophotometric and refractometer, providing insights into its potential applications.

This research not only addresses the environmental challenge of sawdust waste management but also contributes to the development of sustainable materials and biofuels. By transforming a common waste product into a valuable resource, this study aligns with global efforts to promote environmental sustainability and resource efficiency. The findings from this research could pave the way for innovative applications in various industries, including renewable energy, construction, and environmental remediation.

## 2.0 Materials and Methods

The study work was carried out in chemistry laboratory, Department of Science Laboratory Technology, Kebbi State Polytechnic Dakingari, Kebbi State, Nigeria. By using sawdust waste as substrate for fermentation.

### 2.1 Fermentation of Sawdust Waste

The substrates were collected, prepared and subjected for fermentation as shown in the Figure 1. It is a degradation process by which the raw materials are fermented with the help of chemical reagents in controlled environment. Sawdust was used as substrate in this study, all the reagents i.e. Sodium Hydroxide (NaOH):10 g, Caustic Soda: 10 g, Ammonium Sulfate ((NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>): 10 g, Magnesium sulfate (MgSO<sub>4</sub>): 10 g and Distilled Water: 1000 ml, were mixed in a beaker and diluted with 1 L of distilled water and stirred for about 15 minute. The solution was mixed with the sawdust waste power in a container and kept for 10 hours for fermentation at a controlled temperature of 30 °C, this fermentation technique was also adopted by (Segun *et al.*, 2024). The fermented liquid were collected and centrifuged for 10 minute at 50 rpm for separation using centrifuge machine. The obtained liquid was used for the analysis.

### 2.2 Determination of UV-Vis Spectrophotometry

The UV-Vis spectrophotometry was calibrated using standard procedure. The sample were placed in cuvette and inserted into the device and the ranges of wavelength within UV were selected. Absorbance and transmittance of the fermented liquid were recorded. This device was

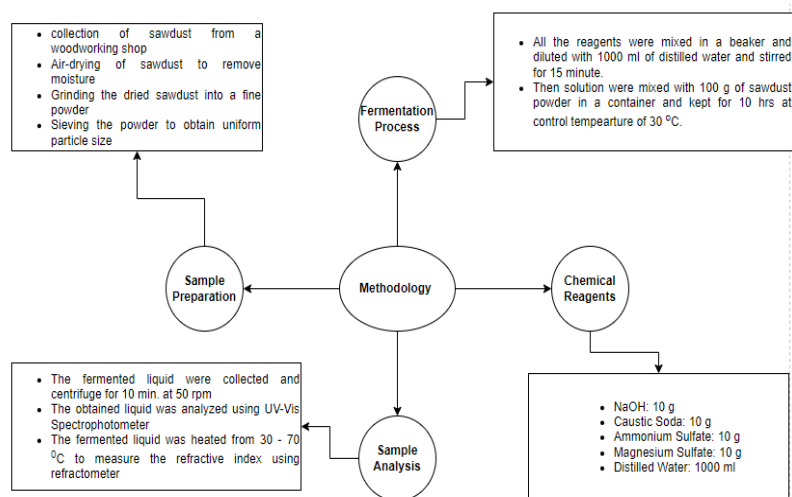


also used by Tarasenko *et al.* (2022), to characterize the optical properties of pine wood sawdust.

### 2.3 Refractometry Procedure

A refractometer was used to measure the refractive index of the fermented liquid at different temperatures 30 – 70 °C in Brix scale after calibration. Equation (1) was used to convert the brix value into standard value of refractive index. The fermented liquid was heated using heating apparatus to record the refractive indices at each temperature.

$$\eta = 1.3330 + (0.0034 \times Brix) \quad (1)$$



**Figure 1: Methodology Chart.**

### 3.0 Results and Discussion

The UV-Visible spectrophotometry data provides valuable insights into the optical properties of the fermented liquid derived from sawdust waste. The results for both the absorbance and transmittance were presented in the Table 1.

**Table 1: UV-Visible Results of Absorbance and Transmittance of Fermented Sawdust**

| S/N | Wavelength (nm) | Absorbance (abs) | % Transmittance | Observations                      |
|-----|-----------------|------------------|-----------------|-----------------------------------|
| 1   | 380             | 2.65             | 0.30            | High absorbance in UV range       |
| 2   | 480             | 1.57             | 2.70            | Presence of specific compound     |
| 3   | 580             | 0.46             | 34.90           | Transition to visible range       |
| 4   | 680             | 0.15             | 142.70          | Lower absorbance in visible range |
| 5   | 780             | 0.12             | 154.80          | Minimal absorbance                |

The absorbance value of 2.65 at 380 nm indicates significant absorption in the UV range. This high absorbance suggests the presence of compounds that strongly absorb UV light, which could be attributed to aromatic compounds or conjugated systems present in the fermented liquid and it contained a typical feature of carbon dot (Liu *et al.*, 2020). Such compounds are

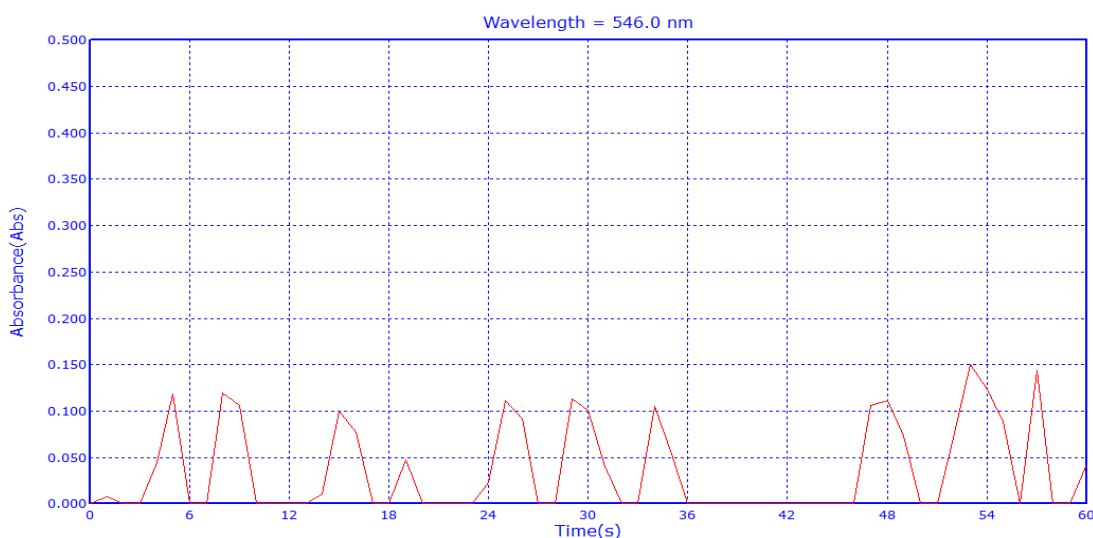
known to absorb UV light due to their electronic transitions. At 480 nm, the absorbance decreases to 1.57, with a corresponding transmittance of 2.70 %. This wavelength is within the visible range, and the absorbance indicates the presence of specific compounds that absorb light in this region. This could be due to the presence of chromophores, which are parts of molecules responsible for their color.

The absorbance at 580 nm is 0.46, with a transmittance of 34.9 %, this transition to the visible range suggests that the material has components that absorb less light as the wavelength increases. This behavior is typical for materials that transition from UV to visible light absorption. At 680 nm, the absorbance further decreases to 0.15, with a transmittance of 142.7 %. This lower absorbance in the visible range indicates that the material becomes more transparent as the wavelength increases. This property is beneficial for applications requiring optical clarity. The absorbance at 780 nm is minimal at 0.12, with a high transmittance of 154.8 %. This minimal absorbance suggests that the material has excellent transparency in the near-infrared region, making it suitable for optical applications where low absorption is critical.

The UV-Visible spectrophotometry data highlights the potential of sawdust waste-derived from fermented liquid as a sustainable material with valuable optical properties. The high absorbance in the UV range and the transition to lower absorbance in the visible range suggest that this material can be tailored for specific optical applications, such as UV filters, sensors, and optoelectronic devices.

### 3.1 UV-Vis absorbance for specific wavelength

Figure 2, shows the absorbance for the fermented sawdust liquid at 546.0 nm for a period of 60 sec. Observation shows fluctuation pattern in absorbance over time. At 60 sec, the absorbance value is approximately 0.50 a.u.



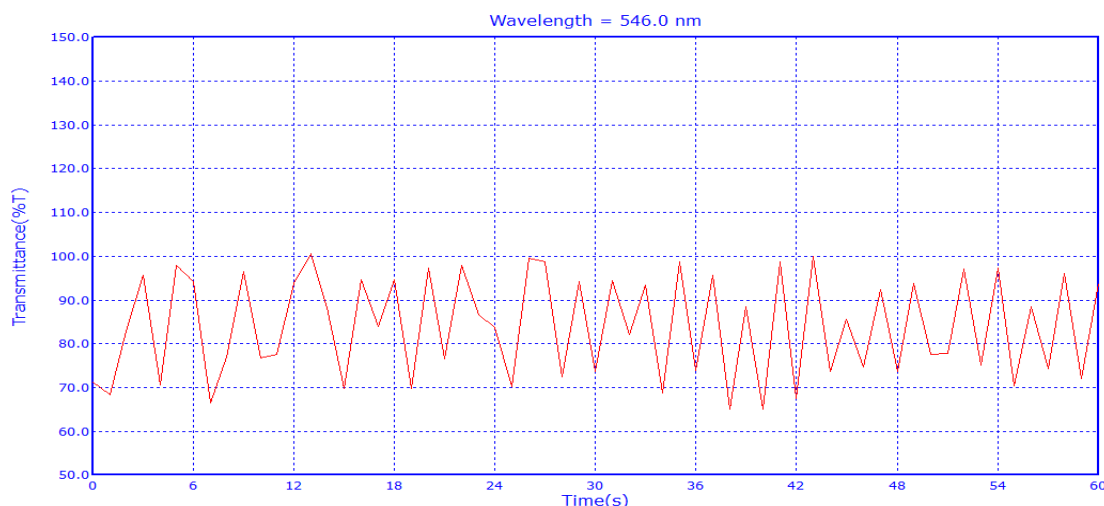
**Figure 2: Absorbance at 546.0 nm for 60.0 sec**

The peak at 60 seconds indicates a significant increase in the concentration of the absorbing species at this wavelength (546.0 nm). This could be due to the formation of a specific compound or a change in the concentration of an existing compound. The periodic nature of the peaks suggests that the reaction or process being monitored has a dynamic behavior, possibly involving intermediate stages or oscillatory kinetics. The consistent pattern of peaks and troughs might indicate a stable process with regular fluctuations, rather than random noise. The peaks could correspond to the formation of intermediate products in a chemical reaction, which absorb light at 546.0 nm. Changes in the physical state of the solution, such as

aggregation or dispersion of particles, could also cause variations in absorbance. Other parameters which could affect the adsorption efficiency include particle size, pH, activation mechanism, adsorption temperature, and ionic state of target solute, initial concentration of contaminant, contact time, and degree or intensity of mixing (Udokpoh & Nnaji, 2023).

### 3.2 UV-Vis Transmittance for specific wavelength

Figure 3, shows the transmittance pattern at 546.0 nm within 60.0 sec. of the fermented sawdust liquid.



**Figure 3: Transmittance at 546.0 nm for 60.0 sec**

Careful observation shows significant fluctuations in transmittance over the 60-sec. The transmittance value at 60 sec is approximately between 68 and 100 %. The values indicates that a large portion of the light at 546.0 nm is passing through the sample. This suggests that the sample has low absorbance at this wavelength. The oscillations in the transmittance values suggest dynamic changes in the sample's properties over time. This could be due to physical or chemical changes occurring within the sample which is also confirmed with findings shown in Figure 3.

### 3.3 Refractometry Analysis

Table 2, depict the refractive index obtained from the fermented liquid using refractometer. The relation between the refractive index and the concentration depends on the solvent and solute, temperature, and wavelength.

**Table 2. Refractive Index of the Sample at Different Temperatures**

| S/N | Temperature (°C) | Refractive index (%Brix) | Refractive index (n) |
|-----|------------------|--------------------------|----------------------|
| 1   | 30               | 37                       | 1.4588               |
| 2   | 40               | 35                       | 1.4520               |
| 3   | 50               | 34                       | 1.4486               |
| 4   | 60               | 32                       | 1.4418               |
| 5   | 70               | 31                       | 1.4384               |

As shown from Table 2, the refractive index of 1.4588 at 30 °C is relatively high, indicating that the fermented liquid has significant optical density at this temperature. This value is comparable to that of borosilicate glass, which is known for its excellent optical properties and low thermal expansion (Prakash *et al.*, 2017). The high refractive index suggests potential applications in optical components where high precision and clarity are required. At 40 °C, the

refractive index decreases slightly to 1.4520 this is comparable to that of fused silica (Schubert, 2003). This reduction indicates a decrease in optical density with increasing temperature, which is typical for most liquids. The change in refractive index with temperature can be attributed to the thermal expansion of the liquid, which affects its density and, consequently, its refractive index. The refractive index continues to decrease to 1.4486 at 50 °C. This trend is consistent with the behavior of many organic liquids, where the refractive index decreases as the temperature increases. This property is important for applications that require precise control of optical properties under varying thermal conditions. At 60 °C, the refractive index further decreases to 1.4418. This value indicates that the fermented liquid maintains good optical clarity even at higher temperatures.

The consistent decrease in refractive index with temperature suggests that the material can be used in environments where temperature fluctuations are common. The refractive index at 70 °C is 1.4384, the lowest value in the dataset which approximately the same to that of fluorite (Schubert, 2003). This continued decrease highlights the material's stability and adaptability to higher temperatures. The ability to maintain optical clarity at elevated temperatures makes this material suitable for various industrial applications, including optical sensors and devices.

The refractive index data further revealed the potential of sawdust waste-derived fermented liquid as a sustainable material with valuable optical properties which is in agreement with the UV-Vis. Analysis. The consistent decrease in refractive index with increasing temperature indicates that the material can maintain optical clarity and stability under varying thermal conditions. This property is crucial for applications in optoelectronics, sensors, and other optical components.

## Conclusion

This research successfully characterized the optical properties of fermented liquid derived from sawdust waste using UV-Vis spectrophotometry and refractometry, demonstrating the potential of repurposing sawdust waste into valuable materials with significant optical properties. The UV-Vis spectrophotometry revealed high absorbance in the UV range, indicating the presence of compounds that absorb UV light, and a transition to lower absorbance in the visible range, suggesting good optical clarity suitable for optoelectronic applications. The refractive index measurements showed a consistent decrease with increasing temperature, highlighting the materials stability and adaptability under varying thermal conditions, with high refractive index values at lower temperatures depicting potential applications in optical components requiring high precision and clarity. These findings emphasize the feasibility of using sawdust waste to create materials with desirable optical properties, promoting environmental sustainability and innovation in material science. By repurposing biomass waste, this research contributes to waste reduction and resource efficiency, aligning with global sustainability goals. Future research should explore the scalability of this approach and its applications in various industries, including optoelectronics, sensors, and other optical devices, while investigating the long-term stability and performance of the material under different environmental conditions to ensure its practical implementation.

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**PERENNIAL GRASS AS A FEEDSTOCK FOR BIOETHANOL PRODUCTION****BY****Abdulsalam A. A<sup>1</sup>., Aliyu S<sup>2</sup>., Dan Illela U. Y<sup>3</sup>., Aminu M.B<sup>4</sup>., Ahmad Z.U<sup>5</sup>., Gbadamosi L<sup>6</sup>., Muftau M.A<sup>7</sup>., Jaji S.O<sup>8</sup>**<sup>1,2,3,4,5</sup> Department of Sciences, Kebbi State Polytechnic, Dakingari., Kebbi State.<sup>6</sup>Department of Chemistry, Adeyemi Federal University of Education, Ondo, Ondo State.<sup>7</sup>Faculty of Agriculture, Kebbi State University of Science and Technology, Aliero, Kebbi State<sup>8</sup>Chemical Sciences Department, Lagos State University of Science and Technology.

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**Abstract**

*The production of bio ethanol from carpet grass was examine by acid hydrolysis and fermentation process to hydrolyzed 100g of substrate at 35<sup>0</sup>C for six days. The method used involved acid hydrolysis of carpet grass with varied acid molarities of 1M, 3M, and 5M. The hydrolyzate was further subjected to fermentation at varied yeast volume of 10cm<sup>3</sup>, 20cm<sup>3</sup> and 30cm<sup>3</sup> in order to obtain ethanol. The result obtain shows a gradual increase in the yield of ethanol with increasingly acid concentration. The final values of the bio ethanol produced for different acid concentrations and volume of yeast are 20.31%, 23.61% and 26,27% from 1M, 24.29%, 25.61% and 29.61% from 3M, and 26.25%, 29,76% and 31,52% from 5M. A combination of acid concentration of 5M and 30cm<sup>3</sup> of yeast gave high yield of ethanol at room temperature for acid hydrolysis of lignocellulosic content of carpet grass and fermentation of the resulting product. This result provide evidence that this method can be used to improve the production of ethanol from carpet grass.*

**Key words:** Ethanol, Lignocelluloses, Fermentation, Pretreatment, Perennial grass**Introduction**

The increase in demand for energy and the negative impacts of fossil fuels such as global warming, greenhouse gasses emissions, and the fast depletion of fossil resources have resulted in an increased interest in the research of alternative energy or sustainable energy such as biofuel (Muhammad and Saha, 2020). Combustion of fossil fuel has offered a numerous advantage to our life but it also leads to GHG which cause global warming and climate change (Zabed et al., 2017). The continuously increasing global demand for energy, fossil fuel resources on our planet are anticipated to become depleted within the several decades, endangering worldwide energy security.

The production of biofuel has been proposed as a suitable alternative for energy generation in order to reduce the usage of fossil fuels which causes global warming, greenhouse effect, and environmentally friendliness (Dey et al., 2020). Among all, bioethanol is one of the most attractive as it can substitute gasoline (Efemwenkikie et al., 2019). However, industrial-scale bioethanol production still faces a severe challenge of feedstock acquisition and economic viability (Robak et al., 2020).

Lignocellulosic biomass is an abundant and renewable resources from plant mainly composed of polysaccharides (cellulose and hemicellulose) and an aromatic polymer (lignin). Lignocellulose biomass has a high potential as an alternative fossil resources to produce second generation biofuel.

Lignocellulose resources consist of virgin biomass comprises all naturally growing terrestrial plants, including herbaceous plants (annual, biennial, and perennial plants) and woody plants (trees bushes, and dwarf shrubs), as well as aquatic plants (e.g, water hyacinth, water fern, water lettuce, and duckweed). Energy crops include perennial grasses and other dedicated energy crops that produced a high yield of lignocellulosic biomass (e.g., switch grass, giant reed, elephant grass, and miscanthus). Waste biomass is a low-value by-product of different industrial sectors such as agriculture (bagasse, cereal, straws, stover, and husks), forestry (branches from dead trees, pruning, and thinning residues), and wood and paper production (bark, sawdust, and wood chips). It also includes an organic portion of municipal solid wastes (Arefin et al., 2021).

Lignocellulosic biomass is mainly composed of three polymers, cellulose ( $C_6H_{10}O_5$ )<sub>n</sub>, Hemicellulose ( $C_5H_8O_4$ )<sub>m</sub>, and lignin ( $C_9H_{10}O_3$  (OCH<sub>3</sub>) 0.9-17)<sub>x</sub> along with pectin. The cellulose, hemicelluloses and lignin content in a typical lignocellulosic biomass falls within the range of 30-60, 20-40 and 15-25% (Rezania et al., 2020). However, the composition of these major-component varies depending on the source.

Cellulose is the main structural polysaccharides of the plant cell wall, providing it with high tensile strength and rigidity. Its amount usually ranges from 30% to 50% of the dry weight of lignocellulosic biomass. Regardless of its origin, cellulose is generally a highly crystalline and a high – molecular-weight polymer with a strong tendency to form high crystalline fibers. Hemicelluloses are the second most abundant polysaccharide of the plant cell wall (second primary polymer) which accounts for 15-30% of the lignocellulosic dry mass. They are complex polymers consisting of short linear and highly branched heteropolysaccharides. The lignin is the third principal component of lignocellulosic biomass, constituting about 15-30% of its dry mass. Present in all vascular plants, lignin is an amorphous, hyper-branched, and a cross-linked three-dimensional network polymer with no regular repeating elements.

Pretreatment process, disrupt the structure of lignocellulosic biomass and the cellulose fibre is exposed. This is carried out to overcome recalcitrance through the combination of chemical and structural changes to the lignin and carbohydrates (Singh et al., 2017). The hydrolysis of lignocellulosic biomass results in the release of various reducing sugars which are highly valued in the production of biofuel such as bioethanol, biogas, various organic acids, phenols and aldehydes. This pretreatment has leads to the development of various pretreatment techniques utilizing various physical, chemical, physico-chemical and biological approach.

Physical pretreatment is a pre-requisite prior to any other pretreatment methods. It is primarily carried out to reduce the particle size that result in the increase surface area, and decrease in degree of polymerization and crystallinity. Consequently, the process becomes more effective and easier (Chen et al., 2017). The methods are eco-friendly and seldom produce any toxic material.

Chemical pretreatment employs various chemicals, including alkalis, acids, gases, salts, ionic liquids, oxidizing agents, or organic solvents, to release polysaccharides from lignocellulosic complex and make them more susceptible to enzymatic hydrolysis (Cardona et al., 2018). Chemical pretreatment aims at removing hemicellulose and lignin in order to improve the biodegradability of cellulose.

Physico-chemical methods utilize both physical (high temperature and pressure) and chemical processes to effectively pretreatment of lignocellulosic biomass. Among such are steam explosion, carbon dioxide explosion, ammonia method, wet oxidation and liquid hot water.



Biological treatment of lignocellulosic materials is conducted to degrade the materials, the process may involve fungal pretreatment, enzymatic hydrolysis and aeration (Sharma et al., 2002). The fungi secrete the enzymes which are involved in the hydrolysis of cellulosic compounds to simple fermentable sugars. Enzymes such as xylanase, hemicellulose,  $\alpha$ -amylase, and arabinose can be used to achieve hydrolysis. The biological process is safe and environmentally friendly.

There are various combinations and several other techniques that are being developed to overcome the main drawbacks of the existing techniques to improve the utilization of the lignocellulosic complex, making the bioethanol production process more economical, efficient and environmentally friendly (Rezania et al., 2020). One of them is alkaline hydrogen peroxide (AHP) pretreatment that combines the application of NaOH and  $H_2O_2$ . The main advantages are high efficiency of enzymatic hydrolysis, high lignin and hemicelluloses solubilisation values for the liquid fraction, low energy consumption, availability of chemicals needed, no furan derivatives produced, no need for special reactors.

Detoxification aims to remove or reduce the concentration of all the toxic compounds from pretreated biomass or hydrolysates, including fermentation inhibitors (such as furan, aldehydes, aliphatic acids, and phenolic compounds) that could minimize the enzymes' efficiency and restrict microbial growth and activity during fermentation. The most common methods to discard inhibitors from biomass and ensure higher bioethanol yield and productivity are various in situ strategies, including membrane extraction, solvent extraction, ion exchange, membrane bioreactors, adsorption, microbial adaption, using microbial consortium or engineered microorganism.

## **2. Material and Methods**

### **2.1. Raw Materials**

The renewable lignocellulosic biomass, carpet grass was collected around Ailero, Kebbi State to be utilized as substrate for bioethanol production. The feedstock was washed with water to remove the impurities present and then sundried for 2 weeks to remove the moisture in the substrate. The dried carpet grass was then subjected to powder form using pestle and mortar and, in a blender, to reduce the particle size. Finally, the powder substrate was sieved to have a homogeneous size.

### **2.2 Biomass Pretreatment**

The pretreatment of the biomass was done by acid hydrolysis method. The 100g of the carpet grass was soaked in dilute tetraoxosulphate vi acid and heated at a temperature of  $90^{\circ}C$  for 2 hours. The slurry was autoclave at  $121^{\circ}C$  for 2 hours, and the solid separated from the liquid by filtration using a muslin cloth.

Three different concentrations of 1M 3M 5M of sulphuric acid were prepared and 10g of the powdered sample was added into each concentration. The mixture was soaked for two hours. The PH of each hydrolysate was adjusted to 6-7 using sodium hydroxide. 10ml 20ml 30ml of prepared yeast was added to each of the mixture respectively and then shaken for 5 mins to activate the yeast. This whole mixture was left for six days to ferment.

### **2.3. Hydrolysis**

#### **2.3.1. Preparation of NaOH (8.5M)**

The preparation of 48.58g of sodium hydroxide pellets were dissolved in  $500cm^3$  conical flask of prepared peptone water and stirred to dissolve.

### 2.3.2 Preparation of 1M H<sub>2</sub>SO<sub>4</sub>

94.6ml of distilled water was measured into 100ml volumetric flask and 5.4ml of concentrated sulphuric acid was added to make it up to the mark.

### 2.3.3 Preparation of 3M H<sub>2</sub>SO<sub>4</sub>

83.6ml of distilled water was measured into 100ml volumetric flask and 15.2ml of concentrated sulphuric acid was added to make it up to the mark.

### 2.3.4 Preparation of 5M H<sub>2</sub>SO<sub>4</sub>

73ml of distilled water was measured into 100ml of volumetric flask and 27ml of concentrated sulphuric acid was added to make it up to the mark.

## 2.4. Chemical Analysis of the Carpet grass

The chemical analysis of the biomass was subjected to estimation of the chemical composition, and the reducing sugars.

## 2.5. Microorganisms

### 2.5.1 Peptone water preparation

The preparation of 7.5g of peptone water was dissolved in 100ml distilled water in a 250ml conical flask, the dissolution was done using Magnetic stirrer. The conical flask was then placed on the hot plate for about eight minutes. After dissolution, it was then autoclaved until the temperature rose to 121°C, the solution was then sterilized, and allowed to cool.

### 2.5.2. Preparation of yeast

The preparation of 1.5g of baking yeast was poured into a 100ml sterilized peptone water in a 250ml conical flask and covered with cotton wool and aluminum foil was kept in an incubator

## 2.6 Production of Bioethanol

The production of bioethanol was carried out using sacharification and fermentation process.

After four days, the mixtures were removed and filtered. The black chunk that was left in the filter paper was the lignin which could be dried and used for fuel. The filtrate contains ethanol and some other impurities. 200cm<sup>3</sup> of the mixture was then distilled using simple distillation at 80°C for 35 minutes. The distillate was collected in a conical flask placed at the end of the distillation column and the test for the presence of ethanol was carried out afterward.

The Bioethanol which was produced from the fermentation process contains significantly amount of water which has to be removed. This is achieved using distillation set up. The ethanol boils at 78°C. Therefore, when boiling the product ethanol turns vapour at its boiling point before the water.

The fermentation was done by adding the activated yeast into different conical flask containing the samples. The conical flask was covered with cotton wool and wrapped with foil sheet to avoid oxygen penetrating into the fermentation medium. The samples were taken into the incubator and incubated at room temperature for 6days.

### 2.6.1. Enzymatic hydrolysis and Fermentation

The carpet grass which had undergone pretreatment are used for enzymatic hydrolysis process to convert the cellulose to glucose. The substrates were autoclaved and the yeast beaker to leading to increasing of high yield of reducing sugars for fermentation process (Ali et al., 2014).

The hydrolysis lasted for 24hours at a temperature of 50<sup>0</sup>C , stirring continuously and placed in the incubator. The vacuum filtration to separate the solid from the liquid part was used for fermentation. 1.0g of the yeast was added to the 200ml of the slurry to commence the fermentation process. This was carried out at room temperature for 21days in a conical flask sealed with an aluminum foil (Ali et al., 2014).

### 3. Results and Discussion

Bioethanol was produced by saccharification and fermentation of the carpet grass. Table 1 shows the chemical composition of feedstock. The production of bioethanol by yeast is essential for the conversion of the carpet grass to reducing sugars as shown in table 1.

Table 1. Chemical composition of carpet grass

**Table 1. Chemical composition of carpet grass**

| Composition | Cellulose | Hemicellulose | Lignin | Ash |
|-------------|-----------|---------------|--------|-----|
| Percentage  | 36.5      | 24.9          | 17.5   | 6.4 |

#### 3.1. Saccharification

During this process, the reducing sugars was released by using DNS method, which indicates released of highest quantity of sugars at 3M, and 3g of yeast after 24hours. Results shown in table 2.

**Table 2. Chemical composition of pretreated carpet grass**

| Composition | Total sugars | Reducing sugars | Cellulose |
|-------------|--------------|-----------------|-----------|
| Percentage  | 18.56        | 6.8             | 22.56     |

#### 3.2 Estimation of Bioethanol

The estimation of ethanol was observed from the results as shown in table 3 - 6.

Table 3-6 shows the results of the percentage yield of ethanol using 1M Acid hydrolysis; 3M Acid hydrolysis; and 5M Acid hydrolysis at different volume of yeast.

**Table 3 Percentage yield of ethanol at 1M concentration**

| S/N | Volume of yeast<br>Cm <sup>3</sup> | Volume of<br>hydrolysate cm <sup>3</sup> | Volume of 4<br>distillate cm <sup>3</sup> | Percentage<br>Yield % |
|-----|------------------------------------|------------------------------------------|-------------------------------------------|-----------------------|
| 1   | 10                                 | 64                                       | 13                                        | 20.31                 |
| 2   | 20                                 | 72                                       | 17                                        | 23.61                 |
| 3   | 30                                 | 82                                       | 22                                        | 26.27                 |

**Table 4: Percentage yield of ethanol at 3M concentration and different volume of yeast**

| S/N | Volume of<br>Yeast cm <sup>3</sup> | Volume of<br>Hydrolysate<br>cm <sup>3</sup> | Volume of<br>distillate<br>Cm <sup>3</sup> | Percentage<br>Yield % |
|-----|------------------------------------|---------------------------------------------|--------------------------------------------|-----------------------|
| 1   | 10                                 | 70                                          | 17                                         | 24.29                 |
| 2   | 20                                 | 80                                          | 21                                         | 25.61                 |
| 3   | 30                                 | 87                                          | 24                                         | 27.61                 |

**Table 5: Percentage yield of ethanol at 5M concentration and different volume of yeast**

| S/N | Volume of Yeast cm <sup>3</sup> | Volume of Hydrolysate Cm <sup>3</sup> | Volume of Distillate Cm <sup>3</sup> | Percentage Yield % |
|-----|---------------------------------|---------------------------------------|--------------------------------------|--------------------|
| 1   | 10                              | 80                                    | 21                                   | 26.25              |
| 2   | 20                              | 84                                    | 25                                   | 29.76              |
| 3   | 30                              | 92                                    | 29                                   | 31.52              |

**Table 6. Characterization of produced Bioethanol**

| Properties (S.I Units)       | Carpet grass | ASTM<br>Standard |
|------------------------------|--------------|------------------|
| Boiling point (°C)           | 78           | 78               |
| Cloud point (°C)             | 20           | 23               |
| Density (g/cm <sup>3</sup> ) | 1.03         | 0.79             |
| Flash point (°C)             | 19.50        | 18.60            |
| Pour point (°C)              | 5.0          | 5.2              |
| Viscosity (Cst)              | 0            | 0.98             |

The effects of acid concentration and variation of yeast concentration was carried out using 1M, 3M, 5M concentration of tetraoxosulphate vi acid.

Table 3, shows the variation of ethanol yield, derived from the fermentation of hydrolyzed lignocellulosic content of carpet grass with 1M concentration of tetraoxosulphate vi acid and different volume of yeast. It was observed that the percentage of ethanol increases with increase volume of yeast. As shown in Table 4, it can be deduced that the percentage yield of ethanol increases with increase in the volume of yeast. Table 5 showed that ethanol yield also increase with increase in acid concentration which also confirmed that the fermentable sugar present in hydrolyzed lignocellulosic content of carpet increases with increase in the concentration of the acid. At 1M concentration, and highest volume of yeast of 30cm<sup>3</sup>, the maximum yield of ethanol was 26.27cm<sup>3</sup>. At 3M concentration and highest volume of yeast of 30cm<sup>3</sup>, the maximum yield of ethanol was 27.61cm<sup>3</sup>. At 5M concentration and highest volume of yeast at 30cm<sup>3</sup>, the maximum yield of ethanol was 31.52cm<sup>3</sup>. It can be deduced that increase in the yield of ethanol is directly proportional to the increase in the concentration of the acid.

### Recommendations

This research has successfully proved that production of bioethanol from sawdust is a good venture that could reduce unemployment in Nigeria. As a result, I will recommend that:

1. Further research should be done using non-acid hydrolysis as an alternative to chemical methods to reduce toxicity.
2. Bioethanol should be produced on industrial scale so as to provide a lasting solution to the gradual depleting ozone layer as a result of greenhouse gasses emission.
3. More research should be conducted on the production of bio energy which are renewable.
4. Various industries should utilize huge volume of cellulosic wastes which provides a low-cost and sustainable resources for production of ethanol in order to reduce the emission of greenhouse gas cause by fossil fuel.

## Conclusions

By analyzing the results above, it can be concluded that acid hydrolysis can be used to improve the production of ethanol from the lignocellulosic content of carpet grass. Ethanol with moderate percentage yields was produced from carpet grass using three different acid concentrations in the hydrolysis processes. The concentration of yeast also affect the yield of ethanol obtained from the fermentation of the fermentable sugar derived from the hydrolyzed lignocellulosic content of carpet grass.

Conclusively, this present work has clearly shows that acid hydrolysis at 5M tetraoxosulphate vi acid with moderate yeast concentration can be used to improve the production of bioethanol production.

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## SOCIAL CAPITAL AND COMMUNITY RESILIENCE IN BIDA, NIGER STATE, NIGERIA.

BY

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### Abstract

*Households and communities, the world over are constantly being exposed to the increasing frequency and negative impacts of environmental and socioeconomic shocks owing to factors such as climate change, weak public institutions, poor government policies and lack of or poor infrastructure. As a result, this study set out to investigate the influence of social capital, demography and civic engagement on the capacity of communities to respond and recover from crises/shocks. To attain these, the study examined the relationships between the indicators of community resilience and those of social capital and demography respectively; as well as the nexus between civic engagement and community resilience among the 592 sampled households in Bida town, Niger State, Nigeria. Data for the study were collected through structured questionnaires and analysed using descriptive and inferential statistics (multiple linear regression). Findings from these revealed that social capital is a strong and statistically significant predictor of community resilience, and with each unit increase in social capital score, there is an associated increase of about 0.2 units in the community resilience index. The outcome similarly indicated that civic engagement index (CEI) explains 61% of the variation in community resilience, and it is as well, a statistically significant predictor of community resilience. The study concluded that enhancing the bridging and linking forms of social capital alongside the establishment of formal support systems, is crucial to fostering resilience in urban communities. The study then recommended improved community engagements and capacity building of the formal, traditional and religious institutions for effective resilience building.*

**Keywords:** Social capital; demography; civic engagement; and community resilience

### Introduction

Communities across the globe are increasingly being exposed to a variety of shocks, ranging from environmental disasters and pandemics to economic disruptions and social instability (Madhav *et al.*, 2017; Botzen *et al.*, 2019; and McKibbin *et al.*, 2023). As a result of these, Desouza (2014) and De Boer *et al.* (2016) asserted that some urban centres are becoming highly fragile and unstable. The implication of this is the inability of such communities to build resilience (Usman, 2019). The capacity of a community to recover from shocks and disturbances, often referred to as community resilience, has thus become a central theme in contemporary development discourse (Aldrich and Meyer, 2015). While physical infrastructure and institutional support are essential, growing evidence suggests that social capital, that is, the networks of relationships, trust, and norms of reciprocity among community members, is a critical but often overlooked driver of resilience (Mpanje *et al.*, 2018; Chen *et al.*, 2024; and Straub *et al.*, 2024).

In Nigeria for instance, and particularly in urbanising towns like Bida, resilience challenges manifest in various forms, including limited access to public services, frequent infrastructural breakdowns, socio-economic vulnerabilities, and climate-related stressors (Usman *et al.*,

2021). These realities place considerable strain on formal governance structures, thereby increasing the reliance on informal networks and communal coping strategies (Usman, 2019). The relevance of social capital becomes even more significant in such settings, where communal ties, religious associations, and neighbourhood groups often fill the governance vacuum and facilitate collective action during times of crisis (Ifeanyi *et al.*, 2022).

Social capital is generally categorised into bonding, bridging, and linking forms, and according to Szreter & Woolcock (2004), they have been conceptualised thus - bonding social capital refers to the strong intra-community ties among close networks, such as family and neighbours. Bridging capital on the other hand involves the connections across diverse groups, while linking capital refers to the networks that connect communities with institutions and authorities. Understanding how these dimensions function in a semi-urban area like Bida is key to identifying the social assets that support or hinder community resilience. Despite its strategic importance in Nier State, North-central Nigeria, research on the intersection between social capital and resilience in Bida remains sparse and largely anecdotal.

Moreover, as Nigeria continues to grapple with challenges such as climate change, population pressure, and economic shocks, the resilience of its urban communities are supposed to be of utmost priority. Yet, much of the efforts or focus of governments and stakeholders remains on infrastructural development, with less emphasis on social processes that sustain community cohesion and support recovery in the face of adversity (Ayanlade and Radeny, 2020). This gap is even more apparent at the local level, where there is limited empirical data to inform community-driven interventions that leverage local networks and capacities (Ziorklui *et al.*, 2024).

This study, therefore, examined the role of social capital in enhancing community resilience among the residents of Bida. It investigated how local social networks, trust, shared norms, and institutional linkages contribute to community adaptation and recovery from shocks. By unpacking the functions and limitations of social capital, the research provided insights for designing more effective and context-sensitive resilience strategies in similar urbanising settings.

## LITERATURE REVIEW

### Conceptualising social capital

Social capital refers to the resources embedded in social networks, including trust, norms, and connections that facilitate cooperation and coordination among people (Zafor, 2018). Bourdieu (1986) framed it as a form of accumulated social obligations, while Coleman (1990) emphasized its function in facilitating action within social structures. In development discourse, social capital is now broadly recognized as a critical component of community development and resilience (Claridge, 2020).

According to Szreter and Woolcock (2004), social capital can be categorised into the following three distinct forms and each plays unique roles in enhancing resilience capacities, from emotional support during crises to access to institutional resources for long-term recovery.

- i. Bonding social capital – these are the strong ties that exist within homogeneous groups, such as family and ethnic communities.
- ii. Bridging social capital – these are the weaker ties that connect diverse groups.
- iii. Linking social capital – these are the vertical ties that connect individuals to institutions or authorities.



## Community resilience: definitions and dimensions

Community resilience is defined as the ability of a community to withstand, adapt to, and recover from external shocks and stressors (Patel *et al.*, 2017; Usman, 2019). The main dimensions of this resilience often explored include economic resilience, infrastructural resilience, and social resilience, with the latter increasingly viewed as foundational (Usman *et al.*, 2021). Researches, according to Aldrich and Meyer (2015), have shown that social connectedness can buffer communities against the impacts of disasters or economic hardships by promoting resource-sharing, psychosocial support, and collective problem-solving. However, resilience outcomes vary based on the quality and type of social capital present in a community (Glover and Parry, 2020).

## The role of social capital in building resilience

Empirical studies have found that communities with stronger social ties tend to recover faster from shocks such as natural disasters, epidemics, and economic downturns (Jewett *et al.*, 2021; and Su *et al.*, 2024). For instance, Aldrich (2012) found that in post-tsunami Japan, social capital was a better predictor of recovery than economic aid. Similarly, in urban Nigeria, informal networks and community-based organizations have been shown to mobilize resources and information more efficiently than formal institutions in times of crisis (Ifeanyi *et al.*, 2022). The integration of social capital into resilience planning is now seen as essential, especially in contexts with weak formal governance structures. In semi-urban areas like Bida, where state capacity may be limited, local associations, religious groups, and neighbourhood fora often take on governance roles during emergencies (Adegbite *et al.*, 2023).

## Gaps in the literature

Despite growing interest in the subject, few studies have explored the role of social capital in resilience at the local community level in Nigeria. Even fewer have done so in smaller towns like Bida, where informal networks play a disproportionately large role in service delivery, information dissemination, and conflict resolution. Most available studies tend to focus on metropolitan cities or disaster-prone regions, neglecting the unique vulnerabilities and assets of middle-sized towns (Ayanlade and Radeny, 2020). This study thus addressed this gap by examining how different forms of social capital influence the resilience of Bida, especially in the face of socioeconomic and environmental stressors.

## Research Methodology

This study adopted a quantitative research technique because of its appropriateness in capturing the multifaceted nature of themes of the study, that is, social capital, demography, CEI, and community resilience. Furthermore, the descriptive cross-sectional and inferential surveys were employed for the study and they formed the core of the data collection process.

This research was conducted in Bida, a major town in Niger State, North-Central Nigeria. The town is characterised by a blend of formal and informal urban systems, with a high reliance on communal ties, religious organizations, traditional institution, and local associations in responding to socioeconomic and environmental shocks. The town is divided into several wards and neighbourhoods, providing a diverse landscape for exploring variations in social capital and resilience.

The target population for this study is household heads across all the neighbourhoods of Bida, that is, both the formally planned areas and informal settlements. A two-stage sampling technique, made up of the cluster and random sampling was employed for this study. The cluster sampling technique was used to divide the study area into 12 clusters (after Usman,

2019), while proportional samples were drawn from each cluster using the random sampling technique.

To estimate the appropriate sample size for the study, Bida's 2006 population count of 188,181, sourced from the National Population Commission (NPC) in the Niger State Bureau of Statistics (NSBS, 2012), was projected to 2025 using the national population growth rate of 3.2% (United Nations Population Fund, UNFPA, 2011; and National Population Commission, NPC, 2016). Hence, using the geometric growth formula, the projected 2025 population for the study area is 342,366. To calculate the number of households in each neighbourhood of Bida, the projected population figure was divided by 7.8, the average household size of Bida (Usman, 2019). To determine the number of required respondents for the study area, the Calculator.net App, a digital tool for sample size determination was used. This therefore gave a sample size of 592 based on a 4% margin of error, and 95% confidence level. This sample was then distributed proportionately across the neighbourhood clusters as shown in Table 1.

**Table 1: Projected 2025 population; estimated number of households and sample sizes of neighbourhoods**

| S/No         | Neighbourhood    | Projected population | Estimated no. of households | Sample size |
|--------------|------------------|----------------------|-----------------------------|-------------|
| 1.           | Bangaie          | 35,990               | 4,614                       | 62          |
| 2.           | Bangbara         | 24,883               | 3,190                       | 43          |
| 3.           | Banma            | 47,985               | 6,152                       | 83          |
| 4.           | Banwuya          | 49,016               | 6,284                       | 85          |
| 5.           | Banyagi          | 43,957               | 5,636                       | 76          |
| 6.           | Dokodza          | 35,932               | 4,607                       | 62          |
| 7.           | Esso             | 55,871               | 7,163                       | 97          |
| 8.           | GRA              | 11,904               | 1,526                       | 21          |
| 9.           | Ndazabo          | 5,341                | 685                         | 9           |
| 10.          | Poly Area        | 17,344               | 2,224                       | 30          |
| 11.          | Project Quarters | 6,403                | 821                         | 11          |
| 12.          | Ramatu Dangana   | 7,450                | 955                         | 13          |
| <b>Total</b> |                  | <b>342,366</b>       | <b>43,857</b>               | <b>592</b>  |

Source: Calculated after Usman (2019)

As earlier stated, the data collected were analysed using descriptive and inferential statistics (regression analysis) with the aid of the Statistical Package for Social Sciences (SPSS). The descriptive statistics was used in summarising the dataset, while the regression analysis was employed to assess the relationships between the respective dimensions of social capital, demography, and civic engagement with those of community resilience among households in Bida. To calculate the CEI, the responses were rated on a 5-point Likert scale, with 1 = Strongly Disagree and 5 = Strongly Agree. The classification of the score is shown in Table 2.

**Table 2: Classification by CEI Score**

| CEI Score | Range Classification      |
|-----------|---------------------------|
| 4.0 – 5.0 | High civic engagement     |
| 3.0 – 3.9 | Moderate civic engagement |
| < 3.0     | Low civic engagement      |

## Results and Analysis

Data obtained from the sampled households indicated that 50% of the respondents are aged 51 and above, and the gender ratio leans significantly toward male (62.3%). The data also showed that 54.2% of the respondents are married, with a notable number of them unmarried (29.1%), indicating a potentially young population. Data on the education attainments showed that 31.6% and 28.2% of the respondents have primary and secondary education respectively, while 52.7% of them are employed. This suggest that most of the respondents are income earners and economically active. Data on the residency duration of the respondents revealed that 63.3% of them have lived in their community for over 10 years, and this indicates deep-rootedness and it is a potential for strong social ties.

Data on bonding social capital revealed that 60% of the respondents frequently attend family gatherings, but 95% do not rely on their relatives during crises, implying emotional connection but limited practical support. On the other hand, the bridging social capital data showed that 73% of the respondents belong to community groups, and 77% collaborate across ethnic/religious lines, suggesting moderate to strong horizontal linkages. Similarly, the data obtained on linking social capital showed that a vast majority (84.6%) of the respondents opined that their community has not received any external support in the past three years, and only a small fraction (4.1%) reported receiving support, while 11.3% were unsure. Furthermore, the data on trust levels revealed that trust is highest in security (93.6%), religious (86%), and traditional institutions (87.2%). The implication of this is that trust in religious and traditional institutions is generally very strong among the respondents, with police and other security agencies enjoying the highest trust levels. This is despite national trends of skepticism in some contexts about the police and other security agencies.

The data obtained on community resilience indicated that the biggest and severest shock recorded was economic hardship (39.5%), followed by flooding (22.3%) and health crises (18.8%). Similarly, 67.4% of the respondents opined that their community always supports each other in times of hardship, although no formal emergency response structures exist. However, data on the perceived rate of recovery of the community showed that 77% of the respondents opined that the community does not recover quickly from shocks, while they all asserted that the community has no formal or informal emergency structures.

Data on the civic engagement of the study area indicated that 17% of the respondents reported high civic engagement, while 52% and 31% reported moderate and low civic engagements respectively. On the other hand, the CEI data presented in Table 3 revealed that civic awareness obtained a mean score of 3.52 on a 5-point Likert scale (indicating moderate awareness), civic participation recorded 3.08, and government responsiveness recorded 2.75 (weak trust in responsiveness). The composite of these indices is 3.07, implying that a majority of Bida residents fall within the moderate category of the civic engagement index.

**Table 3: Civic engagement index (CEI)**

| CEI Component                  | Mean Score | Std. Dev | Interpretation                       |
|--------------------------------|------------|----------|--------------------------------------|
| Civic Awareness (CA)           | 3.52       | 0.94     | Moderate awareness across population |
| Civic Participation (CP)       | 3.08       | 1.10     | Low to moderate participation        |
| Sense of Voice (SV)            | 2.91       | 1.05     | Low perceived influence              |
| Government Responsiveness (GR) | 2.75       | 1.02     | Weak trust in responsiveness         |

|                      |             |             |                         |              |                   |
|----------------------|-------------|-------------|-------------------------|--------------|-------------------|
| <b>Composite CEI</b> | <b>3.07</b> | <b>1.02</b> | <b>Moderate overall</b> | <b>civic</b> | <b>engagement</b> |
|----------------------|-------------|-------------|-------------------------|--------------|-------------------|

### Inferential Statistics: Regression Analyses

This regression analysis predicted the relationships between community resilience and social capital on one hand, and between community resilience and demographics on the other hand. The outcome of the analysis is shown in Table 4:

**Table 4: Regression analysis between community resilience and social capital/demographics**

| Variable       | Coefficient | Std. error | t-value | p-value |
|----------------|-------------|------------|---------|---------|
| Intercept      | 1.15        | 0.36       | 3.2     | <0.01   |
| Social capital | 0.20        | 0.03       | 6.6     | <0.001  |
| Gender         | 0.21        | 0.16       | 1.3     | >0.05   |
| Age            | 0.12        | 0.05       | 2.3     | <0.05   |
| Education      | -0.04       | 0.06       | -0.6    | >0.05   |
| Employment     | 0.01        | 0.04       | 0.2     | >0.05   |

The outcome of the regression analysis as indicated in Table 4 revealed that social capital is a strong and statistically significant predictor of community resilience. Hence, with each unit increase in social capital score, there is an associated increase of 0.2 units in the community resilience index. The Table also revealed that age showed a positive and significant effect on community resilience index, suggesting older respondents reported higher levels of community resilience. However, the analysis indicated that gender, education, and employment do not significantly predict community resilience in this model. The study similarly predicted whether or not, civic engagement significantly predicts community resilience in Bida town. The analysis of this is presented in Table 5.

**Table 5: Regression analysis between civic engagement and community resilience**

| Predictor              | Coefficient<br>( $\beta$ ) | Std. Error | p-value | Interpretation            |
|------------------------|----------------------------|------------|---------|---------------------------|
| Intercept              | 1.25                       | 0.41       | 0.001   | ---                       |
| Civic Engagement (CEI) | 0.48                       | 0.09       | 0.000   | Strong positive predictor |
| Social Trust           | 0.32                       | 0.08       | 0.002   | Moderate positive effect  |
| Network Strength       | 0.27                       | 0.07       | 0.005   | Slightly positive         |

The outcome of the analysis recorded an  $R^2$  value of 0.61, which implies that the model explains 61% of the variation in community resilience. Hence, CEI is a statistically significant predictor of resilience. The implication of this is that residents with higher civic engagement scores are more likely to be resilient to socioeconomic and environmental shocks because of their ability to influence decisions, mobilize quicker, recover better, and adapt faster.

### Recommendations

Based on the findings of the study, the following recommendations have been put forward:

- i. The strengthening of formal structures by developing local resilience plans, and empowering traditional and religious institutions with structured roles in crisis response.
- ii. Enhancing external linkages by facilitating partnerships between local groups, NGOs, and government agencies for technical and financial support.
- iii. Investing in social networks through supporting interfaith and inter-ethnic community programmes that foster cooperation beyond familial ties.
- iv. The strengthening of civic education through town hall fora and radio programmes, as well as improving responsiveness (community feedback by the government).

## Conclusion

This study examined the relationship between the various dimensions of social capital and community resilience among households in Bida. The findings indicated that social capital is a strong and statistically significant predictor of community resilience but indicators of demography such as gender, education, and employment do not significantly predict community resilience in this model. The study also showed that civic engagement in Local Governance is a valuable and statistically robust indicator of social capital and community resilience in Bida. Hence, as local governance becomes increasingly relevant in responding to shocks from climate change to economic downturns, enhancing civic engagement becomes not just a democratic ideal, but a practical necessity for resilience building.

The descriptive statistics showed that a large majority of the respondents reported no formal or structured response mechanisms in their neighbourhoods, though informal support networks were seldom present. Trust levels in traditional and religious institutions were high, while trust in formal security agencies was relatively higher. The respondents overwhelmingly cited economic hardship, flooding, and health crises as the major shocks faced by them in recent years. The regression analysis confirmed that social capital, especially bridging and linking forms, significantly contributes to building resilience. However, the community's ability to bounce back from crises remains limited due to the lack of formal/informal emergency structures, despite high levels of interpersonal trust and social ties.

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## THE USE OF ELECTRONIC INFORMATION RESOURCES BY UNDERGRADUATE STUDENTS OF ADAMAWA STATE POLYTECHNIC, YOLA NIGERIA

By

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### Abstract

*The purpose of this study is to know the extent of use of electronic information resources and identify the type of electronic resources used by undergraduate students at the Adamawa state polytechnic Yola, Nigeria. 267 students in 200 levels and above who used the library during the period of the study formed the population for the study. The survey research method was select for the study. A Questionnaire was use as a data collection instrument. Frequency counts and simple percentages were use in analyzing the data collected. The study revealed that the use of electronic resources has great impact on the academic performances of the undergraduate students of Adamawa State Polytechnic Yola; nevertheless, there is necessary for them to obtain greater skills in the use of electronic information resources.*

**Key words:** *Electronic Resources, Undergraduate Students, Adamawa State Polytechnic, Yola*

### 1. Introduction

Information Technology has influenced all aspects of librarianship and information service delivery. The evolution of information technology in the 20<sup>th</sup> century has influenced student use of information resources. Today, many students access information electronically via the internet using desktop, laptop, palmtop and mobile phones. Electronic resources supply all the information that a library provides through computer network. These include electronic books, electronic journals, bibliographic databases, library web pages articles from magazines, encyclopedias, pamphlets and other resources that are access on electronic devices. Oduwale and AKpati (2003) noted that CD-ROM, electronic mail and internet browsing constitute electronic resources. In developed countries, studies have shown that students prefer electronic resources to print materials.

In recent time, has been the need of electronic information resources in academic libraries to meet up the objective of their parent institution. Electronic information resources are available tools for study, learning and research (Togia and Tsigilis 2009). For many academic libraries to thrive in this information age, the library irrespective of the size of its collection must embrace information communication technology. Online dictionary of library and information science (2004) defines electronic information resources as materials consisting of Data and or computer programs encoded for reading and manipulation by a computer such as CD-ROM drive or remotely via network such as the internet b the use of a peripheral device directly connected to the computer. Shim et al (2001) defined electronic information resources as those that users access electronically via a computing network from inside the library or remote to the library.

The access to electronic information resources in academic libraries and among universities and Polytechnics students is rapidly increasing because of massive adoption of information communication technology. Electronic information Resources (EIRs) Play vital roles in helping libraries in their quest to support the teaching and learning process at universities and



polytechnics level and to provide quality assistance to its users. As an emerging field, information technology has been facilitated by providing electronic and internet resources for fulfilling the day-to-day academic and research requirements of the university students (Manoj Kumar, gaur, and Bimal, 2011). Information technology has made a profound impact on availability and accessibility of Electronic Information Resources to provide a quack accessibility and comprehensive access to resources by using best possible tools and techniques is the ultimate aim of every library. The application of computers to information processing has brought several products and services to librarianship as a profession consequent, library services have undergone tremendous changes during these years. Assuming new dimensions influenced by technology- driven applications. Librarians therefore have witnessed a great transformation in recent years both in their collection development and in their service structures. Thus, libraries are using technology to improve the acquisition and management of scholarly information to strengthen and speed access to scholarly information not held locally electronic information resources are easily accessible in the remote areas and solve storage problems and control the flow of information.

Commenting on the advantages of electronic resources, Dazie (2005) writes that electronic resources are invaluable research tools that complement the print-based resources that are available in a traditional library setting. Their advantages, according to her includes: access to information that might be restricted to the user due to geographical location or finance, access to more current information because they updated frequently, they offer advanced search capabilities, they offer flexibility in the storage of the results of time of location. This rapid emergence and development of electronic information technologies therefore makes it possible to envision radically different ways of organizing the collections and services of the library as traditionally provided. A number of studies have been making with a view proffering solutions to problems encountered in the use of electronic information resources. However, little or no efforts have been recording in identification of influence and the usage of electronic information resources among undergraduate students, in the Adamawa State Polytechnic Yola. The gap that researched intended to identify. The purpose of study is to investigate the use of electronic information resources among undergraduate students of Adamawa State Polytechnic Yola.

### **Objective of the study**

The main objective of the study is to examine the usage of electronic resources by undergraduate of Adamawa state polytechnic yola, Nigeria, the perceive impact of the e-resources on their academic efficiency and problems faced by them while using the e-resources. This study was particular conducted to assess the benefits of the e-resources over conventional sources of information.

Some of the major objectives are to:

- (i) To determine the level of awareness of electronic information resources available in Adamawa state polytechnic library;
- (ii) To study the purpose of the use of these electronic information resources and services available in the library by under-graduates
- (iii) To know the effect of these electronic information resources on students academic improvement
- (iv) To examine the challenges faced by undergraduate students while accessing and using electronic information resources in the library;

## Research Questions

*The following questions were raised to guide the study:*

4. Are the undergraduate students aware of the availability of electronic information resources in Adamawa state polytechnic library?
5. What are the purposes for which the undergraduate students make use of electronic information resources available in Adamawa state polytechnic library?
6. What effect do these electronic information resources have on student academic improvement?
7. What are the challenges faced by the undergraduate students when using electronic information resources?

## 2. Literature Review

The introduction of Information and Communication Technologies (ICT) has greatly influenced how students search and retrieve information. It has also influenced library services. Osif (2008) citing Frey's article states that we have transitioned from a time where information was scarce precious, today information is vast and readily available and in many classes. Therefore, with the explosion of information by technology, information is accessible anytime and anywhere with the use of computer. Information is no longer restricted to the library building.

Electronic information resources are information resources that are acquiring from computer anytime, anywhere provided and the necessary facilities. Electronic resources are relatively fast and are accessible 24 hours in a Day, 7 Days in a week and you can use it from your own computer (Jagboro, 2003). Electronic information resources are indispensable information resources in institutions of higher learning especially the university and polytechnic in this digital age. All academic libraries expected to have these resources to promote greater learning, research and communication. More so, the National University Commission (NUC) accreditation team is interested in the installation and of electronic information resources in Nigerian university libraries. The transition from print and electronic medium, apart from resulting in a growth of electronic information, has provided users with new tools and application for information seeking and retrieval. Okiki and Asiru (2011) remarks that libraries all over the world make a wide variety of electronic information sources available for use by the undergraduate, post graduate, researchers and staff in their respective institutions. In their studies, it was revealed that the internet is the major source of accessing information and it has made possible access to electronic books, journal databases and search engines. They are the popular tools for research and academic activities (Chirra et al, 2009).

### *Types of Electronic Resources Available in the Library*

The university of Chicago library listed some of the electronic information resources that should be available at every academic libraries disposal include:

- CD ROMs: is a pre-pressed optical compact disc, which contains data. The name is an acronym, which stands for 'compact Disc Read - only Memory' – computers, can read CD ROMs, but cannot write on the CD-ROMs that are writable or erasable. Until the mid-2000s, CD-ROMs were popular used to distribute software for computers and video game consoles. Some CDs, called enhanced CDs, hold both computer data and audio with the latter capable of being played on a CD player, while data (such as software or digital video) is only usable on a computer (such as ISO 9660 format PC CD-ROMs).

- Electronic Books: library now provides access to a variety of electronic books, as well as the other printed works (such as essays, poems, or historical documents). Some of these electronic books and texts are part of the large searchable databases.
- Electronic Journals: most academic libraries now have an online E-journals database to help you find journal materials that is useful to users and an online versions of e-journals which the library subscribe to have access to current journal publication.
- Online Database: is a web base filling system designed to store information- it is a database accessible from a network, including from the internet. Most academic libraries now subscribe to online databases of books and journals that are relevant to the university curriculum, which will help to facilitate teaching and learning in the university environment.
- Online sources: online is a material which available online. It can be an online newspaper, magazine or television website such as NBC or CNN peer-reviewed journals, web pages, forums and blogs are also online sources. Some other names for online sources are electronic sources and internet sources. These are very useful electronic information resources, which many libraries are now making available to satisfy the urgent needs of their user community.

### *Effect of the Electronic Information Resources on Library Users in Academic Institution*

The emergence of electronic resources has cut the barrier to valuable information resources that until now were difficult to access especially by scholars in the developing nations of the world. Salaam (2008) attributes the popularity of electronic resources to flexibility in searching than their paper based counterpart, and that they can accessed remotely at any time. Tenopir (2003) in a major survey analyzed the findings of over 200 studies on the use of electronic resources in libraries that were publishes between 1995 and 2003 the results revealed that electronic resources have been rapidly adopted in academic spheres; however, behavior varies according to discipline. The importance and wide ranging scope of these electronic information resources for general communication, information retrieval and instructional delivery to support teaching and research activities in tertiary educational institutions and academic libraries in particular is a acknowledge worldwide. The literature also shows that a number of relevant studies have been carried out on the use of electronic resource by lecturers, research scholars and students worldwide. General user opinion towards the use of electronic resources in particular CD-ROM, has been positive, with students enjoying using these sources and finding relatively few problems

According to Bar-Ilan, Perutz, and Wolman (2003) most of the users of electronic books and journals are the younger members of the teaching and research staff. In a related study, Bush (2004) showed that age was not an influential factor in whether the respondent reads articles on paper or electronic format. Brennan et al (2002) in studies that centered on how the adoption of electronic information resources has affected academic information behavior revealed that faculty make fewer visits to the library and read more of electronic books and journals than in the print era, most academic report use generic databases to locate information while rely on smaller discipline-specific databases. Corroborating this, Dilek-Kayaoglu, (2003) in a research on use of electronic journals by faculty students at Istanbul university, also revealed that majority of respondent supported transition from print to electronic resources because of the numerous opportunity its present to their studies have also been carried out on the use of electronic resources by teachers, students, researchers, and scholars. (78%) of the respondents feel that the use of OPAC, e-books, e-mail, e-reference sources, e-journals etc. has created high dependency value on their research work and they needed current article alert services and electronic document supply services (Madhu Sudhan, 2008). Uzuebu et al (2002) in his study

Asserts that for effective utilization of electronic database, not only is computers and internet connection necessary, creating a usable inter-face is indispensable.

### *Challenges of the Use of Electronic Information Resources*

Electronic resources have contributed immensely to teaching, learning, research and communication but there are challenges that affect the effective use of these resources, such as:

-Lack of skills and knowledge: it is a fact that the major problem in the use of electronic resources is lack of skills and knowledge. Students, research scholars and staff lack skills and knowledge for effective search, retrieval and evaluation of information (Baron, Eze & Nkanu, 2013). Many students and research scholars depend on library staff, friends, cybercafé assistants for assignment. Chisenga (2000) among others identified general shortage of skilled IT human resources in libraries as of the factors hindering internet connectivity. He also identified lack of consistent training for new IT services and inadequate knowledge.

- Lack of subscriptions to relevant e-journals: majority of the relevant journals and books on the internet can only be access through subscription. Many universities have internet connectivity in their libraries but do not subscribe to journals. For instance, majority of articles in emerald journals on the internet are not accessible unless you subscribe to them.

- Lack of Maintenance and poor infrastructure: according to Baron, and Asaba (2010) our universities lack maintenance culture. They lack the skilled labor to maintain and manage the system after the initial installation. After installation and some of the workstation could not be access the server.

- Poor Power Supply and slow internet connectivity: this is one of the biggest problems in the use of electronic information resources. Okiki and Asiru (2011) states that slow internet connectivity, incessant power outage and lack of IT skills are the problems that affect the use of electronic information resources. Similarly, Ojokoh and Asaolu (2005) also assert that insufficient training, slow internet connectivity and frequent power failure in Nigeria are problems that affect the use of electronic information resources.

- Inadequate Finance: finance is indispensable in the use of electronic information resources in our institutions. Finance will need to train the staff and maintain the infrastructure. Subscription of e-journals and e-books also depend on finance. Some university management does not see the need to adequate finance the library. The money giving to the library is not sufficient to provide these resources. Bozimo (2005) submitted that inadequate funding and support to procure and maintain equipment, retrospective conversion of library documents in to digital formats, training of skilled labor in computer literacy and internet training, ability to subscribe to relevant online databases.

### **Methodology**

The very research method was adopt for this study because it was consider more appropriate for this type of study. Data was collect for the study with questionnaire. '267' students in 200 levels and above who used the library during the period of the study formed the population for the study. The questionnaire was administering to 267 students who visited and used the library within the period of research through the assistance of the library assistants. The questionnaire was in four parts. Part A elicited background information such as gender and college of respondent. Part B elicited information on respondent awareness of electronic information resources. Part C sought of information on the usage of electronic information resources. Part D elicited information on respondent perception of the effect of electronic information

resources on their academic performance while part E sought information on the challenges of using electronic resources. The data was analysed using simple percentages and frequency counts.

**Table 1: Respondents gender**

| Gender      | Frequency | Percentage |
|-------------|-----------|------------|
| Male        | 176       | 65.9       |
| Female      | 89        | 33.3       |
| No Response | 2         | 0.7        |
| Total       | 267       | 100        |

Table 1 shows that the 267 (100%) respondents, 176 (65.9%) were male, 89 (33.3%) were female while two (0.8%) did not respond to the question that sought to reduce their gender. This clearly reveals that male undergraduate students form a larger population of students in Adamawa State Polytechnic Yola.

**Table 2: Breakdown of participant by colleges**

| College     | Frequency | Percentage |
|-------------|-----------|------------|
| Science     | 80        | 30         |
| Technology  | 180       | 67.4       |
| No Response | 7         | 2.6        |
| Total       | 267       | 100        |

Table 2 shows that of the 267 respondents, 80 (30%) were from the colleges of science, 180 (67.4%) were from the college of technology while seven (2.6%) of the respondents did not respond to the question. This reveals that majority of the users of electronic information resources in Adamawa State Polytechnic are from the college of technology.

**Table 3: Respondents Level of Awareness of Electronic Information Resources**

| Resources           | Agreed | %    | Disagreed | %    | Not certain | %    | Total |
|---------------------|--------|------|-----------|------|-------------|------|-------|
| CD ROM              | 73     | 27.3 | 113       | 42.3 | 81          | 30.3 | 267   |
| Online Database     | 168    | 62.9 | 37        | 13.9 | 62          | 23.3 | 267   |
| Electronic Books    | 213    | 79.8 | 4         | 1.5  | 50          | 18.7 | 267   |
| Internet            | 267    | 100  | Nil       | 0    | Nil         | 0    | 267   |
| Electronic Journals | 166    | 62.2 | 56        | 20.9 | 45          | 16.9 | 267   |

Table 3 represents the breakdown of the responses of the participants when they were asked, if they were aware of the electronic information resources. listed in the table Of the 267 (100%) respondents 73 (27.3%) agreed they were aware of the availability of CD-ROM in SPY library. 113 (42.3%) disagreed of the availability of CD-ROM facilities in Adamawa state polytechnic library while 81 (30.3%) said that they are uncertain of the availability of CD-ROM facility in SPY library. 168 (62.9%) said they were aware that online database was available while 37 (13.9%) disagreed that they were aware of the availability of online database in Adamawa State Polytechnic library and 62 (23.2%) said they are not certain of the availability of online database in SPY library. 213 (79.8%) of them agreed they were aware of the availability of electronic books in SPY library, 4 (1.5%) disagree of the availability of electronic books in SPY library, and 50 (18.7%) said they are not certain of the availability of electronic books in

SPY library. 267 (100%) of the students are aware of the availability of internet in SPY library stipulating that all the respondent are aware of the availability of internet in SPY library. 166 (62.2%) of the respondent are aware of the availability of electronic journals in SPY library, while 56 (20.9%) are unaware of the availability of electronic journals, while 45 (16.9%) said they are not certain of the availability of electronic journals in SPY library. This shows that majority of the respondents were aware of the availability of electronic resources in the library.

**Table 4: Respondents Purpose of Use of Electronic Information Resources**

| Purpose                       | Agreed | %    | Disagreed | %   | Total |
|-------------------------------|--------|------|-----------|-----|-------|
| Research                      | 262    | 98   | 5         | 1.9 | 267   |
| Access to Timely Information  | 252    | 94.4 | 15        | 5.6 | 267   |
| Assignment                    | 267    | 100  | 0         | 0   | 267   |
| E-mail                        | 267    | 100  | 0         | 0   | 267   |
| News                          | 251    | 94   | 16        | 6   | 267   |
| Complement classroom teaching | 243    | 91   | 24        | 9   | 267   |

As is shown in table 4, 262 (98%) out of the 267 (100%) of the respondents, agreed that they used the electronic resources for research, purpose while 5 (1.9%) disagree. 252 (94.4%) indicated that they used them for purpose of having timely access to information, while 15 (5.6%) disagree, 267 (100%) agreed they used them to acquire information for their assignment. 267 (100%) indicated that they used electronic information resources for e-mail purpose While 251 (94%) of them indicated that they used electronic resources for news acquisition though 16 (6%) of them disagree to that fact. 243 (91%) agreed that electronic information resources helps to complement classroom teaching/lectures and 24 (9%) disagreed. From table 4 above, it is revealed that majority of the respondents. Use the electronic resources for research, current awareness, information acquisition, assignment, e-mail, and for acquiring news.

**Table 5: Respondents Frequency of use of Electronic Resources**

| Resources           | Regularly | %    | Occasionally | %    | Rarely | %    | Not at all | %    | Total |
|---------------------|-----------|------|--------------|------|--------|------|------------|------|-------|
| CD-ROM              | 12        | 4.5  | 17           | 6.4  | 99     | 37.1 | 139        | 52.1 | 267   |
| Online Database     | 52        | 19.5 | 153          | 57.3 | 50     | 18.7 | 12         | 4.5  | 267   |
| Electronic books    | 93        | 34.8 | 124          | 46.4 | 42     | 15.7 | 8          | 3    | 267   |
| Internet            | 240       | 89.9 | 25           | 9.4  | 2      | 0.7  | Nil        | 0    | 267   |
| Electronic Journals | 78        | 29.2 | 73           | 27.3 | 85     | 31.8 | 31         | 11.6 | 267   |

Table 5 reveals that 12 (4.5%) of the 267 (100) respondents used the CD-ROM facility regularly,

Seventeen (6.4%) used it occasionally, 99 (37.1%) used it rarely while 139 (52.1%) indicated that they do not use it at all. Also, 52 (19.5%) confirmed that they use the online database regularly, 153 (57.3%) used it occasionally, 50 (18.7%) used it rarely while 12 (4.5%) said they

never used it. Meanwhile, 93 (34.8%) said they used electronic books regularly, 124 (46.4%) used it occasionally, 42 (15.7%) used it rarely while 8 (3%) said they do not use it at all. 240 (89.9%) of them used the internet regularly, 25 (9.4%) used it occasionally, 2 (0.8%) used it rarely while 0 (0%) said they do not use it at all. 78 (29.2%) of them indicated that they used e-journals regularly, 73 (27.3%) used it occasionally, 85 (31.8%) used it rarely while 31 (11.6%) do not use e-journals at all. This reveals that majority of the respondents do not make use of the electronic information resources available in SPY library regularly.

**Table 6: Challenges with the use of electronic information resources**

| Problems                                                                 | Response | %    | Response | %    | Total |
|--------------------------------------------------------------------------|----------|------|----------|------|-------|
| Lack of Awareness                                                        | YES      |      | NO       |      |       |
|                                                                          | 65       | 24.3 | 202      | 75.7 | 267   |
| Unfriendly User Interface                                                | 66       | 24.7 | 201      | 75.3 | 267   |
| Inadequate Electronic Information Resources Gadgets                      | 177      | 66.3 | 90       | 33.7 | 267   |
| Slow Network Problem                                                     | 219      | 82.0 | 48       | 18   | 267   |
| Lack of Required Searching Skills                                        | 179      | 67   | 88       | 33   | 267   |
| Lack of Consistence Training for Users                                   | 230      | 86.1 |          | 13.9 | 267   |
| The Use of Electronic Resources does not Present any particular problems | 0        | 0    |          | 100  | 267   |

Table 6 is a summary of the challenges respondents face in their use of electronic information resources in SPY library. 65 (24.3%) of the responded in the affirmative when they were asked if lack of awareness of the availability of electronic resources was a challenge to their use of these resources while 202 (75.7%) of them said no. 66 (24.7%) of the respondent agreed that unfriendly user interface is a challenges to them in their quest to make use of electronic information resources available in SPY library while 201 (75.7%) they had no problem with that. 177 (66.3%) of the respondents noted that their challenge is the inadequate electronic information resources in SPY library while 90 (33.7%) of them said they had no problem with that. 219 (82%) of the respondents noted that their challenge with the use of electronic information resources in SPY library is slow network problem while 48 (18%) of them responded negative. 179 (67%) of the respondents noted that lack of required searching skill in use of internet was their challenge while 88 (33%) of them did not see that as a challenge. 230 (86.1%) of the respondents agreed that lack of consistence training for the users as a challenge to them, while 33 (13.9%) did not see lack of consistence training for the users as a challenge while using electronic information resources. None of the respondents agreed that the use of electronic information resources did not pose any challenge to them while using the resources and 267 (100%) indicating all the respondents agreed that they had one or two challenges while they used the resources. It is revealed from the table that majority of the respondents had challenges with the use of electronic resources.

### Discussion of findings

The findings of this study revealed that the respondents even though were aware of the different types of electronic information resources available in the polytechnic library: their usage rate of these resources is low. Therefore, information professionals at SPY need to pay more attention to making every user aware of the various available e-resources and search strategies among others to promote the use of electronic information services in the polytechnic. It was also discover that a large proportion of the respondents made use of the electronic resources

mostly for research, assignment, current awareness, information acquisition, and e-mail and news acquisition. Various factors that militate against effective utilization of electronic resources by undergraduate students were discovered during the course of the study. Among the factors are: download delay i.e. slow network problem, lack of adequate electronic information resources facilities, high cost of access, inaccessibility of some electronic resources, difficulties in navigating through electronic resource as a result of inconsistency training for users etc.

### **Conclusion**

Based on the findings of this study, the researchers concluded that the use of electronic resources had tremendously impact on the academic performance of the undergraduate students of Adamawa State Polytechnic Yola. However, there was need for the students to acquire more skills on the use of electronic information resources. The purpose of this study was to enable the library to improve on the provision of electronic information resources to meet the academic needs of the undergraduate students of the polytechnic. This paper expected to be helpful to libraries to improve library services, especially in assisting the undergraduate students in their academic work. This study will be making available for the polytechnic library management for implementation.

### **Recommendation**

Based on the findings of the study the following recommendations were makes by the researchers:

8. The management of Adamawa state Polytechnic Yola should ensure that the acquisition of information communication technology skills is acknowledge as one of the key learning objectives for its students so that it will be fully equipped to cope with the information intensive world. To end more practical courses on ICT, should be teach into the curriculum of the library and information science department of the polytechnic.
9. The library management should organize periodic training on the use of electronic resources for undergraduate students.
10. The paper has shown high level of acceptance of electronic resources by undergraduates in Adamawa State Polytechnic Yola. The Polytechnic management should as a matter of importance acquire, subscribe and create access to electronic information resources that can be of benefits to the students and the entire polytechnic community.
11. The polytechnic library should update faculties on the available of electronic information resources. In addition, academic staff should sensitize students on the usefulness of electronic resources to student course works, and assignments requiring the use of the electronic resources should be develop. This will compel students to make use of electronic information resources made available in the library.
12. The polytechnic and library in particular should ensure that there are sufficient networked computers with fast internet connectivity. This will improve on full text delivery of resources, electronic documents delivery and the use of search engines.



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