

CONTENTS	PAGES
1. Effects of Vinegar (5% Acetic Acid) Treatments on Reduction of Microbial Load on Lettuce Mohammed Murtala Kyari	1-7
2. Harvested Rainwater Quality: Roof Age and Types Perspective Mohammed Ya'u and Nura Hassan	8 – 12
3. Triterpenoids Characterization with Antioxidant activity from the Aerial Part of <i>Deinbollia pinnata</i> Yakubu Rufai^{*1}, Norazah Basar² and Suleiman Kabiru³	13-27
4. Evaluation of Weight Gain of Abor- Acre Broiler Chickens Supplemented With <i>moringa Oleifera</i> Pods, Proboiotic, Levamisole and Vitamin E / Selenium. Mohammed, Murtala Kyari	28 - 35
5. Impact of Micro-Credit Programmes On Poverty Reduction in Yobe State, Nigeria Audu Sani¹, Fatima Kalli Ba'aba², Abba Muktar³, Sadiq Mai Modu⁴ & Baba Mohammed⁵	36 – 46
6. Impact of Socio-Cultural Factors On the Performance of a Multinational Company in Nigeria; Evidence From Shoprite Kano Shettima Alhaji Umar¹, Audu Sani² & Abdullahi Ahmed Tahir³	47 - 53
7. Automation as A Panacea to Manual Administration of Polytechnics in Ogun State, Nigeria. (A Study of Abraham Adesanya Polytechnic, Ijebu-Igbo) Kuola, Aanu Joseph	54 - 66
8. Automated Audit and Competitive Advantage of Selected Banks in Nigeria Obasan, Olabowale Taiwo	67 - 78
9. Financial Management and Profitability of Selected DepositMoney Banks in Ogun State, Nigeria Oloyede, Isaiah Abidemi¹ & Atere, Akinsogo²	79 – 92
10 Effect of Cloud-Based Accounting On Manufacturing Firms in Nigeria A study of Twinstar Industries Ltd., Ogun State Obasan, Olabowale Taiwo¹ and Kuola, Aanu Joseph²	93 - 104
11 Impact of Child Abuse On Academic Performance of Secondary School Students in Geidam Local Government Area of Yobe State Shettima Alhaji Umar	105 - 112
12 Forecasting Quarterly Exchange Rates Using Fuzzy Time Series: A Catalyst for Business Projections Amidst Global Pandemic Maigana Alhaji Bakawu¹, AhmedBuba Tarajo² & Abdulrahman Malik³	113 – 121
13 Comparative Evaluation and Analysis of Hardware/Software Partitioning Algorithms for Embedded System	122 - 134

Babangida Jauro Mohammed¹, Hussaini Abatcha Geidam²

- 14 The Invasion of Cattail (*Typhaspecies*) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area 135 – 154
Mohammed Inusa Nguru, Rabiu Sabo and Mustapha A.U.
- 15 Information a Tool for Social Advocacy Protection Services for Children in Damaturu Metropolis, Yobe State 155 - 1563
Mohammed Karfa Bizi¹, Dikkuma Mohammed Ibrahim², Ali Usman³, Gambomi Goni Musa⁴ & Musa Adamu Mahdi⁵
- 16 Endangered Trees, Herbs and Shrubs in Nigeria, Why They Are Endangered and Conservation Approaches 164 - 176
Mohammed Inusa Nguru and Rabiu Sabo
- 17 Impact of Poor Selection Interview On Future Performance of Potential Employee and Organizational Productivity in Tertiary Institutions in Yobe State, Nigeria 177 - 189
Musa Mohammed¹, Gambomi Goni Musa², Abdullahi Mustapha Geidam³, Musa Adamu Mahdi⁴ & Dikkuma Mohammed Ibrahim⁵
- 18 Origin, Classification and Distribution of *Typha* Species a Paradigm for Understanding the Biology and Ecology of the Wetland Emergent Plant Species 190 – 197
Mohammed Inusa Nguru and Rabiu Saboss
- 19 Clients' Needs and Satisfaction in Construction Industries 198 - 205
Alhaji Attahir Hussaini¹, Babagana Kachalla²
- 20 Evaluation of efficiency of neem seed oil against *Dermestes maculatus* and *Necrobia Rufipes* in stored smoked fish; *Clarias gariepinus* 206-214
Bukar A¹., Mustapha A.U²., Jinjiri B. A²., Idriss M.M², and Nguru M. I².
- 21 Innovative Approaches for Climate Change Mitigation in Transport Institutions in Nigeria 215-231
Alhaji Attahir Hussein¹, Babagana Kachalla²
- 22 Interactive Effects of Crude Oil Price and Exchange Rate on Economic Growth in Nigeria 232-245
¹Ali Kole, ²Mohammed Girgir & ³Abba Muktar
- 23 Occupational Stress and Its Effects on Organizational Performance in Higher Education Institution of Yobe State (Case Study of Mai Idris Aloomo Polytechnic, Geidam) 246-264
Alhaji Umar Alhaji Mallum¹, Mohammed Zannah² Abdullahi Ahmed Tahir³, Abubakar Usman .A⁴, Saidu Ali⁵
- 24 Isolation of Microorganisms from Food Handler (Bread Sector) In Geidam Local Government Area, Yobe State, Nigeria 265-276

- M. M. Idriss^{*1}; Mustapha A. U²; Fatima Mohammed Maina³**
- 25 The Role of the French Language in Democratic Governance in Nigeria 277-289
¹Olawoyin John Olajire, ²Adeyemi Adekemi Oluwatosin, ³Omotayo Gbenga Oluyemi, ⁴Adeyemo Rashidat Ayo, ⁵Adegbemi Esther Omolola, ⁶Olufunmi R. Debo-Ajayi
- 26 A Survey of Urinary Schistosomiasis in Iknwakap Mushere Chiefdom Bokkos Local Government Area of Plateau State, Middle Belt, Nigeria 290-299
Dangot Godfrey Gufom
- 27 Gendered Preferences at an Early Age as Affecting Choice of Fields of Study in South- South Universities in Nigeria 300-309
Nwokoro, Catherine Isioma^{*1} & Nwokeocha, Martins Ifeanyi
- 28 Seroprevalence of Brucella Infection in Humans, Bovine and ovine in Wards of Tal District, Pankshin LGA, Plateau State Nigeria 310-317
¹Dayok, O; ¹Kum, F.O & ²bismoyi Dilkit,I
- 29 Assessment of Bacteria and Fungi Responsible for the Spoilage of Tomato Sold in Gada-Biu Market, Jos, Plateau State 318-324
Dayok O, Kum F.O & Danjuma, Gwamzhi

Effects of Vinegar (5% Acetic Acid) Treatments On Reduction of Microbial Load On Lettuce

Mohammed Murtala Kyari

Department of Animal Health and Production Technology,

Federal Polytechnic Bali, Taraba State

mmkyari@gmail.com 07030610999

Abstract

Vegetable promotes good health but harbor a wide range of microbial contamination. This study was carried out to compare the effectiveness of two commercially available vinegars labeled as (X and Y) at different concentration in decontamination of lettuce sold in Ahmadu Bello University, Zaria. Thirty (30) samples of lettuce vegetable were purchased from two different sell points in the University. The samples were analyzed using standard bacteriological method to enumerate total aerobic plate count before and after washing with vinegars at different concentrations. In addition Minimum Inhibition Concentration (MIC) was used to measure zone of bacterial inhibition. The result showed that the mean total aerobic plate count of 5.64 log₁₀ cfu/g before washing with vinegar. After treatment with vinegar X the mean counts were 3.79, 4.95, and 5.28 log₁₀ cfu/g for different concentration 1:1, 1:2 and 1:3 respectively. While after treatment with vinegar Y the mean total aerobic plate counts were 4.09, 5.27, and 5.39 log₁₀ cfu/g at different concentration 1:1, 1:2, and 1:3 respectively. Two genera of bacteria were isolated with the percentage isolation rate of 22 (75%) for proteus and Eschericia coli 8 (25%). From the MIC mean zone of inhibition of 16.6mm and 13.4mm for the stock solution X and Y respectively were recorded showing a slight difference compared to one obtained after treating the lettuce with higher concentration above the manufacturers recommended concentration. The use of vinegar in washing fruits and vegetable using the appropriate concentration is recommended as shown by the result.

Key words: Vinegar, Minimum inhibition concentration, Lettuce, Vegetables.

Introduction

Effects of Vinegar (5% Acetic Acid) Treatments On Reduction of Microbial Load On Lettuce

The importance of fruits and vegetables to human cannot be over emphasized as they are high in fiber, vitamins, water, and minerals, varying proportions of sugar, proteins and various phytochemicals such as flavonoid, saponin, tannin and anthocyanin. Example of those fruits and vegetables are apple, banana, pineapple, paw-paw, oranges, lettuce, spinach, cabbage, cauliflower (Gruda, 2005).

Vegetable salad is a very common food accompaniment in Nigeria. The vegetables that usually make up this recipe include tomatoes, cucumber, carrots, green chili, cabbage and lettuce. They are sold in almost every market, and can be seen hawked around by traders (Oji, p.c., 2016). Fruits and vegetables have been identified as significant sources of pathogens and chemical contaminants (Uzeh *et al.*, 2009). As a result, environmental and food microbiologists have continued to identify and suggest control measures for hazards at all stages in the supply chain (Johngen, 2005). Micro-organisms capable of causing human illness such as *Salmonella spp*, *Eschericia coli*, *proteus spp*, *Aeromonas hydrophila*, *Citrobacter freundii*, *Enterobacter cloacae* and *Klebsiella spp*. have also been isolated in lettuce and salad vegetables (Francis *et al.*, 1999).

Khan *et al.* (1992) reported that bacterial contamination results from various unsanitary cultivation and marketing practices. In another study, Tambekar *et al.* (2006) reported that bacterial contamination of salad vegetables was linked to the fact that they are usually consumed without any treatment. These vegetables can become contaminated with pathogenic microorganisms during harvesting, through human handling, harvesting equipment, and transport containers. Pathogens from the human and animal reservoir as well as other environmental pathogens can be found at the time of consumption. Although spoilage bacteria,

yeasts and mould dominate the micro flora on raw fruits and vegetable, the occasional presence of pathogenic bacteria, parasites and viruses capable of causing human infections has also been documented (Hassan *et al.*, 2006).

Coliforms are facultative anaerobic Gram negative rods belonging to the family *Enterobacteriaceae*. They are known contaminants of food and water, causing various intestinal and extra-intestinal infections such as urinary, central nervous system and respiratory tract infections (John, 2007). The presence of *E. coli*, *Enterobacter sp*, *Salmonella sp*, *Shigella sp* and *Pseudomonas aeruginosa*, has been reported in salad vegetables (Khan *et al.*, 1992; Tambekar, 2006). Mehmet and Aydin (2008) also reported the presence of *E. coli* in some green leafy vegetables.

Due to the favourable climatic condition for cultivation of salad vegetables, as well as the cultural practice of dwellers in Northern Nigeria, the consumption rate of these vegetables is higher than in other regions in Nigeria.

Vinegar (Acetic acid) is well recognized as a cleaning agent. It is especially effective in removing inorganic soils and mineral deposits such as hard water films. It is also effective against a broad range of bacteria, destroying or reducing these organisms to acceptable levels. Acetic acid in small amounts and at relatively high pH values proved more toxic to representative bacteria, yeast and mold than lactic or hydrochloric acid. Not only can acetic acid inhibit and destroy microorganisms when used in sufficiently high concentrations, it also aids materially in reducing thermal death rates of bacteria when present in sub-lethal concentrations (Levine and Fellers, 1990). Most manufacturers recommend one part of vinegar to be diluted in two part of water. There is

Effects of Vinegar (5% Acetic Acid) Treatments On Reduction of Microbial Load On Lettuce

paucity of information obtained on the effectiveness of commercially available vinegar in the market.

Objectives

- To assess the microbial load on lettuce sold in Ahmadu Bello University, Zaria, Nigeria.
- To compare the effectiveness of two different available vinegar solutions at different concentrations on the microbial load of lettuce.
- To suggest the appropriate concentration that is more effective in reducing the microbial load.

Materials and Methods

Sample collection

Five (5) Samples per week at different sales point for a period of Six (6) weeks a total of 30 samples of fresh lettuce were collected from Ahmadu Bello University Zaria community market and ICASA. The lettuce samples were collected in a sterile polythene bags and transported to the laboratory immediately for analysis.

Laboratory procedures

Unwashed (Untreated) Samples

10 grams of lettuce samples were weighed (before washing) and homogenized with 90mls of 0.1% bacteriological peptone using stomacher. Subsequently, 0.1ml of each homogenate were serially (100 fold) diluted and 0.1ml of 10^{-4} dilution were pipette into solid medium (Nutrient agar) following surface plating techniques and inverted, incubated at 37°C for 24-48 hour for bacterial counts. The colonies that appeared were preserved by sub culturing on nutrient agar slant for further biochemical test.

Vinegar (5% Acetic acid) Treatment of Lettuce

To determine the effect of various concentrations of acetic acid solution on the microbial load of lettuce, with the same samples (i.e unwashed). 10grams of each sample was weighed and washed vigorously in different concentration of 5% acetic acid (I.e 1:1, 1:2 and 1:3) ratio of acetic acid to water, with the manufacturer recommended concentration of 1:2. Then the washed samples were homogenized with 90mls of 0.1% bacteriological peptone, 0.1ml of each homogenate was serially (100 fold) diluted then 0.1ml of 10^{-4} dilution were pipette into nutrient agar following surface plate technique and inverted then inoculated at 37°C for 24 hours for bacterial counts. Biochemical test namely: TSI, urea, citrate, Indole, Methyl red and volkes prosker, then motility were carried out for identification.

Minimum Inhibition Concentration was determined by Gel Diffusion Test:

The isolates were sub-cultured on nutrient agar, the colonies were picked with Pasteur loop and put into a 5ml of normal saline diluents in a screw cap test tube and eluted into the saline diluents by swirling the Pasteur loop into it. The sterile swab was removed and dipped into the diluents and excess saline removed by pressing against the inner side of the tube. The swab was smeared on the already prepared nutrient agar. Eight circular well were made on the agar with two of the wells located centrally, the wells were labeled as follows; two central wells contained the stock solutions X and Y while the other six contained different concentrations of vinegar X and Y (i.e 1:1, 1:2, 1:3), then incubated at 37°C for 24hrs. The minimum zone of inhibitions for the different concentrations and stock solutions were measured in millimeters and recorded.

Effects of Vinegar (5% Acetic Acid) Treatments On Reduction of Microbial Load On Lettuce

Data Analysis

Descriptive statistics was used to express the mean log and standard deviation of total aerobic plate count before and after washing

with vinegar. Paired t-test was also employed to check the difference in mean before and after washing with vinegar X and Y.

RESULT

Table I: Range count of microbial load on lettuce in log₁₀ cfu/g for vinegar X

CONCENTRATION	RANGE COUNT
PRE-TREATMENT	5.30 — 6.89
1:1	3.00 — 5.07
1:2	3.48 — 5.79
1:3	3.95 — 5.79

Table II: Range count of microbial load on lettuce in log₁₀ cfu/g for vinegar Y

CONCENTRATION	RANGE COUNT
PRE-TREATMENT	5.30 — 6.89
1:1	3.0 — 5.19
1:2	3.69 — 5.70
1:3	3.78 — 5.87

Table III: Mean Zone Of Inhibition (Mean± Standard Deviation) Of Micro-Organism to Different Concentration of Vinegar X and Y

Vinegar Type	1:1	1:2	1:3	STOCK SOLUTION
X	16.6±0.87	13.33±1.09	9.73±1.02	17.86±0.82
Y	13.4±0.89	10.66±0.58	6.2±0.93	15.46±0.68

Table IV: Showing percentage of isolates biochemically characterized from the lettuce

ISOLATE	SAMPLE NUMBER (%)
<i>Proteus spp</i>	22(75)
<i>E coli</i>	8(25)

Effects of Vinegar (5% Acetic Acid) Treatments On Reduction of Microbial Load On Lettuce

Table V: Mean log₁₀ cfu/g total aerobic plate count before and after treatment with commercial vinegar X (subjected to t-test paired two samples for means)

Concentration	Before Treatment	After Treatment
1:1	5.64±0.04	3.79±0.19
1:2	5.64±0.04	4.95±0.10
1:3	5.64±0.04	5.28±0.05

The decrease in the mean difference values after and before treatment was statistically significant (P < 0.05)

Table VI: Mean log₁₀ cfu/g total aerobic plate count before and after treatment with commercial vinegar Y (subjected to t-test paired two samples for means)

Concentration	Before Treatment	After Treatment
1:1	5.64±0.04	4.09±0.20
1:2	5.64±0.04	5.27±0.06
1:3	5.64±0.04	5.39±0.07

The decrease in the means difference values after and before treatment was statistically significant (P < 0.05)

Discussion

Cenci-Goga *et al.* (2005) pointed out that total aerobic bacteria count was a good indicator of food safety. In this study the bacterial count obtained from lettuce sample before treatment with vinegar the minimum value of 5.64 log₁₀ cfu/g (Table I and II) has exceeded the recommended World Health Organization (WHO, 1996) and International Commission on Microbiological Specifications for Food (ICMSF, 1998) standards of 10³ CFU/g (for example, Log₁₀ 3.0 CFU/g). This finding is as a result of common agricultural practice in the study area where contaminated water with micro-organism is used in the irrigation of farm fields to produce vegetables. Also indicated when non-properly composite manure are used in fertilizing the farm field contribute to microbial contamination of vegetables produced as indicated by other studies (Taban and Halkman, 2011; Adjrah *et al* 2013). However Yeboah-manu has reported

the total aerobic count which is higher than the present study with values ranged from 8.54—8.69 log₁₀ cfu/g for lettuce sold around the university of Ghana, he gives similar reasons of used of contaminated irrigated water with micro-organism in the farm fields.

When result of total aerobic plate count before and after treatment with two different commercial vinegar was subjected to simple t-test there were statistically significant different in the microbial load after treatment with vinegar. However this indicates that the vinegar is effective against the bacteria.

As shown in this study, increase in concentration of vinegar had marked effect on bacterial load as increase in dilution reduced the effect on the bacterial organism. Vinegar X has more effect on the bacteria as compare to vinegar Y.

Effects of Vinegar (5% Acetic Acid) Treatments On Reduction of Microbial Load On Lettuce

The detection of *E coli* in this study (Table IV) showed poor hygienic standard in the handling of this salad vegetables or it could be from contamination during harvest. Presence of *E coli* indicate recent contamination by faecal matter and possible presence of other enteric pathogens known to be causative agent of food borne gastroenteritis and bacterial diarrhea diseases (Adebayo-Tayo *et al.* 2012). Also reported by Lawan *et al* (2015) in Zaria STEC was isolated from cabbage sampled from the farm irrigated from stream contaminated with Abattoir effluent. The lettuce that was used in this study originated from the same farm where STEC was isolated in cabbage.

The Minimum inhibition concentration (MIC) technique indicated that the vinegar appeared to inhibit bacterial growth at 24 hours. Also increasing concentration had marked effect on the inhibition, this was evident for mean zone of inhibition obtained with the highest concentration (i.e 1:1) (Table III) for vinegar X and Y respectively having a slight different with the mean zone of inhibition of the stock solution (17.86mm and 15.46mm for X and Y respectively). While on the other hand the manufacturers recommended concentration of 1:2 having 13.33mm and 10.66mm as zone of inhibition with a wide difference compare to the values obtained with stock solution. This has shown that the higher concentration of 1:1 have greater effect on the microbial load almost similar to the stock solutions, the manufacturers recommended concentration (1:2) is not as effective compare to the one used in this study (Table I and II), meanwhile the acetic is not known to have any effect on the body at the concentration that was used which is higher than the manufacturers recommended concentration.

Conclusion

In conclusion use of high concentration of 1:1 in the study above the manufacturer's recommendation of 1:2 indicated more

effective in reduction of microbial load on lettuce.

Recommendation

- The use of vinegar in washing fruits and vegetable using the appropriate concentration is recommended as shown by the result.
- Recommend that more vinegar in the market should be evaluated.
- Recommend that manufacturers should review their dilution

REFERENCE

- Adjrah, Y., Soncy, K., Anani, K., Blewussi, K. D. & Karou, A. (2013), Socio-economic profile of street food vendors and microbiological quality of ready to eat salads in Lome. *International Food Research Journal* 20(1), 65-77.
- Adebayo-Tayo et al (2012), Microorganism associated with spoilage of stored vegetables in Uyo metropolis, Akwa Ibom State, Nigeria. *Nature and Science* 10(3), 23-32.
- Cenci-Goga B., Robert Ortenzi, E Bartocci and A. Codega De Oliveira., (2005), Hygiene practices in urban restaurants; investigating possibilities of introducing HACCP system in Thika town.
- Francis, A. G, Thomas, C. & O'beirne, D. (1999). The microbiology safety of minimally processed vegetables. *International Journal of Food science technology* 34:1-22.
- Gruda, N. (2005). Impact of environmental factors on product quality of greenhouse vegetables for fresh consumption: *Crit. Rev. Plant Sci.* 24(3), 227-247.

Effects of Vinegar (5% Acetic Acid) Treatments On Reduction of Microbial Load On Lettuce

- Hassan, A. Litku, O. & Koray, K. (2006). Determination of total aerobic and indicator bacteria on some raw eaten vegetables from wholesalers in Ankara, Turkey. *International journal of Hygiene and Environmental Health*, 209:197-201.
- John, R.W. (2007). *The Enterobacteriaceae basic properties*. Department of Pathology North Western University, Feinberg School of Medicine. P.40
- Jongen, W. (2005). *Improving the safety of fresh fruit and vegetables*. Wageningen University, the Netherlands.P.28
- Khan, M. R., Saha, M. L.& Kibria, A. M. (1992). A Bacteriological profile of salad vegetables in Bangladesh with special reference to Coli forms. *Journal of Applied Microbiology*, 14:88-90.
- Lawan, M. K, Mohammed, B., Junaid, K., Laura, G. & Stefeno, M. (2015) Detection of pathogenic E coli in samples collected at an Abattoir in Zaria, Nigeria at different point in the surrounding environment. *International Journal Environmental Research and Public Health*. ISSN 1660-4601
- Levine & Fellers, (1990), Inhibiting effect of acetic acid upon microorganism in the presence of sodium chloride and sucrose. *Journal of Bacteriology* 40(2).
- Meehmet, E.E.& Ayidin, V. (2008). Investigation of the microbial quality of some leafy green vegetables. *Journal of Food Technology*, 6(2),285-288.
- Oji, P. C. (2016). Applied microbiology and brewing, Nnamdi Azikiwe University Awka, Anambra State. *International Journal of Scientific and Research Publications*, 6(6). ISSN 2250-3153.
- Patience, M., Dorathy Yeboah-Manu, Kwaku Owusu-Darko & Anthony A. (2002). *Bulletin of World Health Organisation*. 80,546-554,2002.
- Taban, & Halkman, (2011). Do leafy green vegetable and their ready-to-eat (RTE) salads carry a risk of food bornes pathogens. *Anaerobe* 17(6), 286-287.
- Tambekar, D. H. & Mundhada, R. H. (2006). Bacteriological quality of salad vegetables sold in Amravati City, India. *Journal of Biological Sciences*, 6:28-30.
- Uzeh, R. E., Alade, F. A. & Bankole, M. (2009). The Bacterial quality of pre-packed mixed vegetable in some retail out lets in Lagos, Nigeria. *African Journal of Food Science* 3(2),270-272.

Effects of Vinegar (5% Acetic Acid) Treatments On Reduction of Microbial Load On Lettuce

Harvested Rainwater Quality: Roof Age and Types Perspective

Mohammed Ya'u and Nura Hassan

katamma300@gmail.com / 08032897056

Department of Civil Engineering Technology, Federal Polytechnic Damaturu.

Abstract

Due to the increasing demand for good and safe drinking water, the use of water harvest to supplement the other sources of quality drinking water is on the rise. The contamination of the harvested roof water from collection to conveyance and storage is a source of concern. This research work evaluates the quality of harvested rainwater from new and aged corrugated zinc, aluminum roof, and open source. The methodology used involves a stratified sampling technique. Ten (10) samples from all categories were collected monthly for three (3) months. The physicochemical and biological properties of the harvested rain waters were analyzed. A simple percentage was used for the analysis. The results revealed that a total coliform count of 15-17 was determined which is above the WHO recommended value of 0 for safe drinking water. The findings further revealed that samples from new corrugated zinc roofs have an alkalinity of 70mg/l which is above the WHO recommended value of 50mg/l. fluoride, zinc, and aluminum concentrations are all below the WHO-recommended values. It was therefore recommended that harvested rainwater should be treated before drinking.

Keywords: Water Quality, harvested rainwater, and aged.

1.0 Introduction

Globally, about 2 Billion people lack good and safe drinking water, while about 50% of the developing world population lack access to safe and sustainable drinking water (World Health Organization, 2019). The continuous demand for safe drinking water has been characterized by population growth because the groundwater aquifers have been over-exploited (Sánchez, Cohimb, & Kalidc, 2015). Other causes of the water shortage include frequent drought and changes in climate patterns. Groundwater has been the major source of urban water supply. The depletion of the groundwater aquifers has been fueled by climate change, man activity, and frequent drought (Chukwuma, . Nnodu, Okoye, & Chukwuma, 2014).

To meet the water demand, several other sources of water supply have been in use including recycling water, water harvest, and the use of water treatment plants that utilized water from rivers, ponds, and lake (Sánchez, Cohimb, & Kalidc, 2015). The use of water treatment plants and recycled water requires a lot of technology and finance, coupled with losses of water supply due to leakages and the need for energy to power the water supply mechanism (OJO, 2019). This makes the system unsustainable in developing countries. Water harvest that used simple technology to collect rainwater from the roof for domestic use is gaining more attention. This is because it's a low-cost technique (Abegunrin, Sangodoyin, odeniyi, & Onufua, 2014).

Water harvest has been defined as any technology used to collect and store rainwater from the roof for domestic and agricultural uses (Texas Water Development Board , 2010). Ojo (2019) defined rainwater harvest as the technology used for the collection, conveyance, and storage of rainwater from clean roof material, land surface, and rock catchment for future use.

Even though water harvest is the cost-effective means of getting access to safe drinking water, however, contamination of the harvested water is possible through the collection, conveyance, and storage process (Texas Water Development Board , 2010). The contaminants will negatively

affect the water quality. According to Osunkiyes, Olawunmi & Soyemi (2016) collected rainwater often contains organic and inorganic impurities. This contradicts the widespread belief that harvested rainwater is safe for drinking. However, the level of potential contamination depends on the general condition of the area which includes industrialization, urbanization, and the population (Sánchez, Cohimb, & Kalidc, 2015).

The contamination might be from the environment or from the rooftop from which the water is collected. The fact that the rooftop is exposed to dust and, flying and nesting birds makes the water from this source less suitable for consumption (OJO, 2019).

The materials used for roofing purposes are also a source of concern. The roofing materials used are sources of dissolved iron, it includes galvanize iron, ceramics, metal sheets, anodized aluminum, and asbestos (Osunkiyesi, Olawunmi, Soyemi, & Okibe, 2016).

In the Damaturu metropolis, the major source of water used by the majority of the household for drinking purposes is groundwater. Currently, about 73 boreholes owned by the state government are in operational to serve a population of about 550,458 people. To supplement these rising demand, the residents of the Damaturu metropolis resort to the use of harvested rainwater during the rainy season. However, some of the roofing materials are aged. Therefore this research work is aimed to determine the chemical properties and bacteriological properties of the harvested water with regard to the age and type of the roofing materials. In this research work, roofs that are not more than 5 years are regarded as new, and roofs above five years are regarded as aged.

2.0 Methodology

The research work is conducted in Damaturu metropolis latitude 11° 44' 55" N and longitude 11° 57' 50" E. The study area was divided into four zones namely Maiduguri, Potiskum, Gashua, and Gujba Road. Samples were collected using stratified sampling techniques. The harvested

rainwater was collected from new and aged corrugated zinc roofs, and aluminum roofs. The control samples were collected using an elevated sterilized container in an opened place. Ten samples from each category were collected monthly for 3 months. For all the samples collected first flush was first allowed for at least 5 minutes to wash the roof surface. Physico-

chemical and biological properties of samples were tested. The properties tested include: total coliform count, turbidity, zinc, aluminum, chromium, silica, calcium hardness, copper, alkalinity, fluoride, and total hardness. The results obtained were compared with WHO-recommended values. A simple percentage was used in analyzing the data.

3.0 Results and Discussions

3.1 Physio-Chemical Properties

Table 3.1: Physico-Chemical Properties of the collected Rainwaters

Parameters.	WHO standard.	Water from new corrugated roofing sheets.	Water from aged corrugated roofing sheets.	Water from aged aluminum roofing sheet.	Control
Turbidity	5.0 NUT	0.96mg/l	1.52mg/l	0.63mg/l	0.46mg/l
Zinc	5.0 mg/l	0.70mg/l	0.70mg/l	0.01mg/l	0.01mg/l
Aluminum	0.2 mg/l	0.00mg/l	0.03mg/l	0.00mg/l	0.00mg/l
Chromium	0.05 mg/l	0.03mg/l	0.06mg/l	0.04mg/l	0.02mg/l
Silica	0.8 mg/l	2.15mg/l	3.20mg/l	0.02mg/l	0.00mg/l
Calcium hardness	30.0mg/l	6.0mg/l	31.0mg/l	6.0mg/l	5.0mg/l
Copper	1.0 mg/l	3.60mg/l	0.28mg/l	2.30mg/l	0.2mg/l
Alkalinity	50 mg/l	70mg/l	60mg/l	30.0mg/l	40.0mg/l
Fluoride	2.0 mg/l	0.80mg/l	0.80mg/l	0.00mg/l	0.00mg/l
Total hardness	30.0mg/l	30mg/l	20mg/l	0.00mg/l	10.0mg/l

Table 3.1 shows the chemical properties of the harvested rain waters from aged, new corrugated zinc roofing sheets, aged aluminum roofing sheets and control. The results revealed that turbidity of 1.52mg/l was obtained from harvested aged corrugated zinc roof, this is 58% higher than the water harvested from the new corrugated zinc roofing sheet, 1.4% higher than

the aluminum roofing sheets and 2.3% higher than the control. However, the turbidity of all the samples collected is within the limits of WHO recommended values. Similarly, the zinc and aluminum concentrations of all the harvested samples and the control are below the WHO maximum values of 1.52mg/l and 0.2 mg/l respectively. The chromium content of 0.06mg/l

for harvested water from aged corrugated zinc roofing sheets is above the maximum value of 0.05 mg/l recommended by WHO. However, the chromium concentration of the harvested samples for new corrugated zinc and aged aluminum roofing sheets is below the WHO maximum value. The silica concentration of 2.15mg/l and 3.20mg/l for new and aged corrugated zinc roofing sheets was obtained as against the 0.02mg/l and 0.00mg/l obtained for aged aluminum roofing sheets and the control. New and aged corrugated roofing sheets have silica concentrations higher than the WHO maximum value of 0.8 mg/l.

Fluoride concentrations and total hardness of all the samples collected are below the maximum value specified by WHO of 2.0 mg/l and 30.0mg/l respectively. However, the alkalinity of 70mg/l and 60mg/l for samples collected from new and aged corrugated zinc roofing sheets were observed, these values are above the 50mg/l maximum value specified by WHO. The alkalinity of the control sample and sample from the aged aluminum sheet is below the maximum WHO value, this is in conformity with findings by Osei, Fredrick, & Nathaniel (2011). Samples collected from aged corrugated roofing sheets have a calcium hardness of 4% higher than the WHO recommended maximum value.

3.2 Biological Properties

A total coliform count (TCC) value of 0 cfu/ml for the control sample was observed against 15, 16, and 17 cfu/ml of new, aged galvanized roofing sheet and aged aluminum roofing sheet samples respectively. The results corroborate the findings by Abegunrin, Sangodoyin, odeniyi and Onufua (2014). The results further revealed that the contamination in the harvested rainwater was due to the nesting bird and other animals (rodents and bats) that defecate on the roofs, coupled with rotten leaves. The WHO recommended coliform value is 0 cfu/ml, which conformed with the value obtained for the control. The samples have a total coliform count range of 15-17, which made the harvested water potable but not safe for drinking. The findings further indicated that the harvested water requires treatments for biological

contaminants before it will be safe for consumption.

4.0 Conclusions

From the outcome of this research work, it could be concluded that:

1. The turbidity is higher in a water samples collected from aged corrugated roofs than new corrugated roofs and aged aluminum roofing roofs.
2. Zinc and aluminum concentrations of all the sample tested were below the WHO maximum recommended value.
3. Fluoride concentration and total hardness are below the values specified by WHO
4. Samples from new and aged corrugated roofs have alkalinity above the WHO maximum recommended value.
5. The samples have a total coliform count greater than zero, this makes the harvested water not suitable for drinking without treatment.

It is therefore recommended that:

1. Boiling and the first flush should be adopted as a way of treating the water before consumption
2. Safe collection techniques for water storage should be employed to reduce contamination
3. A sensitization campaigns on the need for hygienic water storage should be encouraged.
4. Treatment of harvested rainwater before use is recommended.

References

- Abegunrin, T., Sangodoyin, A., odeniyi, J., & Onufua, A. (2014). Roof Age Effect on the Quality of Harvested Rainwater and its Health Implication in Selected Locations, Southwest Nigeria. *International Journals of Water Resources and Environmental Engineering*, 261-266.

- Chukwuma, J. N., . Nnodu, V. C., Okoye, A. C., & Chukwuma, E. C. (2014). Assessment of Roof Harvested Rainwater in Parts of Anambra State for Environmental Pollution Monitoring. *British Biotechnology Journal*, 1105-1114.
- OJO, O. (2019). Effects of Roofing Materials on Harvested Rain Water Quality. *Journal of applied science, Environment and Management*, 23(4), 735-738.
- Osei, A., Fredrick, A., & B., N. O. (2011). Physicochemical Analysis of Roof Runoffs from the Obuasi Area. *Water Practice & Technology*.
- Osunkiyesi, A. A., Olawunmi, M., Soyemi, O., & Okibe, O. (2016). Effects of Materials and The Age of Roofing Sheets on The Quality of Harvested Rainwater in Totoro Abeokuta, Ogun State Nigeria. *Journal of Applied Chemistry*, 64-69.
- Sánchez, A., Cohimb, E., & Kalidc, R. (2015). A review on physicochemical and microbiological contamination of roof-harvested rainwater in urban areas. *Sustainability of Water Quality and Ecology*.
- Texas Water Development Board. (2010). *Effect of Roof Material on Water Quality for Rainwater Harvesting Systems*. Texas: Texas Water Development Board.
- World Health Organization. (2005). *Guidelines for drinking-water quality. 4th ed.* Geneva, Switzerland: Who Press.
- World Health Organization. (2019). *Drinking-Water*. United state of America: WHO Press.

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of *Deinbollia pinnata*

Yakubu Rufai*¹, Norazah Basar¹ and Suleiman Kabiru²

¹Department of Chemistry, Faculty of Science, Universiti Teknologi Malaysia (UTM), 81310 Johor Bahru, Johor, MALAYSIA

²Chemistry Department, Federal College of Education (FCE) Okene P.M.B 1062 Kogi State, NIGERIA

*Corresponding authors email address: yakuburufaibaby@gmail.com

Abstract

Deinbollia pinnata is a tropical and sub-tropical continental plant widely used by hunters for traditional medicine. It contains large constituents of triterpenoids from which seven (7) known triterpenes for the first time reported using combined chromatographic separation. These include squalene (1) stigmasterol (2), stigmasta-5,22-diene-3-ol acetate (3), γ -sitosterol (4), lupeol (5), taraxasterol (6), and betulinic acid (7) from aerial parts. Their structures were elucidated using HR-ESIMS, 1D NMR compared with existing data. Methanolic leave extracts showed a very high antioxidant potential of minimum inhibitory concentration for DPPH, 22.07 $\mu\text{g/mL}$; ABTS, 15.40 $\mu\text{g/mL}$; FRAP, 3.45 \pm 1.30 mM. Stigmasta-5,22-diene-3-ol acetate (3) and betulinic acid (7) showed strong to moderate activity as an anti-oxidant reducing agent. These can be in the management of oxidative causative diseases.

Keywords: *Deinbollia pinnata*, Triterpenoids, Antioxidant activity, oxidative causative diseases

Introduction

The term 'terpene' was originally used to describe mixtures of isomeric hydrocarbons (C₁₀H₁₆) occurring in essential oils obtained from sap in tissues of plants and trees (Connolly & Hill, 2010). Their broader meaning which is referred to as 'triterpenoid' encompasses secondary metabolites, found in the most variety of ethno-medicinal plant species with numerous pharmacological activities. The medicinal uses of triterpenoids are antioxidant sources for biological activities, ranging from anti-inflammatory, hepatoprotective, sedatives, cardiogenic, general tonic, anti-HIV-1 and anti-cancer (Hsu & Yen, 2014) are overwhelming. Plants have provided a source of inspiration for novel drug compounds as plant-derived (Walker, 2012), and medicines have made large contributions to human health and wellbeing. Herbal plants and their preparations have been reported for antimicrobial, antimalarial, anti-inflammatory, antidiabetic, anthelmintic, antiparasitic, anti-obesity, anticancer, and antiviral activities (Shakya, 2016). Phytochemicals have been recognized as the basis for traditional herbal medicine practised in the past and currently in all parts of the world (Lalitha et al., 2012). They have been in use and continue today as medicines. The *D. pinnata* roots and leaves are used in folkloric medicine as a remedy for numerous diseases (Lasisi, Bamidele, et al., 2016), (Borokini, 2018). Reports on their essential oil bioactivity and volatile constituents were documented (Sotubo et al., 2016). Isolated compounds range from flavonoids, coumarins, phenolics, esters and ethers (Lasisi, Akinhanmi, et al., 2016; Rufai et al., 2019, 2020) were identified. But up to date, comprehensive reports on terpenes as isolated phytochemicals from *D. pinnata* leaves are scanty talk-less of its antioxidant evaluation. This engrossed our interest in carryout extraction, isolation of their constituents and their antioxidants.

Materials and Method

Materials

The *D. pinnata* (Poir.) Schumach. & Thonn leaves were collected from Okehi Local Government Area of Kogi State, Nigeria during the dry season, early January, for one week (daytime temperature ranges from 28 °C in January to 32 °C). The plant was identified and confirmed at the Biological Department, Federal College of Education Okene Kogi State by Mrs Aniaya S.O.A., a botanist. The plant material was authenticated at Forestry Research Institute of Nigeria Ibadan through comparison with voucher specimen under the accession number of FHI 3251. The leaves were collected, washed, air-dried at room temperature for one month and grind to a powder.

Chemicals and Reagents

Folin-Ciocalteu phenol reagent, 5% sodium nitrite, acetate buffer, FRAP reagent, ABTS and potassium persulfate, 2, 2'-diphenyl-2-picrylhydrazyl (DPPH), 2, 2'-azino-bis-3-ethylbenzthiazolin-6-sulphonic acid (ABTS), (+) 6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid (trolox) and butylated hydroxyanisole (BHA) pyrogallol, quercetin, butylated hydroxyl toluene (BHT), gallic acid, and ascorbic acid were obtained from Sigma-Aldrich. tripyridyl-s-triazine (TPTZ) and potassium persulfate were purchased from Fluka. The absorbance for test samples and positive control solutions were determined against the reagent blank at 760 nm by microplate reader EPOCH (Bio Tek) ELISA. All determinations were carried out in triplicate and averaged. Solvents used were of general-purpose grade and the reagents used were of analytical grade. The solvents used were *n*-hexane (HEX), diethyl ether (DEE), dichloromethane (DCM), chloroform (CHCl₃), ethyl acetate (EtOAc), acetone (ACE), methanol (MeOH), Deuterated acetone (D6) Deuterated chloroform (CDCl₃). TLC plates were sprayed with vanillin sulphuric acid reagent.

METHODS

Extraction and Isolation Method

Powdered plant material of *D. pinnata* (Poir.) Schumach. & Thonn was extracted using the Ruf-

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata

azah method (Rufai et al., 2019). Briefly, the leaves were taken into several conical flasks (30 g each) and extracted with organic solvents (150 mL) such as *n*-hexane, ethyl acetate, and methanol in a sonicator using an ultrasonic-assisted extraction method at an interval of ten minutes' agitation with expert design software conditions; filtered into a bottle and allowed for 24hr; then

Table 1. Fractionation and purification of methanol crude extracts were carried out using vacuum liquid chromatography (VLC), column chromatography (CC), and guided by thin-layer chromatography (TLC). These purification processes using repeated chromatographic methods led to the isolation and identification of seven terpenes. The pure compounds isolated from *D. pinnata* leaves with the crude extract were evaluated for antioxidant activities.

Method of Antioxidant Assays

Evaluation of antioxidant potentials using different antioxidant assays was carried out for selected compounds. These include total antioxidant capacity using 2, 2'-azino-bis (3-ethylbenzthiazoline-6-sulphonic acid (ABTS), Ferric reducing antioxidant potential (FRAP), and 2, 2'-diphenyl-2-picrylhydrazyl (DPPH).

2, 2'-diphenyl-2-picrylhydrazyl (DPPH) Assay

The free radical scavenging assay was conducted based on the method described in (Hashim et al., 2012). with minor modification. Briefly, 100 μ M DPPH (1 mL) dissolved in MeOH was added to the MeOH solution (3 mL) of the tested samples at different concentrations. An equal volume of MeOH was added to the control test. The mixture was shaken vigorously and allowed to stand at room temperature for 30 mins. Then, the absorbance at 517 nm was measured with Epoch microplate reader. The percentage of scavenging of DPPH was calculated using Equation 1.

$$S\% = \frac{[A_{\text{blank}} - A_{\text{sample}}]}{A_{\text{blank}}} * 100 \quad (1)$$

filtered using Whatman No. 1 filter. The extraction was repeated for various solvents until complete extraction. The combined extracts were filtered and concentrated in *vacuo* at 40°C using a rotary evaporator, the extractives were evaporated to dryness and residues were obtained in grams for all selected parts of *D. pinnata* (Poir.) Schumach. & Thonn as shown in

Where A_{blank} is the absorbance value of the control reaction (containing all reagents except the test compound) and A_{sample} is the absorbance value of the test compound. The sample concentration providing 50% scavenging/ inhibition (SC_{50}/IC_{50}) was calculated by plotting scavenging percentages against concentrations of the sample. All tests were carried out in triplicate and scavenging values were reported as means (scavenging percentage).

Ferric Reducing Antioxidant Potential (FRAP) Assay

The ferric reducing antioxidant potential (FRAP) assay was carried out according to (Jutiviboonsuk, 2012; Shahwar et al., 2012) with minor modification. FRAP reagent was freshly prepared, consisting of stock solution with a ratio of 10:1:1 of 300 mM acetate buffer, acetate buffer. 5 μ L of the sample, 15 μ L of MeOH and 150 μ L of FRAP reagent were added to the 96-well plates. The absorbance at 573 nm was measured after 10 min of incubation at 37°C. $FeSO_4 \cdot 7H_2O$ solution (0.06 mM – 1.0 mM) was used to build up calibration curves of standard antioxidants.

2,2'-Azino-bis(3-ethylbenzthiazoline-6-sulphonic) acid (ABTS) Assay

The ABTS assay was determined as described in (Zou et al., 2011) with minor modification. ABTS and potassium persulfate were dissolved with distilled water to obtain concentrations of 7 mM and 4.9 mM, respectively. The two solutions were mixed and incubated in dark for 12-16 hours at room temperature. After incubation time, the ABTS radical was added with distilled water until the absorbance is 0.7 at 734 nm. 10 μ L of sample and 190 μ L of ABTS solutions were added to the

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata

96-well plates. The absorbance was recorded after 30 mins incubation in dark at room temperature. The percentage of antioxidant activity was calculated using Equation 2.

$$\text{Scavenging Percentage} = \frac{\text{Abs (ABTS)} - \text{Abs (ABTS + A Sample)}}{\text{Abs (ABTS)}} \times 100 \quad (2)$$

Where Abs (ABTS) is the absorbance of ABTS solution with methanol and A Sample is the absorbance of the tested samples with ABTS solution. All determinations were carried out in triplicate and averaged.

INSTRUMENTATION

Gravity column chromatography (CC) was carried out on Silica gel Merck silica 60 (70-230 mesh size) for VLC; Merck silica 60 (230-400 mesh size) for CC and 0.20 mm precoated gel aluminium plate (DC Kieselgel 60 F254) (TLC). The ¹H NMR (400 MHz) and ¹³C NMR (400 MHz) spectra data were recorded on Bruker Avance AMX (400 MHz) instrument. UV spots were detected on UVITEC Cambridge CB4 IQB (light short and long waves (254 nm - 365 nm). Infrared (IR) were taken as KBr pellet on Perkin-Elmer series 1600 FT-IR spectrophotometer.

Table 1.

Table 1: Yield from the Extraction of *D. pinnata* Leaves

	Extraction time mins	Extraction temperature 0°C	Solvents (g/%)		
Yield(g) (%)	35	40	Hex 48.25 (3.22)	EtOAc 20.91 (1.39)	EtOH 73.92 (4.93)
The residue (marc)	Extraction time hrs 8	Extraction temperature 0°C 80	1.30 (0.09)	0.7 (0.05)	2.1 (0.14)

X mL/1.5kg proportion solvent to sample ratio was used in the experiment. Values are expressed in both grams/percentages compared to residual.

Compound (1) was obtained through elution of sub-fraction from the *D. pinnata* leaves *n*-hexane (DPLH) extracts over silica gel (70-230 mesh)

GC-MS analyses of isolates were performed on Agilent 7820A (G4350) instrument coupled with S9877E. The HP-5MS column with a dimension of 30 m × 0.25 μm × 0.25 μm was used. The initial temperature was 100°C, maintained for 10 min, while the final temperature was 300°C kept for 10 mins, with pressure at 10.686 psi, septum purge flow at 3.5 mL/min, split ratio (26.8: 0.1) and split the flow of 24.228 mL/min. Helium gas was used as a carrier gas. The ionization energy of 70eV was maintained for MS detection. Mass spectral data were obtained from Mass Spectrometry Laboratory, National Institute of Standards and Technology. The melting point was determined using a capillary tube on the electrothermal 9100, apparatus.

RESULTS AND DISCUSSION

The crude extracts from different solvents such as *n*-hexane, ethyl acetate and methanol were significant with various physical properties in terms of coloured. The manual agita-sonication extraction process yielded hexane (48.25 g, 3.22%), ethyl acetate (20.91 g, 1.39%) and ethanol (73.92 g, 4.93%) compared to the residual yield from the Soxhlet method; hexane (1.3 g, 0.09%), ethyl acetate (0.7 g, 0.05%) and methanol (2.1 g, 0.14%) respectively as shown in

using column chromatography afforded compound (1) as a colourless oil (35 mg, 0.91%), *R_f* value of 0.83 (*n*-hexane 100%). The IR

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata

spectrum of **(1)** exhibited sp^3 C-H stretching absorption band at 2927, sp^2 C-H stretching at 3100 cm^{-1} and C=C stretching at 1602 cm^{-1} . The 1H NMR spectrum displayed multiplet olefinic proton signals with different chemical shift values. The centre olefinic protons at H-11/H-14 both displayed signals at 5.15 (1H, *m*) while the outer olefinic protons H-3, H-7/H-18 showed signals at 5.10 (1H, *m*). Another multiplet signals range at δ_H 2.02 and δ_H 2.10 were observed in the upfield region and assigned to methylene (-CH₂-) protons H-4/H-21, H-5/H-20, H-8/H-7, H-9/H-16 and H-12/H-13. The singlet signals at δ_H 1.70 integrated for six protons corresponded to H-1/H-24. The other two singlet signals observed at 1.63 account for the remaining eighteen protons assigned to the methyl protons at H-25/H-30, H-26/H-29 and H-27/28. The ^{13}C NMR and DEPT spectra showed fifteen peaks from thirty carbons. The EIMS chromatogram displayed one peak at *t_r* 23.07 min and EIMS spectrum of a molecular ion, M⁺ at *m/z* 410 consistent with the molecular formula C₃₀H₅₀. Based on the spectral data obtained from *Hemigraphis hirta* (Alam et al., 2002). Compound **(1)** was characterized as squalene.

Compound **(2, 3 & 4)** was obtained by purification of *D. pinnata* ethyl acetate fraction (DPLEA). Elution through the column chromatography resulted in the isolation of compound **(2)** as white crystalline solid (8 mg, 0.24%), *R_f*-value of 0.60 in pet. ether: EtOAc (19:1) with m.p. 167-169°C (Achika et al., 2016) 168-169°C) and compound **(3)** as white needles (15 mg, 0.43%), with m.p. 144-145°C (Osuntokun et al., 2018) 147-149°C). Compound **(4)** was obtained as colourless needles (10 mg, 0.33%), with m.p. 145°C (Pierre & Moses, 2015) 147-148°C). Their TLC profiles gave a purple spot after being sprayed with vanillin sulphuric acid reagent which suggested a terpene-type of compounds. The IR spectrum of **(2)** exhibited absorption bands at 2924 cm^{-1} attributed to C-H stretching (sp^3), a carbonyl (C=O) stretching at 1738 cm^{-1} and C-O stretching at 1170 cm^{-1} . Compound **(3)** showed an absorption band of sp^3 for C-H stretching at 2935 cm^{-1} , a typical hydroxyl group absorption band at 3406 cm^{-1} , C-O stretching at 1052 cm^{-1} and compound

(4) displayed absorption bands at 2933 cm^{-1} for sp^3 C-H stretching. The presence of absorption bands of a hydroxyl group (OH) at 3391 cm^{-1} and C-O stretching was observed at 1051 cm^{-1} . The EIMS spectrum of **(2)** revealed a molecular ion, M⁺ at *m/z* 454.0 corresponded to the molecular formula C₃₁H₅₀O₂. Compound **(3)** revealed a molecular ion, M⁺ at *m/z* 412 corresponded to the molecular formula C₂₉H₄₈O and that of **(4)** with a molecular ion, M⁺ at *m/z* 414 corresponded to the molecular formula C₂₉H₄₈O.

The 1H NMR spectrum of **(3)** and **(4)** differed at C-3 with the presence of multiplet methine proton signals at δ_H 4.60 (1H, *m*) assigned to H-3 which bonded to an acetate group in compound **(2)** while multiplet signals at δ_H 3.54 (1H, *m*) assigned for methine proton at H-3 bonded to hydroxyl group. Another difference between compounds **(3)** and **(4)** is a C-22. Compound **(3)** revealed the presence of olefinic proton signals at δ_H 5.02 (1H, *m*) / 5.17 (1H, *m*) assigned to H-22 and H-23, while compound **(4)** showed multiplet methylene proton signals at δ_H 1.25 (4H, *m*) attributed to H-22/H-23. The major similarity was found in their methyl substituents. The spectrum of **(2)** showed a singlet methyl protons signal at δ_H 1.01 (3H, *s*) and δ_H 0.95 (3H, *s*) corresponded to H-18 and H-19. Another methyl in **(2)** at δ_H 0.91, 0.82, and 0.81 were corresponding to H-21, H-26 and H-27. In compound **(3)** revealed the presence of singlet methyl proton signals at 1.71 (3H, *s*) and 1.06 (3H, *s*) corresponded to H-18 and H-19 along with methyls proton signals at 0.92 (3H, *s*), 0.80 (3H, *m*), 0.88 (3H, *m*) corresponding to H-21, H-28 and H-29 while compound **(4)** afforded methyl proton signals at 0.69 (3H, *s*), 1.02 (3H, *s*) 0.93 (3H, *d*, *J* = 6.4 Hz), 1.29 (3H, *d*, *J* = 8.0 Hz) and 0.85 (3H, *d*, *J* = 7.6 Hz) corresponding to H-18, H-19, H-21, H-28 and H-29 respectively. The presence of triplet methine proton signals at δ_H 5.39 (1H, *t*, *J* = 6.0 Hz) **(2)**; 5.37 (1H, *t*, *J* = 6.0 Hz) **(3)**; 5.35 (1H, *t*, *J* = 2.16 Hz) **(4)** were corresponding to H-6. Analysis of the ^{13}C NMR spectrum of **(2)** showed signals at δ_C 139.7 (C-5) and δ_C 122.5 (C-6). The carbon peak value at δ_C 73.0 was assigned to C-3 which is linked to the carbonyl centre with a sigma bond. The carbon signals at δ_C 19.4 and δ_C 11.9 correspond to C-18 and C-19. The ^{13}C NMR

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata

spectrum of compound (3) showed signals at the downfield region at δ_C 121.6, δ_C 140.7, δ_C 138.2, and δ_C 129.3 which were attributed to the unsaturated carbon (C=C) at C-6, C-5, C-22 and C-23 respectively. Another signal at δ_C 71.8 was assigned for C-3 which bonded to a hydroxyl group (OH). The remaining twenty-four carbons were observed in the upfield region at δ_C 11.8-56.8 ppm for (3). Compound (4) showed signals at the downfield region at δ_C 121,7 and δ_C 140.7 which were attributed to the unsaturated carbon (C=C) C-6, respectively. Another signal at δ_C 71.7 was assigned for C-3 which bonded to a hydroxyl group (OH). The remaining twenty-four carbons were observed in the upfield region at δ_C 11.8-56.0 ppm. Based on the earlier report of 1H and ^{13}C NMR data from the stem bark fraction of *Spondias mombin* (Linn.) (Osuntokun et al., 2018; Pierre & Moses, 2015; Yakubu et al., 2014) and from *Vitex Schiliebenii* extracts (Nyamoita et al., 2013). Compounds (2), (3) and (4) were characterized as stigmasterol, stigmasta-5,22-diene-3-ol acetate and γ - sitosterol.

Further elution of *n*-hexane resulted in the isolation of compound (5) as white needles crystal (5 mg, 0.29%), R_f value 0.59 (*n*-hexane: ethyl acetate, 7:1), m.p. 212-213°C (Alam et al., 2002) 215-216°C). IR spectrum of (5) showed hydroxyl group absorption band at 3421 cm^{-1} , C-O stretching at 1035 cm^{-1} , sp^3 C-H stretching at 2930 cm^{-1} and 2868 cm^{-1} and olefinic C=C stretching at 1637 cm^{-1} . The EIMS spectrum of (5) analysis showed a molecular ion, M^+ at m/z 426 corresponded with a molecular formula of $C_{30}H_{50}O$. The 1H NMR spectrum of (5) showed the characteristic of the triterpene skeleton, which showed overlapping signals at δ_H 0.76 - 1.68 corresponded to methyl groups, and the olefinic protons at (H-29) was assigned to two singlets at δ_H 4.70 and δ_H 4.57, a doublet at δ_H 3.22 was attributable to the oxymethine (H-3). Analysis of the ^{13}C NMR spectrum of (5) supported the triterpenoid skeleton by exhibiting thirty signals which were attributed to thirty carbons in the molecule. Based on the physical properties as well as spectroscopic data from the literature (Adeosun et al., 2019; Gandagule et al., 2018; No et al.,

2018; Saratha et al., 2011), thus, compound (5) was identified as lupeol.

Elution of the *n*-hexane fraction afforded a white solid compound (6), (18.0 mg, 0.60%), R_f value 0.59 (*n*-hexane: ethyl acetate, 8:2) with a purple colour when heated, m.p. 224-226°C (Sen et al., 2017) 221-222°C). The IR spectrum exhibited hydroxyl (O-H) group absorption band at 3386 cm^{-1} , C-H stretching at 1294 cm^{-1} , C-O stretching at 1072 cm^{-1} , C=C stretching at 1669 cm^{-1} and C-H stretching (sp^3) at 2917 cm^{-1} . The EIMS spectrum of (6) analysis molecular ion, M^+ at m/z 426 consistent with the molecular formula $C_{30}H_{50}O$. The 1H NMR spectrum of (6) revealed the presence of methyl groups resonated between δ_H 0.85-0.99. Other protons resonated at δ_H 5.53 (2H, *s*) corresponded to δ_C 116.8 (C-21) for olefinic protons. A methine proton showed multiplet overlapped signals at δ_H 0.78 corresponded to δ_C 49.2 at C-9. Furthermore, doublet of doublet signal was observed at δ_H 3.20 (1H, *dd*, $J = 10.6, 5.6$ Hz) corresponded to δ_C 79.1 at C-3 bearing the O-H group. Analysis of the ^{13}C NMR spectrum of (6) showed thirty carbons signals. These include seven methyls, eleven methylenes, six methines and six quaternary carbons. The data obtained showed similarities with taraxasterol in medicinal plants isolated and identified from endemic *Centaurea kilaea* (Sen et al., 2017)(Mouffok et al., 2012; Sharma & Zafar, 2015). Based on the spectral data, compound (6) was elucidated as taraxasterol.

Compound (7) was obtained as a white solid (12 mg, 0.24%) from the CC of *n*-Hexane fraction after washing in cold *n*-hexane and the m.p. 314.0 – 314.7°C (lit. (Ahmed et al., 2013) 315 – 317°C) was determined. The EIMS spectrum revealed the presence of a molecular ion peak at m/z 456 which was consistent with the molecular formula $C_{30}H_{48}O_3$. The IR spectrum exhibited a broad peak typical of the hydroxyl group at 3224 - 2489 cm^{-1} , carbonyl absorption at 1747 cm^{-1} both for the carboxylic acid group and peaks due to double bond at 1641 and C-O stretching bands at 1230 cm^{-1} . The 1H NMR spectrum revealed a pair of olefinic proton signals at δ_H 4.76 (1H, *d*, $J = 2.0$ Hz) and 4.63 (1H, *s*), a typical feature of the

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata

exocyclic methylene group; six singlet methyl signals observed at δ_H 0.78, 0.85, 0.96, 0.99, 1.00, 1.71 and 1.96; along with a signal at δ_H 3.19 (*dd*, $J = 11.6, 5.2$ Hz) which was assigned to carbinolic proton (H-3). Other resonance at δ_H 2.99 (*dt*, $J = 10.8, 4.4$ Hz, H-19), 2.24 (*m*, H-16), 2.20 (*m*, H-13) and 1.96 (*dd*, $J = 11.2, 5.2$ Hz, H-21) were typical for lupane triterpene skeleton. The ^{13}C NMR spectrum exhibited the presence of thirty

carbons. The DEPT spectra revealed six methines, eleven methylene, seven methyl and six quaternary carbons. The ^{13}C NMR data of compound (7) showed close similarities to betulinic acid (Ahmed et al., 2013). Based on the spectroscopic analyses above, compound (7) was identified as betulinic acid, a triterpene previous isolated from *Holoptelea integrifolia* (Ahmed et al., 2013).

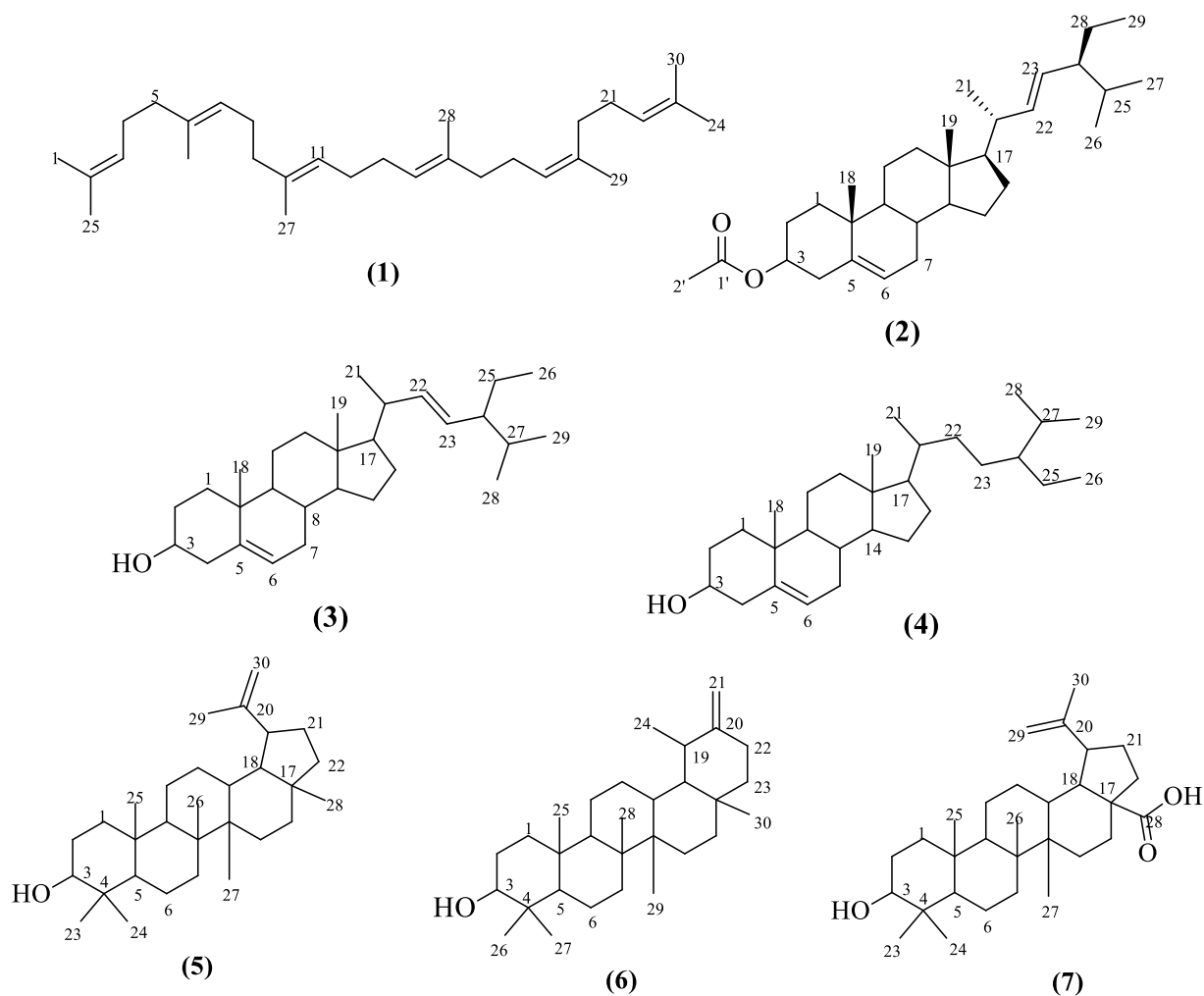


Figure 1: Structures of the Triterpenoids

Terpenoids Spectroscopic Data

Squalene (1): Elution of the same *n*-hexane fraction afforded a white amorphous solid as compound (1) (38 mg), R_f 0.59; m.p. 220-223°C; IR (Neat) ν_{\max} cm^{-1} : δ_H 3386 (O-H), 1072 (C-O), 1669 (C=C), 2917 (C-H, 3011 (C-H). ^1H NMR

(400 MHz, CDCl_3); 1.64 (2H, *m*, H-1), 1.91 (2H, *m*, H-2), 3.20 (1H, *dd*, $J = 10.6, 5.6$ Hz, H-3), 0.78 (1H, *s*, H-5), 1.56 (2H, *m*, H-6), 1.63 (2H, *m*, H-7), 0.78 (1H, *m*, H-9), 1.57 (2H, *m*, H-11), 1.56 (2H, *m*, H-12), 1.58 (1H, *m*, H-13), 1.64 (2H, *m*,

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata

H-15), 1.64 (2H, *m*, H-16), 2.34 (1H, *m*, H-18), 2.03 (1H, *m*, H-19), 5.53 (2H, *s*, H-21), 0.79 (3H, *m*, H-24), 0.85 (3H, *s*, H-25), 0.92 (3H, *s*, H-26), 0.96 (3H, *s*, H-27), 0.88 (3H, *s*, H-28), 0.79 (3H, *s*, H-29), 0.91 (3H, *s*, H-30). ¹³C NMR (400 MHz, CDCl₃): δ_C 16.0 (C-1), 134.8 (C-2), 17.6 (C-2'), 124.2 (C-3), 28.2 (C-4), 39.7 (C-5), 135.0 (C-6), 15.9 (C-6'), 124.2 (C-7), 28.2 (C-8), 39.7 (C-9), 135.0 (C-10), 15.9 (C-10'), 124.2 (C-11), 29.6 (C-12), 29.6 (C-13), 124.2 (C-18), 135.0 (C-19), 39.7 (C-20), 28.2 (C-21), 124.3 (C-22), 134.8 (C-23), 16.0 (C-23), 17.6 (C-24). EIMS; *m/z*: 410 [M]⁺ (C₃₀H₅₀).

Stigmasterol (2): Compound (2) was obtained from the purification of *n*-hexane extracts as white needles (25 mg), m.p. 144-145°C; R_f 0.70; IR (Neat) ν_{max} cm⁻¹: 2935 (C-H), 3406 (OH), 1052 (C-O); ¹H NMR (400 MHz, CDCl₃): δ_H 1.27 (2H, *t*, *J* = 2.4 Hz, H-1), 1.47 (2H, *m*, H-2), 3.54 (1H, *m*, H-3), 2.00 (2H, *m*, H-4), 5.37 (1H, *d*, *J* = 6.0 Hz, H-6), 1.85 (2H, *m*, H-7), 1.47 (1H, *m*, H-8), 1.45 (1H, *m*, H-9), 1.30 (2H, *m*, H-11), 1.35 (2H, *m*, H-12), 1.30 (1H, *m*, H-14), 1.47 (2H, *m*, H-15), 1.48 (2H, *m*, H-16), 1.47 (1H, *m*, H-17), 1.71 (3H, *s*, H-18), 1.06 (3H, *s*, H-19), 1.47 (1H, *m*, H-20), 0.93 (3H, *m*, H-21), 5.02 (1H, *dd*, *J* = 15.2 Hz, 8.8 Hz, H-22), 5.17 (1H, *dd*, *J* = 15.2 Hz, 8.8 Hz, H-23), 0.92 (3H, *s*, H-24), 0.80 (2H, *m*, H-25), 0.84 (3H, *m*, H-26), 0.82 (3H, *d*, *J* = 7.2 Hz, H-27), 0.80 (3H, *m*, H-28), 0.88 (3H, *m*, H-29),); ¹³C NMR (400 MHz, CDCl₃): δ_C 21.2 (C-19), 21.2 (C-18), 12.2 (C-29), 21.0 (C-27), 19.4 (C-26), 19.0 (C-21), 6.4 (C-2), 2.0 (C-1), 42.2 (C-4), 29.0 (C-7), 23.10 (C-11), 31.9 (C-12), 25.4 (C-15), 24.4 (C-16), 27.10 (C-28), 140.8 (C-6), 50.1 (C-9), 51.3 (C-8), 29.0 (C-14), 56.8 (C-17), 32.0 (C-20), 129.2 (C-22), 138.4 (C-23), 31.6 (C-25), 71.89 (C-3), 121.4 (C-5), 40.5 (C-13), 39.7 (C-10), 56.0 (C-24); EIMS; *m/z*: 412 [M]⁺ (C₂₉H₄₈O).

Stigmasta-5,22-diene-3-ol acetate (3): The purification of DPLH 3-9 fraction through the column chromatography resulted to the isolation of compound (3) as white crystalline solid (18 mg), R_f 0.60; m.p. 167-169°C. IR (Neat) ν_{max} cm⁻¹: 2924 (C-H), 1738 (C=O), 1170 (C-O); ¹H NMR (400 MHz, CDCl₃): δ_H 1.62 (2H, *t*, *J* = 8.0 Hz, H-1), 1.52 (2H, *m*, H-2), 4.60 (1H, *m*, H-3), 2.30 (2H,

m, H-4), 5.39 (1H, *d*, *J* = 6.0 Hz, H-6), 1.62 (2H, *m*, H-7), 2.30 (1H, *m*, H-8), 2.06 (2H, *t*, *J* = 4.0 Hz, H-12), 1.06 (2H, *m*, H-15), 1.30 (2H, *m*, H-16), 1.01 (3H, *s*, H-18), 0.95 (3H, *s*, H-19), 0.91 (3H, *d*, *J* = 4.4 Hz, H-21), 5.34 (1H, *m*, H-22), 5.39 (1H, *m*, H-23), 0.97 (3H, *s*, H-23), 0.97 (3H, *s*, H-24), 0.71 (3H, *s*, H-25), 0.81 (3H, *d*, *J* = 4.0 Hz, H-27), 1.30 (3H, *s*, H-28), 0.89 (3H, *t*, *J* = 4.4 Hz, H-29), 2.01 (3H, *s*, H-2'). ¹³C NMR (400 MHz, CDCl₃): δ_C 37.0 (C-1), 31.5 (C-2), 73.0 (C-3), 39.7 (C-4), 139.7 (C-5), 122.5 (C-6), 31.5 (C-7), 31.9 (C-8), 51.2 (C-9), 36.6 (C-10), 21.2 (C-11), 39.7 (C-12), 56.9 (C-14), 25.0 (C-15), 29.0 (C-16), 56.9 (C-17), 11.8 (C-18), 21.2 (C-19), 39.7 (C-20), 23.4 (C-21), 139.7 (C-22), 129.3 (C-23), 50.2 (C-24), 31.9 (C-25), 21.0 (C-26), 19.0 (C-27), 25.3 (C-28), 12.0 (C-29), 173.2 (C-1'), 18.9 (C-2'). EIMS; *m/z*: 454.0 (C₃₁H₅₀O₂).

λ-sitosterol (4): Compound (4) was obtained from the purification of *n*-hexane extract as colourless needles (30 mg); m.p. 146-148°C; R_f 0.65; IR (Neat) ν_{max} cm⁻¹: 2933 (C-H), 3391 (OH), 1051 (C-O); ¹H NMR (400 MHz, CDCl₃): δ_H 1.25 (2H, *m*, H-1), 1.47 (2H, *m*, H-2), 3.51 (1H, *m*, H-3), 2.00 (2H, *m*, H-4), 5.35 (1H, *t*, *J* = 2.16 Hz, H-6), 1.85 (2H, *m*, H-7), 1.45 (1H, *m*, H-8), 1.44 (1H, *m*, H-9), 1.42 (2H, *m*, H-11), 1.35 (2H, *m*, H-12), 1.42 (1H, *m*, H-14), 1.47 (2H, *m*, H-15), 1.48 (2H, *m*, H-16), 1.47 (1H, *m*, H-17), 0.69 (3H, *s*, H-18), 1.02 (3H, *s*, H-19), 1.53 (1H, *m*, H-20), 0.93 (3H, *d*, *J* = 6.4 Hz, H-21), 1.25 (2H, *m*, H-22), 1.25 (2H, *m*, H-23), 0.98 (1H, *m*, H-24), 1.86 ((2H, *m*, H-25), 0.82 (3H, *t*, *J* = 6.0 Hz, H-26), 0.83 (1H, *m*, H-27), 1.29 (3H, *d*, *J* = 8.0 Hz, H-28), 0.85 (3H, *d*, *J* = 7.6 Hz, H-29); ¹³C NMR (400 MHz, CDCl₃): 37.2 (C-1), 32.4 (C-2), 71.8 (C-3), 42.2 (C-4), 140.7 (C-5), 121.7 (C-6), 31.9 (C-7), 31.6 (C-8), 50.2 (C-9), 33.7 (C-10), 21.0 (C-11), 39.7 (C-12), 42.3 (C-13), 56.0 (C-14), 26.1 (C-15), 28.2 (C-16), 56.7 (C-17), 11.8 (C-18), 19.3 (C-19), 36.5 (C-20), 33.9, 19.0 (C-21), (C-22), 26.1 (C-23), 45.8 (C-24), 29.1 (C-25), 18.2 (C-26), 19.8 (C-27), 23.0 (C-28), 12.2 (C-29). EIMS; *m/z*: 414 [M]⁺ (C₂₉H₅₀O).

Lupeol (5): Further elution of *n*-hexane resulted in the isolation of white needles crystal (19 mg), m.p. 215-217°C; R_f 0.59; IR (Neat) ν_{max} cm⁻¹:

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata

3421 (OH), 1035 (C-O), 2930 (C-H), 1637 (C=C); ¹H NMR (400 MHz, CDCl₃): δ_H 0.91 (2H, *t*, *J* = 8.0 Hz, H-1), 1.54 (2H, *m*, H-2), 3.20 (1H, *m*, H-3), 1.39 (2H, *m*, H-6), 1.42 (2H, *m*, H-7), 1.26 (1H, *d*, *J* = 8.0 Hz, H-9), 1.24 (2H, *m*, H-11), 1.07 (2H, *m*, H-12), 1.66 (1H, *t*, *J* = 4.0 Hz, H-13), 1.68 (2H, *t*, *J* = 8.0 Hz, H-15), 1.39 (2H, *m*, H-16), 1.36 (1H, *m*, H-18), 2.37 (1H, *m*, H-19), 1.32 (2H, *m*, H-21), 1.24 (2H, *m*, H-22), 0.95 (3H, *s*, H-23), 0.79 (3H, *s*, H-24), 0.83 (3H, *s*, H-25), 1.03 (3H, *s*, H-26), 0.97 (3H, *s*, H-27), 0.80 (3H, *s*, H-28), 4.58 (1H, *s*, H-29), 1.68 (3H, *s*, H-30); ¹³C NMR (400 MHz, CDCl₃): δ_C 19.2 (C-23), 19.3 (C-24), 29.1 (C-25), 20.9 (C-26), 27.4 (C-27), 25.1 (C-28), 109.3 (C-30), 35.2 (C-1), 19.2 (C-6), 35.5 (C-7), 50.4 (C-9), 27.4 (C-15), 40.0 (C-16), 34.2 (C-12), 40.0 (C-13), 29.83 (C-11), 42.81 (C-22), 43.0 (C-21), 34.2 (C-2), 29.1 (C-29), 50.4 (C-5), 48.2 (C-18), 151.0 (C-20), 55.25 (C-19), 79.0 (C-3); EIMS; *m/z*: 426 [M]⁺ (C₃₀H₅₀O).

Taraxaterol (6): The unambiguous characterization of ursane skeleton for taraxasterol as a white solid, **(6)** (28 mg), with a purple color when heated, m.p. 224-226°C (lit. (Sen et al., 2017) 221-222°C). IR (Neat) *v*_{max} cm⁻¹: 3486 (O-H), 2926 (C-H), 1159 (C-O), 1679 (C=C alkene). ¹H NMR (400 MHz, CDCl₃): δ_H 1.64 (2H, *m*, H-1), 1.91 (2H, *m*, H-2), 3.20 (1H, *dd*, *J* = 10.6, 5.6 Hz, H-3), 0.78 (1H, *s*, H-5), 1.56 (2H, *m*, H-6), 1.63 (2H, *m*, H-7), 0.78 (1H, *m*, H-9), 1.57 (2H, *m*, H-11), 1.56 (2H, *m*, H-12), 1.58 (1H, *m*, H-13), 1.64 (2H, *m*, H-15), 1.64 (2H, *m*, H-17), 2.34 (1H, *m*, H-18), 2.03 (1H, *m*, H-19), 5.53 (2H, *s*, H-21), 1.35 (2H, *m*, H-22), 0.99 (3H, *s*, H-23), 0.79 (3H, *s*, H-24), 0.85 (3H, *s*, H-25), 0.92 (3H, *s*, H-26), 0.96 (3H, *s*, H-27), 0.88 (3H, *s*, H-28), 0.79 (3H, *s*, H-29), 0.91 (3H, *s*, H-30). ¹³C NMR (400 MHz, CDCl₃): δ_C 38.7 (C-1), 27.3 (C-2), 79.1 (C-3), 38.7 (C-4), 55.5 (C-5), 18.2 (C-6), 34.0 (C-7), 41.3 (C-8), 49.2 (C-9), 57.3 (C-10), 21.4 (C-11), 26.0 (C-12), 38.9 (C-13), 41.3 (C-14), 26.6 (C-15), 38.7 (C-16), 34.0 (C-17), 48.7 (C-18), 38.9 (C-19), 158.0 (C-20), 116.8 (C-21), 38.9 (C-22), 28.1 (C-23), 15.3 (C-24), 16.4 (C-25), 16.0 (C-26), 15.0 (C-27), 19.3 (C-28), 25.4 (C-29), 21.4 (C-30). EIMS; *m/z*: 426 [M]⁺ (C₃₀H₅₀O).

Betulinic acid (7): Purification of *n*-hexane fraction using CC and then washing the solid obtained in cold *n*-hexane gave white solid of compound **(7)**, (22 mg); R_f 0.60 (*n*-hexane-EtOAc, 3:2); m.p. 314.0 – 314.7°C (lit. (Ahmed et al., 2013) 315 – 317°C); IR (ATR) *v*_{max} cm⁻¹: 3224 - 2489 (OH), 2938 (*sp*³ CH), 1747 (C=O), 1641 (C=C), 1230 (C-O); ¹H NMR (400 MHz, CDCl₃): δ 0.78, 0.85, 0.96, 0.99, 1.00, 1.71, 1.96 (each, 3H, *s*, CH₃ ×7), 2.01 (1H, *m*, H-21), 2.20 (1H, *m*, H-13), 2.24 (1H, *m*, H-16), 2.99 (1H, *dt*, *J* = 10.8, 4.4, H-19), 3.19 (*dd*, *J* = 11.2, 5.2, H-3), 4.63 (1H, *s*, H-29), 4.76 (1H, *d*, *J* = 2.0, H-29); ¹³C NMR (100 MHz, CDCl₃): δ 14.6 (C-27), 15.3 (24), 16.0 (C-25), 16.1 (C-26), 18.2 (C6), 19.3 (C-30), 20.8 (C-11), 25.4 (C-12), 27.3 (C-2), 27.9 (C-23), 29.6 (C-21), 30.5 (C-15), 32.1 (C-16), 34.2 (C-7), 37.0 (C-22), 37.1 (C10), 38.3 (C-13), 38.6 (C-1), 38.8 (C-4), 40.6 (C-8), 42.4 (14), 46.8 (C18), 49.2 (C-19), 50.4 (C-9), 55.3 (C-5), 56.3 (C-17), 79.0 (C-3), 109.7 (C-29), 150.4 (C-20), 180.7 (C-28); 248 (24), 203 (45), 189 (100). EIMS *m/z*; 456 [M]⁺ (C₃₀H₄₈O₃).

The antioxidant properties for isolated terpenoids except for compounds **(3)** and **(7)** displayed inactive activity towards DPPH radicals with an IC₅₀ value of more than 1000 µg/mL. Compound **(3)** and **(7)** showed IC₅₀ valued 88.92 µg/mL and 143.7 µg/mL respectively. The potent •OH scavenging capacity present in compounds may be related to its protective power. The terpenoid least inhibitor percentage as calculated began at 30.38% **(1)**, 58.34% **(2)** 69.33 **(4)**, 78.33 **(5)** and **(6)**, 60.34%. The isolated compounds were evaluated for ABTS radical scavenging activity but only a few compounds showed significant activity towards ABTS radical with IC₅₀ value of 100.0-144.7 µg/mL for compounds **(1)**, **(2)**, **(3)**, **(4)** **(5)** **(6)** and **(7)** as shown in **Table 2**. The terpenoids-related compounds showed a similar percentage of scavenging activity with least at 36.39%; **(1)** and others with 39.60%; **(6)**, 41.61%; **(2)**, 43.95%, **(4)** and 62.95% **(5)**. The percentage of total ABTS radical scavenging activity of terpenoids level was moderately remarkable. Interestingly, only compound **(5)** showed a significant radical scavenging activity. The correlation analysis of FRAP values for total

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata

antioxidant capacity was calculated using ferric sulfate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) solution. The ferric sulphate graph expressed as mM FeSO_4

equivalent with linearity over calibration range with an R^2 value of 0.994 shown in **Error! Reference source not found.**

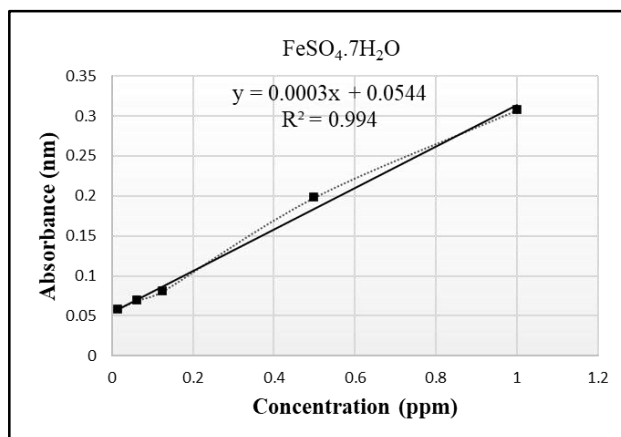


Figure 2: Calibration Curve of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$

The EtOAc extracts (DPLEA) with reducing potential value of 3.33 ± 0.09 mM FeSO_4 equivalent. This significant difference between MeOH extracts and EtOAc extracts compared to positive control in were Trolox (FRAP equivalent values = 2.23 ± 0.12 mM), BHA (FRAP equivalent values = 2.74 ± 0.11 mM), Gallic acid (FRAP equivalent values = 2.83 ± 0.02 mM),

Ascorbic Acid (FRAP equivalent values 2.87 ± 0.03 mM), BHT (FRAP equivalent values = 2.93 ± 0.18 mM), Pyrogallol (FRAP equivalent values = 3.07 ± 1.44 mM), Quercetin (FRAP equivalent values = 3.11 ± 0.05 mM) at concentration of 1.0 Mm as indicated in **Error! Reference source not found.**

Table 2: DPPH Inhibitory Activity of Compounds from *D. pinnata* (Poir.) Schumach. & Thonn.

Fractions	Compounds	IC ₅₀ (µg/mL)
<i>n</i> -Hexane (DPLH)		105.0
Ethyl Acetate (DPLEA)		605.4
Methanol (DPLMT)		22.07
	(1)	>1000
	(2)	>1000
	(3)	88.92
	(4)	>1000
	(5)	>1000
	(6)	>1000
	(7)	143.7
Postive Control		IC₅₀ (µg/mL)
BHA		25.758
BHT		22.22
Trolox		11.40
Gallic Acid		31.01

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata

Ascorbic Acid	105.70
Pyrogallol	1.70
Quercetin	6.95

The IC₅₀ value represented the concentration of the isolated compounds that caused 50% inhibition of DPPH•. IC₅₀ (µg/mL) of antioxidant activity <50 (very strong), 51-100 (strong), 101-150 (moderate), 151-200 (weak), 201-250 (very weak and >251 (inactive). All values expressed as mean ± SD values for three replicates experiment; P<0.05. Positive Control: BHT = butyl hydroxyl toluene, BHA = butyl hydroxyl anisole, trolox = (+)-6-hydroxy-2,5,7,8-tetramethylchromane-2-carboxylic acid, gallic acid, ascorbic acid; pyrogallol and quercetin. Isolated compounds:

Squalene (1) Stigmasterol (2), Stigmasta-5,22-diene-3-ol acetate (3), γ-sitosterol (4), Lupeol (5), Taraxasterol (6), and betulinic acid (7). DPL = *D. pinnata* leaves; HE = Hexane; EA = Ethyl acetate; MT = Methanol.

The higher antioxidant capability was displayed by MeOH (DPLMT) extracts as shown in

Table 3: ABTS Radical Scavenging Activity of Compounds from *D. pinnata* (Poir.) Schumach. & Thonn.

with 50% scavenging activity at 15.41 µg/mL. Ethyl acetate extract showed lower activity at 24.38 µg/mL and *n*-hexane showed interference.

All the terpenoids under test showed moderate activity and compound (3) with 100.0 µg/mL haven greater activity. Compound (6) showed an inactive test. Among the positive controls, pyrogallol showed the highest activity with 12.81 µg/mL followed by quercetin at 15.81 µg/mL, gallic acid at 17.83 µg/mL, BHT at 27.60 µg/mL, ascorbic acid at 40.25 µg/mL, Trolox at 41.14 µg/mL and BHA at 47.28 µg/mL.

Table 3: ABTS Radical Scavenging Activity of Compounds from *D. pinnata* (Poir.) Schumach. & Thonn.

Fractions	Compounds	SC ₅₀ (µg/mL)
<i>n</i> -Hexane (DPLHE)		INT
Ethyl Acetate (DPLEA)		24.38
Methanol (DPLMT)		15.41
	(1)	125.0
	(2)	123.3
	(3)	100.0
	(4)	119.1
	(5)	144.7
	(6)	>1000
	(7)	114.4
Positive Control		SC₅₀ (µg/mL)
BHA		47.28
BHT		27.60
Trolox		41.14

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata

Gallic acid.	17.83
Ascorbic acid	40.25
Pyrogallol	12.81
Quercetin	15.81

The SC₅₀ value represented the concentration of isolated compounds that caused 50% scavenging of ABTS radicals. SC₅₀ (µg/mL) of antioxidant activity <50 (very strong), 51-100 (strong), 101-150 (moderate), 151-200 (weak), 201-250 (very weak and >251 (inactive). All values expressed as mean ± SD values for three replicates experiment; P<0.05. Positive control: BHT = butyl hydroxyl toluene, BHA = butyl hydroxyl anisole, trolox = (+)-6-hydroxy-2,5,7,8-tetramethylchromane-2-carboxylic acid, gallic acid, ascorbic acid, pyrogallol and Quercetin. Isolated compounds: Squalene (1) Stigmasterol (2), Stigmasta-5,22-diene-3-ol acetate (3), γ-sitosterol (4), Lupeol (5),

Taraxasterol (6), and betulinic acid (7). DPL = *D. pinnata* leaves; HE = Hexane; EA = Ethyl acetate; MT = Methanol.

The evaluation of isolated compounds for FRAP scavenging activity presented in **Table 4** showed lower potency for only compounds (3) and (7) with FRAP equivalent values = 1.91 ± 0.02 mM and 1.11 ± 0.03. Methanol (DPLMT) showed higher activity at 3.45 ± 1.30 mM. The EtOAc extracts (DPLEA) with reducing potential value of 3.33 ± 0.09 mM FeSO₄ equivalent.

Table 4: Ferric Reducing Antioxidant Power (FRAP) of Compounds from *D. pinnata* (Poir.) Schumach. & Thonn. Leaves

Conc.	FRAP (mM equivalent to FeSO ₄ .7H ₂ O)				
	0.06 mM	0.12 mM	0.25 mM	0.50 mM	1.0 mM
Fractions/comps					
<i>n</i> -Hexane (DPLHE)	0.15 ± 0.01	0.31 ± 0.01	0.61 ± 0.02	1.99 ± 0.04	2.54 ± 0.08
Ethyl Acetate (DPLEA)	0.53 ± 0.01	0.91 ± 0.04	1.79 ± 0.14	3.04 ± 0.16	3.33 ± 0.09
Methanol (DPLMT)	0.83 ± 0.12	1.38 ± 0.18	2.26 ± 0.24	3.72 ± 0.82	3.45 ± 1.30
(1)	-	-	-	-	-
(2)	-	-	-	-	-
(3)	0.02 ± 0.03	0.10 ± 0.01	0.17 ± 0.05	0.71 ± 0.02	1.91 ± 0.02
(4)	-	-	-	-	-
(5)	-	-	-	-	-
(6)	-	-	-	-	-
(7)	0.12 ± 0.03	0.21 ± 0.06	0.60 ± 0.12	1.11 ± 0.02	1.21 ± 0.03

The ferric sulfate graph expressed as mM FeSO₄ equivalent with linearity over the calibration range with an R² value of 0.9940. All values are expressed as mean ± SD values for three replicates experiment; P<0.05. Squalene

(1) Stigmasterol (2), Stigmasta-5,22-diene-3-ol acetate (3), γ-sitosterol (4), Lupeol (5), Taraxasterol (6), and betulinic acid (7). DPL = *D. pinnata* leaves; HE = Hexane; EA = Ethyl acetate; MT = Methanol.

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata

This significant difference between MeOH extracts and EtOAc extracts compared to positive control were Trolox (FRAP equivalent values = 2.23 ± 0.12 mM), BHA (FRAP equivalent values = 2.74 ± 0.11 mM), Gallic acid (FRAP equivalent values = 2.83 ± 0.02 mM), Ascorbic Acid (FRAP equivalent values 2.87 ± 0.03 mM), BHT (FRAP equivalent values = 2.93 ± 0.18 mM), Pyrogallol (FRAP equivalent values = 3.07 ± 1.44 mM), Quercetin (FRAP equivalent values = 3.11 ± 0.05 mM) at concentration of 1.0 mM as indicated in Error!

Reference source not found. which clearly approve of the plant as a promising antioxidant source to compact radical related disease.

Table 5: Ferric Reducing Antioxidant Power (FRAP) of Positive Control

Conc.	FRAP (mM equivalent to $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$)				
	0.06 mM	0.12 mM	0.25 mM	0.50 mM	1.0 mM
Positive Controls					
Trolox	0.39 ± 0.06	0.65 ± 0.07	1.40 ± 0.11	2.15 ± 0.13	2.23 ± 0.12
BHA	0.40 ± 0.12	0.74 ± 0.11	1.27 ± 0.07	2.36 ± 0.06	2.74 ± 0.11
VIT. C	0.20 ± 0.03	0.89 ± 0.03	1.96 ± 0.12	2.98 ± 0.12	2.87 ± 0.03
BHT	0.45 ± 0.02	0.83 ± 0.01	1.51 ± 0.02	2.50 ± 0.05	2.93 ± 0.18
GLA	1.02 ± 0.03	1.88 ± 0.06	2.68 ± 0.12	2.70 ± 0.07	2.83 ± 0.02
QUE	1.14 ± 0.05	2.10 ± 0.10	2.87 ± 0.06	2.95 ± 0.14	3.11 ± 0.05
PYRO	0.84 ± 0.06	1.63 ± 0.12	2.26 ± 0.19	2.44 ± 0.21	3.07 ± 1.44

The ferric sulfate graph expressed as mM FeSO_4 equivalent with linearity over the calibration range with R^2 value of 0.9940. All values expressed as mean \pm SD values for three replicates experiment; $P < 0.05$. Positive Control: BHT = butyl hydroxyl toluene, BHA = butyl hydroxyl anisole; Trolox = (+)-6-hydroxy-2,5,7,8-tetramethylchromane-2-carboxylic acid; GLA. = Gallic acid; VIT. C. = Ascorbic acid; PYR = Pyrogallol; QUE = Quercetin.

CONCLUSION

It is rudimental information for the use of plant parts for research work to reveal phytochemicals and their activity. *D. pinnata* (Poir.) Schumach. & Thonn. leaves will have been more beneficial to our immediate society if their antioxidant potential was early studied and sourced. Based on the antioxidant activity profile found, methanolic extracts and their isolated constituents can be extensively investigated clinically for very common neurodegenerative diseases such as cancers, Alzheimer's, coronary artery disease, convulsion, epilepsy, Hallervorden-Spatz syndrome and other highly demanded use of antioxidant products in cosmetic and food industries.

AUTHOR CONTRIBUTIONS

All the experiments have been carried out by the authors listed.

CONFLICT OF INTEREST: Authors have none to declare.

ACKNOWLEDGMENT

This research received funding from the Ministry of Higher Education (MOHE) under the Vote 16H93, Q.J130000.2526.18H69 and Collaborative Research Grant (R.J130000.7354.4B502), and Research Grant from Nippon Sheet Glass Foundation for Materials Science and Engineering (R.J130000.7354.4B515). A great appreciation

*Triterpenoids Characterization with Antioxidant activity from the Aerial Part of *Deinbollia pinnata**

goes to Tertiary Education Trust Fund-Nigeria (TET Fund) for their support and the Faculty of Science, Universiti Teknologi Malaysia for the research facilities.

REFERENCES

- Achika, J. I., Ndukwe, G. I., & Ayo, R. G. (2016). Isolation, Characterization and Antimicrobial Activity the Aerial Part of *Aeschynomene uniflora* E. Mey. *British Journal of Pharmaceutical Research*, 11(5), 1–8. <https://doi.org/10.9734/BJPR/2016/23506>
- Adeosun, A. A., Ndukwe, I. G., & Bello, I. A. (2019). Isolation and characterization of lupeol from the whole plant of *Phaulopsis bateri*. *Journal of Applied Sciences and Environmental Management*, 23(2), 229. <https://doi.org/10.4314/jasem.v23i2.5>
- Ahmed, M., Rizwani, G. H., Mohammed, F. V., Mahmood, I., Ahmed, V. U., & Mahmud, S. (2013). A triterpenoid antioxidant agent found in *Holoptelea integrifolia* (Roxb) Planch. *Int.J.Pharm., Chem.Biol.Sci.*, 3(1), 63–67. <http://www.ijpcbs.com/files/07-312.pdf>
- Alam, A. H. M. K., Harun-or-Rashid, M., & Rahman, M. A. A. (2002). *Chemical constituents of Hemigraphis hirta* T. andera (Acanthaceae). *Pakistan Journal of Biological Sciences* 5(11) (Vol. 4, Issue 5, pp. 1264–1266).
- Borokini, I. (2018). Ethnobiological Survey of Traditional Medicine Practice for The Treatment of Piles and Diabetes Mellitus in Oyo State. *Journal of Medicinal Plants Studies*, 1 (5) 30-40.
- Connolly, J. D., & Hill, R. A. (2010). Triterpenoids. *Natural Product Reports*, 28, 79–132. <https://doi.org/10.1039/b808530g>
- Gandagule, U. B., Duraiswamy, B., Bhurat, M. R., & Nagdev, S. A. (2018). Isolation and Characterization of Lupeol a Triterpenoid from Stem Bark of of *Ziziphus xylopyrus* (Retz) Willd . *Invent Rapid Analysis & Quality Assurance*, 2018(4), 1–8.
- Hashim, N. M., Rahmani, M., Cheng, Gwendoline Ee, L., Sukari, M. A., Yahayu, M., Aizat, Muhamad Amin, M., Ali, A. M., & Go, R. (2012). Antioxidant, Antimicrobial and Tyrosinase Inhibitory Activities of Xanthenes Isolated from *Artocarpus obtusus* F.M. Jarrett. *Molecules*, 17, 6071–6082. <https://doi.org/10.3390/molecules17056071>
- Hsu, C. L., & Yen, G. C. (2014). Ganoderic Acid and Lucidenic Acid (Triterpenoid). In *Enzymes* (1st ed., Vol. 36). Elsevier Inc. <https://doi.org/10.1016/B978-0-12-802215-3.00003-3>
- Jutiviboonsuk, A. (2012). Total Reducing Antioxidant Capacity of Thai Herbal Aromatic Powder (Ya- Hom) Measured by FRAP Assay. *Thai Pharm Health Sci. Journal*, 7(3), 2–6.
- Lalitha, P., Jayanthi, P., & Thamaraiselvi. (2012). Preliminary studies on phytochemicals and antimicrobial activity of solvent extracts of *Eichhornia crassipes* (Mart .) Solms. *Asian Journal of Plant Science and Research*, 2(2), 115–122.
- Lasisi, A. A., Akinhanmi, T. F., Adebisi, S. A., Ajayi, M. O., Ogbodu, O. A., Oyagbinrin, Y. O., Lawal, M., Drug, C., State, O., Government, O. L., & State, O. (2016). *Proximate Composition, Nutritive Values and Phytochemical Evaluation of Deinbollia pinnata* (SCHUM and THONN) SAPINDACEAE, 1(2), 423–426.
- Lasisi, A. A., Bamidele, M. O., Balogun, S., & Adebisi, S. A. (2016). Chemical Constituents and Antibacterial Evaluation of *Deinbollia pinnata* (Schumand Thonn) Sapindaceae. *The Pacific Journal of Science and Technology*, 17(1), 183–199.
- Mouffok, S., Haba, H., Lavaud, C., Long, C., & Mohammed, B. (2012). Chemical constituents of *Centaurea omphalotricha*

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata

- Coss. & Durieu ex Batt. & Trab. *Record of Natural Products*, 6(3), 292–295.
- No, P., Gurupriya, S., Cathrine, S. L., Pratheema, P., & Ramesh, J. (2018). Isolation and Characterization of Lupeol from Methanolic Extract of *Tapinanthus dodoneifolius*. *International Journal of Current Advanced Research*, 7(4), 11397–11402. Available Online at www.journalijcar.org.
- Nyamoita, M. G., Ester, I., Zakaria, M. H., Wilber, L., Ochola, B. J., & Ahmed, H. (2013). Larvicidal and brine shrimp activities of *Vitex schiliebenii* extracts and isolated phytoecdysteroids on *Anopheles gambiae* Giles S.S Larvae. *Journal of Applied Pharmaceutical Science*, 3(5), 91–95. <https://doi.org/10.7324/JAPS.2013.3517>
- Osuntokun, O. T., Idowu, T. O., & Cristina, G. M. (2018). Bio-guided Isolation, Purification and Chemical Characterization of Epigallocatechin; Epicatechin, Stigmasterol, Phytosterol from of Ethyl Acetate Stem Bark Fraction of *Spondias mombin* (Linn.). *Biochemistry & Pharmacology: Open Access*, 07(01), 1–9. <https://doi.org/10.4172/2167-0501.1000240>
- Pierre, L. L., & Moses, M. N. (2015). Isolation and Characterisation of Stigmasterol and B - Sitosterol from *Odontonema Strictum* (Acanthaceae). *Journal of Innovations in Pharmaceuticals and Biological Sciences*, 2(2349–2759), 88–95. <https://pdfs.semanticscholar.org/7eda/8a365c6030388c08888742ce802d73672ca4.pdf>
- Rufai, Y., Basar, N., Chandren, S., Suleiman, K., & Yinusa, I. (2020). Antiradical Activity of 1,4-and 1,2-benzene dicarboxyl Esters from *Deinbollia pinnata* Leaves. *Journal of Chemical Society of Nigeria*, 54(6), 1177–1187. <https://doi.org/10.31857/s0320930x20040088>
- Rufai, Y., Basar, N., & Sani, A. (2019). Optimization and Isolation of 4,8,12,16-Tetramethylheptadecan-4-olide from *Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata*
- Deinbollia pinnata*. *Asian Journal of Chemistry*, 31(11), 2503–2511. <https://doi.org/10.14233/ajchem.2019.22165>
- Saratha, V., Iyyam Pillai, S., & Subramanian, S. (2011). Isolation and characterization of lupeol, a triterpenoid from *calotropis gigantea* latex. *International Journal of Pharmaceutical Sciences Review and Research*, 10(2), 54–57.
- Sen, A., Turan, S. O., & Bitis, L. (2017). Bioactivity-guided Isolation of Anti-proliferative compounds from endemic *Centaurea kilaea*. *Pharmaceutical Biology*, 55(1), 541–546. <https://doi.org/10.1080/13880209.2016.1255980>
- Shahwar, D., Raza, M. A., Bukhari, S., & Bukhari, G. (2012). Ferric reducing antioxidant power of essential oils extracted from *Eucalyptus* and *Curcuma* species. *Asian Pacific Journal of Tropical Biomedicine*, 2(3), S1633–S1636. [https://doi.org/10.1016/S2221-1691\(12\)60467-5](https://doi.org/10.1016/S2221-1691(12)60467-5)
- Shakya, A. K. (2016). Medicinal plants : Future Source of New Drugs. *International Journal of Herbal Medicine*, 4(4), 59–64.
- Sharma, K., & Zafar, R. (2015). Occurrence of Taraxerol and Taraxasterol in Medicinal Plants. *Pharmacogn Rev.* 9(17), 19–23. <https://doi.org/10.4103/0973-7847.156317>
- Sotubo, S. E., Lawal, O. A., Osunsami, A. A., & Ogunwande, I. A. (2016). Constituents and insecticidal activity of *Deinbollia pinnata* essential oil. *Natural Product Communications*, 11(12), 1889–1890. <https://doi.org/10.1177/1934578x1601101228>
- Walker, J. M. (2012). *Methods in Molecular Biology-Natural Products Isolation* (S. D. Sarker & L. Nahar (eds.); Third Edit). Humana Press.
- Yakubu, M. ., Yusuf, J., & Gambo, J. . (2014).

Isolation of Stigmast- 4 -ene-3-One and Gamma- Sitosterol from the Aerieal Part of *Synedrella Nodiflora* Linn (Asteraceae). *IOSR Journal of Pharmacy and Biological Sciences*, 9(5), 74–77. <https://doi.org/10.9790/3008-09557477>

Zou, Y., Chang, S. K. C., Gu, Y., & Qian, S. Y. (2011). Antioxidant Activity and Phenolic Compositions of Lentil (*Lens culinaris* var . Morton) Extract and Its Fractions. *Journal of Agricultural and Food Chemistry*, 59, 2268–2276.

Triterpenoids Characterization with Antioxidant activity from the Aerial Part of Deinbollia pinnata

Evaluation of Weight Gain of Abor- Acre Broiler Chickens Supplemented with *moringa Oleifera* pods, probiotic, levamisole and vitamin E / Selenium.

Mohammed Murtala Kyari

mmkyari@gmail.com, +2347030610999

Department of Animal Health & Production Technology, Federal Polytechnic Bali, Taraba State, Nigeria.

Abstract

*This study evaluates the effects of Moringaoleifera pods in comparison to probiotic, levamisole and vitamin E/Selenium on the growth performance of broiler chickens. A total of 100-day-old ABOR-ACRE broiler chicks of average weight of 38 grams were purchased from hatchery in Ibadan and used for this study. The chicks were randomly divided into 5 groups (A, B, C, D and E). Group A was fed basal diet supplemented Moringaoleifera pods powder at inclusion rate of 50g/kg, group B fed basal diet supplemented with commercial probiotic (Bactofort®) at 0.5g/kg, group C with commercial Vitamin E/Selenium (Vitamin E/Se®100/50) in drinking water for 3 days, repeated after 14 days, group D were given Levamisole (Wormcare®) in drinking water for 3 days, repeated after 14 days and group E served as control. Chickens in all groups were served same quantities of feed and water ad-libitum. The birds were weighed weekly and feed intake evaluated. Data were analyzed using simple descriptive statistics and two-way ANOVA. Results showed significant difference ($p < 0.05$) weight gain of birds fed *M. oleifera* and probiotic. It was concluded that broilers diet containing *M. oleifera* pods powder improvelive body weight gain. It is recommended among others that *M. oleifera* pod supplementation at 50 g/kg can be used as growth promoter in broilers.*

Keywords: *Moringaoleifera, Growth promoter.*

Evaluation Of Weight Gain Of Abor- Acre Broiler Chickens Supplemented With Moringa Oleifera Pods, Proboiotic, Levamisole And Vitamin E / Selenium.

Introduction

Today's commercial broiler is the most efficient ever, representing the combined efforts of genetics and improved operational and managerial practices, with the most striking growth capability of 70-75g per day occurring in the first weeks (Leeson, 2008). Owing to continuous genetic selection of broilers for fast growth the rearing period necessary to reach the same live weight has been reduced (Gonzales *et al.*, 2003; Gous, 2010). The efficiency in genetic modeling of poultry entails the ability to predict the bird's growth and development, which allows the prediction of its nutrient requirements (Zuidhof *et al.*, 2006). This provides an insight into the efficient capability of the chick to digest feed and to cope with environmental and management stresses (Mateos *et al.*, 2002).

Poultry production is practiced in all levels ranging from subsistence to large scale commercial operations. Poultry meat and eggs are the most consumed animal protein; unrestricted by any religion or culture in Nigeria. It was recorded that the poultry industry contributed about 25% of the country's Agricultural GDP (FAO, 2010). Nigeria presently produces above 550,000 metric tonnes of poultry meat per annum and 700,000 metric tonnes of eggs according to (FAO, 2010). Despite these, Nigeria is far from meeting her domestic demand when compared with developed countries that are involved in poultry production.

According to FAO (2010), the poultry expansion was 3.2% against global increase

of 2.2%; Nigeria supply had increased beyond her domestic borders to countries like Cameroon, Togo, Benin Republic, Niger and many of her neighboring countries, but despite that Nigeria supply with respect to broiler production has not been consistent compared to layers production (FAOSTAT 2007).

Natural substances are viewed as a possible solution that would address public health concerns without compromising the efficiency of poultry production (Peric *et al.*, 2009). Plant additives, are often referred to as phytobiotics, a term used to describe plant-derived natural bioactive compounds that affect animal growth and health; mostly applied to essential oils, botanicals, and extracts derived from herbal plants (Kim *et al.*, 2008; Windisch *et al.*, 2008). Plant supplements are common dietary additives for humans, preferred for their non-toxic chemical composition, relatively low cost and easy availability (Cross *et al.*, 2007). However, for use in animal diets, phytochemicals, are a relatively new class of feed additives and knowledge with regards to their modes of action and aspects of their application is still rather limited (Windisch *et al.*, 2008). The present study was, planned to evaluate the weight gain of ABOR-ACRE broiler chickens supplemented with *Moringaoleifera* pods, probiotics, levamisole and vitamin E / selenium.

Objectives

- i. To assess the effect of *Moringa oleifera* pods on body weight gain of broiler chickens.

Evaluation Of Weight Gain Of Abor- Acre Broiler Chickens Supplemented With Moringa Oleifera Pods, Probiotic, Levamisole And Vitamin E / Selenium.

- ii. To compare the growth rate and weight gain of broiler chickens fed *Moringa oleifera* pods, probiotics, levamisole and vitamin E/ Selenium.

Statement of research problem

There are concerns being raised on the adverse effects of antibiotics and drugs residues in meat and poultry products. Information on the utilization of plant products alone and in combination in form of phytobiotic or phytomedicine as alternative to reduce overdependence on antibiotics (as growth promoters or for treatment) in poultry production is scanty in Nigeria. Also the use of sub-therapeutic dose of antibiotic is still practiced in poultry industries either to control diseases or as a growth promoters. Despite the current use of a variety of alternative growth and production enhancers there is no single treatment or product that has been successful in replicating the relatively consistent and robust effects of AGPs (Dibner and Buttin, 2002). Another problem is that some additives such as vitamin E and selenium, which are usually added in mono-gastric feeds, are very expensive. Identifying naturally occurring alternatives, such as plants is a possible alternative. The effect of such alternatives on the growth performance, digestibility, digestive organ size, gut health, bone characteristics, as well as meat yield, and the quality and shelf-life of meat from broiler chickens is important for the poultry industry.

Justification

This widespread claim of *M. oleifera*'s nutritional and medicinal properties on humans is encouraging further investigation of its use as an additive in chickens. This research will also help the broiler production industry by possibly coming up with an alternative to the synthetic antibiotics and growth promoters. This is more critical given that natural substances are viewed as a possible solution that would address public health concerns without compromising the efficiency of poultry production.

Moringa oleifera leaves have properties that make them a possible alternative in broiler production. Synthetic growth enhancers and supplements in poultry nutrition are expensive, usually unavailable and possess adverse effects in birds and human. Sub-therapeutic levels of antibiotics given to poultry as growth enhancers may result to the development antibiotic-resistant bacteria, which are hazardous to animal and human health (Ghazalah and Ali 2008).

Research hypothesis

Ho: There is no statistically significant difference in the body weight gain of broilers fed with *M. oleifera* pods, probiotic, vitamin E/Selenium and levamisole under experimental condition.

Material and Methods

Total of 100 one-day old (Abor-acre) broiler chicks, with average weight of about 38 gram were subjected to a 42-days experimental period. The chicks were

Evaluation Of Weight Gain Of Abor- Acre Broiler Chickens Supplemented With Moringa Oleifera Pods, Proboiotic, Levamisole And Vitamin E / Selenium.

randomly divided into five experimental groups (Group A, B, C, D and E), each group with 20 chicks. The chicks were managed intensively in deep litter system with a floor of 0.024 to 0.10 square metre per bird. Continuous lighting was provided throughout the experimental period by placing 200 watts electric bulbs at center floor of each partition and adjusted by pulling it away from floor based on the response of chicks, weather condition and feather growth. The chicks in both groups were fed a broiler starter from day 1 to 28, and broiler finisher from day 29 to 42. The basal diets fed to the chicks in both groups were the same. The birds were provided with feed and water at libitum and litter material changed two weeks apart. The treatments were as follows:

1. Group A: Basal diet + *Moringa* pods at inclusion rate of 50g/kg
2. Group B: Basal diet + Bactofort[®] probiotic, containing *Lactobacillus acidophilus* (77×10^9 cfu/kg), *Enterococcus faecium* (44×10^9 cfu/kg), *Saccharomyces cerevisiae* (5000×10^9 cells/kg), *Bacillus subtilis* (2.2×10^9 cfu/kg) at the rate of 0.5g/kg, the probiotic was used according to manufacturer's recommendation.
3. Group C: Basal diet + vitamin E and Selenium (VitE/Se[®] 100/50) at 2ml/4 litres for 3 days in drinking water and repeated after every 14 days according to manufacturer recommendation.

4. Group D: Basal diet + levamisole at 2ml/4 litres in drinking water for 3 days and repeated after 14 days.
5. Group E: Basal diet (Control)

During the experimental period the birds were weighed weekly and feed intake per experimental group was recorded at the same time. Feed intake per group was determined for each partition as the difference between the amount of feed supplied and the remaining feed at the end each week. Body weight and body gain were calculated as the difference between the final and initial bird weight. Feed conversion ratio (FCR) was calculated as the ratio between feed intake and body gain at the end of each week (NRC 1994).

Data Analyses

All data were expressed as means and their standard error of mean (SEM) using Graph Pad prism version 5.0, difference between group mean was determined using analysis of variance (ANOVA) followed by Tukey's post-hoc for multiple comparison test. Values of $p < 0.05$ was considered significant.

Result

Results of feed consumption and weight gain of broilers supplemented with *Moringa oleifera* pods, Probiotic, Levamisole, Vitamin E and Selenium is presented in table 1. The details of growth performance of broilers fed *Moringa oleifera* pods, Probiotic, Levamisole, Vitamin E and Selenium and Control are presented in

Evaluation Of Weight Gain Of Abor- Acre Broiler Chickens Supplemented With Moringa Oleifera Pods, Probiotic, Levamisole And Vitamin E / Selenium.

tables 2. During the growing and finishing periods, there was no statistical significant difference of the body weight gain among the groups at day 7 of age. The body weight gain of the chickens in group A was significantly higher ($P \leq 0.05$) than those in other groups at day 14 of age. Chickens in group A and those in group B were observed to have higher ($P \leq 0.05$) body weight gain compared to those in group C, D and E at day 21. However, from day 28 to 42, chickens in group A had higher ($P \leq 0.05$) body weight gain than those in groups. Chickens in group B had higher

($P \leq 0.05$) body weight gain than those in groups (C, D and E) at day 21 and 28 but there was decrease in weight gain at day 35 with increase in weight gain at day 42. There was no statistical significant difference in weight gain of chickens in group C than those in groups (D and E) at day 14 and 21. However, there was decrease in weight of group C chickens from day 28 to 42 of the experiment. Weight gain of chickens in group D does not differ from those in group E throughout the overall experimental period.

Table1: Feed consumption and weight gain of Abor acre Broiler chickens supplemented with *Moringa oleifera* pods, Probiotic, Levamisole and Vitamin E/ Selenium by Age (Days) in grams.

Age (Days)	GROUP 'A' (<i>M. oleifera</i>)		GROUP 'B' (Probiotic)		GROUP 'C' (Vit. E/Sel.)		GROUP 'D' (Levamisole)		GROUP 'E' (Control)	
	Feed Consumed	Weight gained	Feed Consumed	Weight gained	Feed Consumed	Weight gained	Feed Consumed	Weight gained	Feed Consumed	Weight gained
7	2037	219	2214	222	2108	190	2128	213	2201	204
14	3393	536	3548	524	3697	466	3568	499	3563	483
21	6233	925	6351	901	6425	780	6251	847	6348	816
28	9951	1150	1055	1129	1058	973	1040	1081	1049	1073
35	13113	1487	14568	1409	14532	1243	14507	1406	14605	1398
42	19498	1708	20953	1682	20918	1402	20889	1639	20990	1592

Evaluation Of Weight Gain Of Abor- Acre Broiler Chickens Supplemented With Moringa Oleifera Pods, Probiotic, Levamisole And Vitamin E / Selenium.

Table 2: Comparative effect of *Moringa oleifera* pods, Probiotic, Levamisole, Vitamin E and Selenium supplementation on weight gain (MEAN±SEM) by age (days) of broiler chickens.

AGE (DAY)	A (n=10) (MORINGA)	B (n=10) (PROBIOTIC)	C (n=10) (VITAMIN E/ SELENIUM)	D (n=10) (LEVAMISOLE)	E (n=10) (CONTROL)
7	219 ± 3.33 ^a	222 ± 4.50 ^a	190 ± 1.93 ^a	213 ± 2.67 ^a	204 ± 5.14 ^a
14	536 ± 10.62 ^b	524 ± 5.31 ^a	466 ± 7.77 ^a	499 ± 8.77 ^a	483 ± 4.62 ^a
21	925 ± 11.51 ^b	901 ± 7.50 ^b	780 ± 22.59 ^a	847 ± 9.96 ^a	816 ± 2.38 ^a
28	1150 ± 20.13 ^b	1129 ± 5.0 ^b	973 ± 6.59 ^b	1081 ± 5.17 ^a	1073 ± 3.55 ^a
35	1487 ± 16.12 ^b	1409 ± 32.60 ^a	1243 ± 10.27 ^b	1406 ± 10.40 ^a	1398 ± 1.74 ^a
42	1708 ± 30.42 ^b	1682 ± 10.60 ^b	1402 ± 21.63 ^b	1639 ± 3.94 ^a	1592 ± 5.82 ^a

SEM= standard error of means

In each row, means with different superscript letters are significantly different (P≤0.05)

Discussion

The result of this study showed that *Moringa oleifera* pods inclusion to broiler diet had improved live weight gain on broiler chickens compared to control and this is in agreement with the work of Lannon, 2007 who reported that the performance of stabro broiler given *Moringa oleifera* leaf decoction revealed the improvement of feed consumption, daily weight gain, final weight gain and profit. And this also coincided with the work of Du *et al.*, (2007) who evaluated the effect of dietary supplementation *Moringa oleifera* on growth performance, blood characteristics and immune system of Arbor-acre strain of broiler. Also Yang *et*

al., (2007) evaluated the effect of *Moringa oleifera* on growth performance, immune function and ileum microflora in broiler. Result showed that dehydrated leaves of *Moringa oleifera* when given in diet, revealed significant enhancement of duodenum traits, increased lactobacillus counts in the ileum while reducing *Eschericia coli* and enhancement of immune system in broilers.

Probiotics supplementation to broiler diet had positive effect on weight gain compared to control. These results are in agreement with the findings of Yeo and Kim (1997) and Anjum *et al.*, (2005) who reported that the use of probiotic in chick's

Evaluation Of Weight Gain Of Arbor- Acre Broiler Chickens Supplemented With Moringa Oleifera Pods, Probiotic, Levamisole And Vitamin E / Selenium.

diet significantly improved the daily weight and conversion efficiency.

Result showed that vitamin E/Selenium supplementation was related with body weight gain. The result is in agreement with findings of Swain *et al.*, (2000) who reported that supplementation of vitamins E/Selenium improves health and overall growth performance in boilers.

There is no significance difference observed between treatments with levamisole and the control group. This is in disagreement with the work of Alishahi *et al.*, (2012) who reported that levamisole had significant effect on weight gain.

Conclusions

Based the results obtained, the *Moringa oleifera* pods supplementation to the broiler diet had improved the live body weight (1.708 kg) at 42 weeks despite lowest feed consumption (19,498 kg). Vitamin E and Selenium adversely affected body weight gain of broiler (190-1402) throughout the period of study. Levamisole supplementation does not produce any significant difference on growth performance.

Recommendations

- i. *M. oleifera* pod supplementation at 50 g/kg can be used as growth promoter in broilers.
- ii. Further study should be carried out to determine the nutrient content of the *Moringa oleifera* pods.
- iii. Inclusion rate below and above 50g/kg should be used to determine most effective level of supplementation.
- iv. Extracts of the *M. oleifera* pods should be used to evaluate its

effect on growth performance and immune system.

References

- Alishahi, M., Mesbac, M., Namjouyan, F., Sabzevarizadeh, M., Razi, J.M (2012). Comparison the effects of some chemical and natural immune stimulant on Oscar fish (*Astronotus ocellatus*). Iranian vet. Journal, 8(2), 58-59.
- Anjum, I.M, Khan W., Zim A., and Afza M. (2005). Effect of dietary supplementation of multi-strain probiotic on broiler growth. Pakistan veterinary journal.
- Cross, D.E., McDevitt, R.M., Hillman, K. and Acamovic, T. (2007). The effect of herbs and their associated essential oils on performance, dietary digestibility and gut micro-flora in chickens from 7 to 28 days of age. *British Poultry Science*, 48 (4): 496-506.
- Dibner, J.J. and Buttin, D. (2002). Use of Organic Acids as a Model to Study the Impact of Gut Microflora on Nutrition and Metabolism. *Journal of Applied Poultry Research*, 11 (4): 453 – 463.
- Du P.L, Lin P.H, Yang R.Y and Hsu J.C (2007). Effect of dietary supplementation of moringa oleifera on growth performance, blood characteristics and immune response in broilers. *Journal of Chinese Society of Animal Science*, 36(3): 135-146.
- FAO (2010). Poultry meat and Eggs. Agribusiness handbook. Director of Investm

Evaluation Of Weight Gain Of Abor- Acre Broiler Chickens Supplemented With Moringa Oleifera Pods, Proboiotic, Levamisole And Vitamin E / Selenium.

- ent Centre Division.FAO. Rome. Italy. P. 77.
- Ghazalah, A.A., and Ali, A.M. (2008). Rosemary leaves as dietary supplement for growth in broilers. *International Journal of Poultry Science*, 7(3): 234-239.
- Gonzales, E., Kondo, N., Saldanha, E.S.P.B., Loddy, M.M., Careghi, C. and Decuyper, E. (2003). Performance and physiological parameters of broiler chickens subjected to fasting on the neonatal period. *Poultry Science*, 82: 1250 – 1256.
- Gous R.M.,(2010), Nutritional limitation on growth and development in poult.
- Kim, S.W., Fan, M.Z. and Applegate, T.J. (2008). Nonruminant Nutrition symposium on natural phytobiotics for health of young animals and poultry: Mechanisms and application. *Journal of Animal Science*, 86 (E. Supplement): E138 – E139.
- Lannaon, W.J., (2007). Herbal Plants as Source of Antibiotics for Broilers. *Agriculture Magazine* 11(2): 55.
- Leeson, S. (2008). Future Developments in Poultry Nutrition. *Carolina Feed Industry Association 35th Poultry Nutrition Conference*, pp. 1 – 5.
- Mateos, G.G., La´zaro, R. and Gracia, M.I. (2002). The feasibility of using nutritional modifications to replace drugs in poultry feeds. *Journal of Applied Poultry Research*, 11: 437 – 452.
- National Research Council.(1994). Nutrition Requirement of Poultry (9th Ed.).National Academy Press, Washington D.C., USA.
- Peric, L., Zikic, D. and Lukic, M.(2009). Application of alternative growth promoters in broiler production. *Biotechnology in Animal Husbandry*, 25 : 387 – 397.
- Swain B.K, Johri T.S, Swain P. and Shrivastav A.K. (2000). Ind J. poul science 35(3): 247-51.
- Windisch, W., Schedle, K., Plitzner, C. and Kroismayr A. (2008). *Journal of Animal Science*, 86 (E. Supplement): E140–E148.
- Yang, R.Y., Chang, L.C., Hsu, J.C., Weng, BBC., Palada, M.C., Chadha, M.L. and Levasseur, V. (2007). Nutritional and Functional Properties of Moringa oleifera Leaves- From Germplasm, to Plant, to Health. in: *Moringa Leaves: Strategies, Standard and Market for a Planning*, ABU, Zaria, Nigeria, Pp. 1-5.
- Zuidhof, M.J., Carney, V.L., Schneider, B.L., Renema, R.A., Robinson, F.E. and Betti, M. (2006).Broiler meat quality and yield dynamics. *Poultry Service Industry Workshop October*, 3rd – 5th, pp 79 – 88.

Impact of Micro-Credit Programmes On Poverty Reduction in Yobe State, Nigeria

Audu Sani¹, Fatima Kalli Ba'aba², Abba Muktar³, Sadiq Mai Modu⁴ & Baba Mohammed⁵

¹Department of Business Administration, Mai Idris Aloomo Polytechnic, Geidam, Yobe State

²Department of General Studies, Mai Idris Aloomo Polytechnic, Geidam, Yobe State

^{3&4}Department of Public Administration, Mai Idris Aloomo Polytechnic, Geidam, Yobe State

⁵Department of Accountancy, Mai Idris Aloomo Polytechnic, Geidam, Yobe State

*(Author: E-mail: audusaniha@yahoo.com)

Abstract

This study attempted to examine the impact of micro-credits on poverty reduction and its determinants in Yobe state, Nigeria. The study employs a multi-stage random sampling techniques to selects 450 respondents from the three (3) senatorial zones: zone A (Yobe East), Zone B (Yobe South) and Zone C (Yobe North). But it was only three hundred and seventy-two (372) questionnaires were retrieved and subjected to analysis. The study used descriptive statistics, and Logistic regression Model for analysis. The findings reveals that micro-credits supply is statistically significant in reducing poverty level in Yobe State with 77.96% level. The result of logistic model showed that household size, educational status, investment and source of water are significantly associated with micro-credits supply in the study area, while age of the household head, gender, house ownership status, assets ownership status and monthly incomes are those factors inversely related with micro-credits in the study area. The study recommends among others that the government should promote stable macroeconomic environment as no meaningful development would be achieved without it, government should also not renege in any of the promises packaged in Micro-Finance Policy Framework and the establishment of more microfinance banks in all the communities in Yobe state and Nigeria by extension.

Key words: Impact, Micro-credits, Investment, Government, Nigeria.

Impact of Micro-Credit Programmes On Poverty Reduction in Yobe State, Nigeria

1 Introduction

Micro-credit programmes have emerged as a means of providing credit facilities to the poor through a financial intermediation strategy that is responsive to their socio-economic realities. Micro-credit as the name implies is a small amount of money or incentives given out by banking process in order to cushion the effect of poverty. The most important aspect of micro-credit is the reduction of poverty in any living society. Therefore, all its strategies are channeled toward poverty reduction and at times alleviation of poverty. The concept of poverty reduction has gained topicality in development discourse against a back Oladunni (1999) notes that poverty is a worldwide phenomenon. However, Nigeria is one of the poorest countries in the world. The situation has reached an alarming stage as more than 45% of the population lives below the poverty line, while 67% of the poor are extremely poor NBS (2012). For example, the Bureau of Statistics (BOS) report for the period 1980-1996, indicates about 67 million Nigerians are living below the poverty level. The report also indicates that from 1980 to 1985, the percentage of rural dwellers and urban inhabitants in the core poverty bracket rose from 6.5 and 3.0 percent to 14.8 and 7.5 percent, respectively. Within the same period, the percentage of moderately poor in the rural areas rose from 21.8 to 36.6 percent and 14.2 to 30.3 percent, respectively. Also, the number of non-poor in both rural and urban areas dropped from 71.7 and 82.8 percent to 48.6 and 62.2 percent, respectively (Awoseyila, 1999; Okumadewa, 1999). The increasing incidence of poverty in Nigeria within this period is not surprising. Going by the documentaries of Oladunni (1999) the overall dependency ratio in Nigeria is 234 dependents per 100 gainfully employed persons. In the rural areas, it is 286 dependents per 100 workers, while in the urban centre it is 219 dependents per 100 workers. The labor force age (between 15 and 64 years) dependents ratio is 259 dependents per 100 workers nationwide. It is 302 and 222 dependents per 100 workers in the rural and urban centers, respectively. The above scenario works concertedly to further reinforce the poverty syndrome of the average Nigerian employee, as each bear's heavy economic burden.

The discussion on the term and concept of poverty is of paramount so as to understand fully what micro-credit would do. Kwanga (2015) after a perusal of the tenets of poverty submits that poverty could be viewed as a situation of acute need and inability to meet all the basic necessities like food, clothing, shelter, education and family. This generally means that a household is considered to be poor, when it cannot satisfy any of the above mentioned necessities on a relatively permanent basis. Furthermore, Sani (2017) views poverty as a global phenomenon whose impact is multi-dimensional and it touches the economic, social, political, psychological and physical aspects of human endeavors. And it is found in almost all communities of the world, if poverty were to be sighted as a visible object, it would definitely appear horrific, devastating and unpleasant in all ramifications. Also Sani et al (2020) view Poverty as one of the world most popular words because of its negative scourge inflicting upon the human race globally. Poverty is a complex, multidimensional and hydra-headed phenomenon that has existed from time immemorial and has continued to occupy the centre stage in global affairs.

According to National Bureau of Statistics (NBS, 2012) incidence of poverty has continued to worsen in rural areas than in urban centres. Reported also that National relative poverty level is 69 percent, there is 73 percent relative rural poverty in the country compared to 61 percent of urban relative poverty. Also whereas absolute poverty level is 66 percent while that of urban areas is 52 percent. The scourge of poverty in Nigeria has many dimensions and may include: Inadequate access to government utilities and services, poor infrastructures, illiteracy and ignorance, poor health, insecurity, social and political exclusion (NBS, 2012).

Oladunni (1999) notes that poverty is a worldwide phenomenon; however, Nigeria is one of the poorest countries in the world. The situation has reached an alarming stage as more than 45% of the population lives below the poverty line, while 67% of the poor are extremely poor. Also the number of non-poor in both rural and urban areas dropped from 71.7 and 82.8 percent to 48.6 and 62.2 percent, respectively (Awoseyila, 1999; Okumadewa, 1999). The increasing incidence of poverty in Nigeria within this period is not surprising.

Impact of Micro-Credit Programmes On Poverty Reduction in Yobe State, Nigeria

The World Bank (2009) and Landes (2010) asserted that this is unfortunate given the Nigeria's rich resources in agriculture, oil wealth, human capital and friendly geo-climatic conditions. Indeed, it is estimated that over 70 percent of Nigerians are classified as poor, and half of this number live in absolute poverty.

Emerging debate posits that empowering the private sector to take its place as the prime mover of the economy holds the key to accelerating economic development and reducing poverty. As part of its National Economic Empowerment and Development Strategy (NEEDS), the Government of Nigeria has sought to strengthen and support the private sector towards improved efficiency and productivity (NPC, 2004), in line with its commitment to engendering sustainable economic growth and general improvement in the quality of life of the Nigerian people. As a strategy for achieving the above, the government provides financial services to small and medium scale enterprises mostly through Commercial Banks. However, poor people, especially rural dwellers, have very limited access to microcredit.

The formal banking system still faces constraints in reaching dispersed poor clients due to lack of improved service infrastructure. Similarly, formal lending is highly collateralized and attracts very high interest rates. Collateral requirements help commercial institutions in determining the credit worthiness of potential borrowers, since they often know very little about would-be borrowers. This makes financial services inaccessible to the poor. Improved access to credit for the rural poor is central to sustainable poverty alleviation because it enables them to invest in and improve productivity in agriculture, small businesses and small-scale manufacturing, thereby empowering them to break out of poverty in a sustained and self-determined way. Guaranteeing rural people access to credit for meaningful economic activities require robust and significant financial service schemes that mobilize savings from the surplus unit of the society and empowers those with entrepreneurial spirit. Micro-credit schemes emerged to fill this gap in the financial service delivery system. Modeled after the Grameen Bank poverty reduction initiatives in Bangladesh, micro-credit schemes mediate the

delivery of small, low interest and non-collateralized credits to the rural poor, relying on social collateral and joint liability (Aryeteey, 2005; Olomola, 2000). This is what necessitates the study of the impact of micro-credit scheme on rural poverty and the factors constraining their effectiveness in Yobe State, Nigeria.

Many studies have dwelled on microcredit at urban level but little was on rural communities in Nigeria and developing countries by extension. This particular segment of the society is characterized with inadequate access to government intervention, poor infrastructures, illiteracy and ignorance, poor savings and investment attitude, insecurity, social and political exclusion. Whether measured in terms of income, literacy, or access to social services, this creates a wider gap between the rural and urban areas. The main aim of this study is to assess critically the impact of micro-credit on poverty reduction with emphasis on Yobe state, Nigeria.

The paper is organized into five sections given the introduction as section one. The rest of the paper is organized as follows: Section two presents the literature review. In section three, the methodology adopted for this study is presented. Results and discussions are done in section four and conclusion and recommendations is drawn in section five.

2 Literature Review

Sani, Nasiru, Mustapha, Fatimah and Alhaji (2018) used a multistage random sampling technique to analyse the data obtained from a well-structured questionnaire. The analysis of data was done by the use of Foster, Greer, Thorbeck (FGT) poverty index analysis, probit and logit regression models with marginal effects. The study discovered that the incidence of poverty stands at 70.24%, while both probit and logit regression models revealed that the age of household heads and farm size are negatively significant at 1% levels of significance. The Age of household head and farm size revealed an inverse results of (-0.0453868, -0.0774235, -0.0146508) and (-0.2053323, -0.3476851, -0.657922) from the probit, logit and marginal effects results respectively. This means that as these variables increase, so also the households' poverty situation

Impact of Micro-Credit Programmes On Poverty Reduction in Yobe State, Nigeria

decreases, leading to a down fall of poverty level in the study area. Variables like gender, marital status, household size; educational status, dwelling type, and occupational status of the household head are also determinants of poverty in the study area but are insignificant in both models.

Godwin (2010) in his study *Microfinance Banks and Poverty Alleviation in Nigeria*, focused on the identification of critical factors that cause poverty in Nigeria and the investigation of the extent to which microfinance institutions have helped in the alleviation of poverty. To identify the critical factors, the researcher adapts the data on reasons for poverty generated by National Bureau of Statistics and employed the method of factor analysis. Regression analysis on a quadratic equation model which is found to be most appropriate in explaining the variations between the two variables. The result of the analysis identifies five factors: low profit, prices of commodities are too high, hard economic times, lack of finance to start or expand their business, and business not doing well, as critical factors causing poverty. It further reveals that the impact of microfinance on poverty in Nigeria can be explained in two phases. The first phase, the take-off stage, sees poverty as increasing though at a decreasing rate as microfinance credit increases. In the second phase, precisely starting from the year 2001, persistent increase in microfinance credit reduces drastically the poverty index in Nigeria. Thus, currently, microfinance credit lowers poverty in Nigeria.

Oluwatayo (2004) analysed the impact of income risk on the level of well-being of rural households in Ekiti State, Nigeria. Income risk was defined as the risks associated with variability in income well-being. It was found that household heads' age, years of formal education, household size, size of land cultivated and total expenditure (on food and non-food items) are major determinants of income risks among rural households, while income risk impacts negatively on the well-being of households. This could be generalized to include the North East geopolitical zone, since income forms a major source of satisfying the daily needs.

Sani (2017) assesses household degree of vulnerability to poverty in Yobe State, Nigeria. The study used a well-structured questionnaire to obtain the primary data from field survey. A multi-stage purposive random sampling technique was used in the selection of 300 respondents from the three local government areas namely; Damaturu, Geidam, and Potiskum (100 respondents per local government). However, a descriptive statistic for socio-economic characteristics of the respondents, and the Foster, Greer and Thorbecke (FGT) index analysis were employed to analyse the incidence of poverty, and the Multinomial logistic regression (mlogit) model was used to analyse the extent and the determinants of vulnerability to poverty in Yobe State. The results reveal that, poverty incidence (head count ratio) in the state is high and stands at 63%. However, the degree of vulnerability to poverty stands at 58.7%; the factors that are responsible for vulnerability to poverty in the state include Age, educational status, and household size of the respondents.

Nelson and Nelson (2010) in their paper investigates micro-credit scheme and its impact on rural poverty, using of a lending scheme operated by a local NGO in Akwa Ibom State as a case study. Drawing upon qualitative data collected through in-depth personal and group interviews with beneficiaries of the scheme, the paper examines the scope of micro credit programs for reducing poverty, the constraints facing credit schemes and how they may be addressed. The findings showed among others that micro-credit schemes present enormous potentials for enhancing income generation; improving household's living condition and reducing abject poverty in rural areas.

Sani (2020) examined rural poverty trends, its effects to educational development and factors that are determinants to rural poverty in villages of (Balle, Gumsa, Kalgeri, and Kelluri) in Geidam local government area of Yobe state, Nigeria. The study employed multi-stage random sampling techniques to selects 160 respondents from the four (4) villages (forty respondents per community/village). The study used descriptive statistics, and Logistic regression Model of STATA statistical analysis. The findings reveals that there

Impact of Micro-Credit Programmes On Poverty Reduction in Yobe State, Nigeria

are poorer households (58.13%) than the non-poor households (41.88%) using the \$2 per day per head poverty line. The result of logistic regression model showed that household size, educational status, type of dwelling, nonfarm jobs and source of water are significantly associated with poverty status in the study area, while age of the household head, gender, marital status, house ownership status, assets ownership status and monthly expenditures are those factors that are insignificantly associated with poverty status in the study area.

Collin, Edson and Petronella, (2022) in their study the Impact of Microfinance Institutions on Poverty Alleviation revealed that microfinancing has been targeted as a tool to address Poverty through the provision of credit to the poor and vulnerable group in an economy. However, the main objective upon which these institutions are founded is yet to manifest primarily in developing economies. Their study also examined the role of microfinancing in poverty alleviation by employing a Vector Error Correction Model on quarterly time-series data. The results reveal a significant long-run relationship among the variables poverty, microfinancing, SMEs, and agricultural growth. Contrary to expectations, Microfinancing was found to increase poverty in the long run. SMEs and agricultural development were found to reduce the level of poverty in the long run. In the short run, regression results reveal that SMEs' growth alleviates poverty, and poverty increases the growth of microfinance loans in the country. The increase in SMEs is a tool for alleviating poverty, and the growth in microfinance institutions is also being driven by poverty.

3 Methodology

3.1 The Study Area

Yobe State which is located in the Northeastern corner of Nigeria with Coordinates of 12°00'N 11°30'E. It was carved out from former Borno State on August 27, 1991. The capital of Yobe is Damaturu and its Nicknamed as *the Pride of the Sahel*. With Total land Area of 45,502 km² (17,568 sq mi) and a population estimates of 2,321,591 (NBS, 2006).

The Yobe borders the Nigerian states of Bauchi, Borno, Gombe, and Jigawa. It's also borders with

Diffa and the Zinder Regions of the Republic of Niger to the north. Because Yobe lies mainly in the dry savanna belt, Yobe is hot and dry for most the year, except in the southern part of Yobe which has a milder climate.

The Yobe State consists of seventeen (17) Local Government Areas of: Bursari, Damaturu, Geidam, Bade, Gujba, Gulani, Fika, Fune, Jakusko, Karasuwa, Machina, Nangere, Nguru, Potiskum, Tarmuwa, Yunusari, and Yusufari.

The major ethnic group living in Yobe State is Kanuri, while other ethnic communities include Ngizim, Karai-Karai, Bolewa, Bade, Hausa, Ngamo and Shuwa, Fulani, Bura and Maga.

3.2 Sources and Method of Data Collection

The primary data are used in this study. The primary data was collected from the field survey with the aid of a well-structured questionnaire.

3.3 Population of the Study

The population of Yobe state, Nigeria is the population of study. Yobe which consists of 17 local government areas with an estimated population of two million, three hundred and twenty-one thousand, five hundred and ninety-one (2,321,591) based on the 2006 National population and housing census (NBS, 2006).

3.4 Sampling Techniques and Sample Size

A multi-stage random sampling technique was employed for this study. The first stage is the division of Yobe state into the three (3) senatorial zones: zone A (Yobe East), Zone B (Yobe South) and Zone C (Yobe North). The second stage is the random selection of the three (3) Local Government Areas (LGAs) from each of the senatorial zones. Which are **Damaturu, Gulani** and **Geidam LGAs** from zone A, **Fika, Fune** and **Potiskum LGAs** from zone B and **Bade, Machina** and **Yusufari LGAs** from zone C. The third stage was the random selection of fifty (50) respondents who benefitted from any sort of micro-credit schemes from each of the LGAs selected. These make a total of four hundred and fifty (450) respondents but it was three hundred and seventy-two (372) questionnaires retrieved which was retrieved and subjected for the study analysis.

Impact of Micro-Credit Programmes On Poverty Reduction in Yobe State, Nigeria

3.5 Model Specification

The logistic regression model of analysis was used for this study with it basis in Christiaensen and Subbarao (2004) Adekoyas (2014), and Kabuga, Adamu (2015) and Sani et at (2020) with little modifications, which informed the initial relationship between a binary outcomes variable and also a group of predictors' variables. There on the probability of being poor is specified as the value of the cumulative distribution function Z which is specified as a function of the explanatory variables.

For Positive Impact.

$$\text{Prob (Positive Impact = 0)} = 1-F (Z) = e^{z/(1+e^{-z})} = \dots\dots\dots (2)$$

Therefore, equation 1 and 2 can be written as:

$$\frac{F (Z)}{1- F (Z)} = \frac{1+e^z}{1+e^{-z}} \dots\dots\dots(3)$$

Equation 3 is simply the odd ratio in favour of household failing below the poverty line. This is the ratio of the probability that a household will be

The equation for this type of modeling is of the form:

$$\text{Prob (Poor =1)} = F (Z) = e^{z/(1+e^z)} = F (\beta_0 + \beta_1 X) \dots\dots\dots (1)$$

Where:

F (Z) = $e^{z/(1+e^z)}$ is the cumulative logistic distribution, representing the probability of being poor. Z is the poverty line; β is the vector of parameters and X is the vector of explanatory variables, this include Age, Gender, Household size, Educational status, Assets ownership, Monthly Income / Expenditure, Investment and Source of Water.

poor to the probability that it will not be poor. The natural log of equation 3 results into:

$$L_i = L_n \left(\frac{F (Z)}{1-(F)} \right) = Z = (0 + (1 X_1, \dots\dots\dots (kX_k)) \dots\dots\dots(4)$$

L_i Is the logit (i.e. natural logarithm of the odd ratio)

$\left(\frac{F (Z)}{1-(F)} \right)$ = The odd ratio in favour of the probability of being poor or non-poor.

F (Z)= 1 if household is poor and 1 – (F) = 0 if household is non-poor.

Thus, the dependent variable represents poverty status of household.

For the purpose of this study, the specification of the empirical model is as follows;

$$L_i = L_n ((F (Z)) / (1- F (Z))) = \beta_0 + \beta_1 \text{gen} + \beta_2 \text{age} + \beta_3 \text{hou} + \beta_4 \text{edu} + \beta_5 \text{How} + \beta_6 \text{ass} + \beta_6 \text{inv} + \beta_7 \text{sou} + \beta_8 \text{mex} + \beta_9 \text{sou} + e \dots\dots\dots(5)$$

Where:

Gen = Gender

Age = Age of the household head

Hou = Household size

Edu = Education Status

How = House ownership status

Ass = Assets Ownership

Inv = Investment

Sou = Source of Drinking water

Mex = Monthly expenditure

A prior expectation of this logistic regression model is that: $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9 > 0$

4 Results Analysis and Discussions

Table 1: Selected characteristics of respondents

Variables	Frequency	Percent (%)
Gender		
Female	251	67.47
Male	121	32.53
	372	100.00
Age in years		
18 to30	42	11.29
31 to 40	180	48.39
41 to 50	100	26.88
51 above	50	13.44
	372	100.00
Household Size		
1 to 5	100	26.88
6 to10	122	32.80
11 to15	98	26.34
16 above	52	13.98
	372	100.00
Educational status		
Non formal	190	51.06
Primary	62	16.67
Secondary	55	14.78
Tertiary	45	12.10
Others	20	5.38
	372	100.00
House ownership status		
Owned by household	93	58.13
Not owned by household	67	41.88
	372	100.00
Assets ownership		
Farm land	221	59.41
Livestock	49	13.17
Food stock	22	5.91
Landed Property	24	6.48
None	49	13.17
	372	100.00
Investment		
Yes	240	64.52
No	132	35.48

	372	100.00
Source of water		
Treated pipe borne	23	6.18
Borehole	150	40.32
Hand pump	56	15.05
Well	84	22.58
River or Pond	50	13.44
Others	9	2.42
Total	372	100.00

Source: Field Survey, (2022).

The major socio-economic characteristics in the study area captured on frequency and percentage (%) of respondents were depicted on table 1 and equally in table 2, where the study indicates 67.47% of the respondents are females, while age of the respondents are of active age of which most of them are of age bracket 31 to 50years (75.27%), while their educational status is discouraging because most of them had no formal education entirely and in terms of assets ownership status most of them own relatively small size farm lands (59.41%) then few that had livestock (13.17%). About 64.5% of the respondents have investment apart from their primary income in farming jobs.

The average monthly income and expenditures of the respondents is ₦27,038.

Looking at the above socio-economic characteristics of gender, age bracket, Educational, ownership of assets, monthly income and expenditures. This indicates a strong, large and active population in the study area in which would be of advantage once utilized properly. The educational status, assets ownership status, average monthly income are of negative trends and that cannot be unconnected with the lower educational facilities and the usage of crude agricultural tools, implements and methods in the study area.

Table 2: Micro-credits Classification

Micro-credit Impact	No. Respondents	Percentage (%)
Negative	82	22.04
Positive	290	77.96
Total	372	100.00

Source: Field Survey, (2022).

Table 3, presents factors in determining the probability of a household to be poor or non-poor, and because of the dichotomous nature of the

dependent variables coded as poor (1) and non-poor (0), logistic regression model was employed in the analysis.

Impact of Micro-Credit Programmes On Poverty Reduction in Yobe State, Nigeria

Table 3: Result of Logit Model and Marginal Effect

Variables	Logit	Marginal Effect
Gender(gen)	.4924688 (.554183)	.104384 (.10997)
Age in years(age)	.0123262 (.0226677)	.0027665 (.00508)
Household size(hou)	.0811429* (.0485038)	.0182119* (.01083)
Educational status(edu)	-.1077775* (.1521617)	-.0241898* (.03414)
House ownership status(how)	-.0783757 (.4028481)	-.0175908 (.09037)
Assets ownership(ass)	-.0036842 (.1515531)	-.0008269 (.03401)
Investment (inv)	-1.050399** (.4044163)	-.2412505** (.09245)
Source of water(sou)	.4354464** (.1591766)	.0977324** (.03531)
Monthly Expenditure (mex)	-3.90e-06 (.0000162)	-8.76e-07 (.0000)
Constant	-1.7796601 (1.436965)	
No of Obs = 372 LR ch2(10) = 29.82 Prob>chi2 = 0.0017 Pseudo R2 = 0.1416		

Source: Authors' computation from field survey data (2022) using STATA 12.

The figures in parenthesis are p-values. They implies ***significant at 1%, **significant at 5% and *significant at 10%.

The factors that are significant with the micro-credit supply in the study are household size, educational qualification, investment and source of water supply. While, those factors that are insignificant in explaining the probability of being poor in the study area are household head gender, age, house ownership status, assets ownership and monthly expenditure, also to note that marginal effect is of interest in logit regression model analysis and not the signs of the coefficients.

As depicted from the logit model result in table 3, shows that there is direct relationship between micro-credit supply with household size and good source of water supply which the likelihood will significantly increase taking the marginal effects by 1.8% and 9.8% respectively.

The result also shows that some factors such as educational status level were increases the

probability of household being non-poor by 2.4% and that make them technically in utilizing the micro-credit given to them. The investment factor also indicates potentiality as those households with some job(s) other than their primary farming job have probability of utilizing micro-credit effectively by 24%. This collaborates the findings of Sani et al 2018.

From the foregoing, it can be asserted that micro-credit supply has positive and significant effect on the well-being of citizens in the study areas.

5 Conclusion

The study examine critically the impact of micro-credit on poverty reduction in Yobe state, Nigeria. Factors that are the determinants to micro-credit on poverty reduction in Yobe state was also assessed. The study further finds out that there are

Impact of Micro-Credit Programmes On Poverty Reduction in Yobe State, Nigeria

positive impact of micro-credits by all sort micro-credits schemes or programmes on households in Yobe state (77.96%). Logistic regression model (logit) using STATA 12 was used to analysed a wide range of household socio-economic characteristics to detect the determinants of micro-credits supply on poverty reduction. The result showed that household size, educational status, investment and source of water supply are significantly associated with micro-credits supply, while the age of the household head, gender, house ownership status, assets ownership status and monthly income are associated with micro-credits supply in the study area.

The study further reveals that microfinance credits have in recent times picked up momentum in the drastic reduction of poverty. Ten years after the introduction of community banks/microfinance banks in Nigeria, poverty was still increasing though at a decreasing rate with the increase of microfinance credit. However, persistent increase in microfinance credit leads to drastic reduction of poverty. Thus, increase in microfinance credit currently reduces poverty in Nigeria.

Recommendations

The study proffers some recommendations as follows: the calls on the establishment of more microfinance banks in all the communities in Yobe state and Nigeria by extension. The government should promote stable macroeconomic environment. As no meaningful development would be achieved without stable macroeconomic.

Furthermore, Micro-finance Banks are self-financing and sustaining institution. It is important that government should not renege in any of the promises packaged in the Micro-Finance Policy Framework. Also Government should check on disintermediation and conduit piping. This is where Micro-Finance Banks

mobilize savings from the rural areas and place such funds as deposits in commercial banks.

References

- Adekoya O. A. (2014). Analysis of Farm Households Poverty Status in Ogun States, Nigeria, *Asian Economic and Financial Review*, 2014, 4(3):325-340.
- Christiaensen, L. J. & Subbarao, K. (2004). Toward an Understanding of Household Vulnerability in Rural Kenya. *World Bank Policy Research Working Paper 3326, June 2004*.
- Collin, C., Edson, V. and Petronella, (2022). The Impact of Microfinance Institutions on Poverty Alleviation, *Journal of Risk Financial Management*, 2022, 15, 393. <https://doi.org/10.3390/jrfm15090393>
<https://www.mdpi.com/journal/jrfm>
- Godwin, C. O. (2010). Microfinance Banks and Poverty Alleviation in Nigeria, *Journal of Sustainable Development in Africa*, Vol. 12, No.6, 2010, Clarion University of Pennsylvania, Clarion, Pennsylvania, ISSN: 1520-5509.
- Kabuga, N. A. & Adamu, U. M. (2015). Analysis of rural Poverty in Katsina state, Nigeria. *Yobe Journal of Economics (YOJE)*, 2015, Vol. 2, No. 1, pp 115 – 123.
- Kwanga C. N. (2015). Trade liberalization and poverty in Nigeria: 1986 -2013, *Department of Economics, Bayero University Kano, unpublished Ph.D. thesis*.
- National Bureau of Statistics (NBS, 2012). *“Nigerian Poverty Profile”*. NBS Office, Abuja, Nigeria, pp.28-30.
- Nelson, E. E. & Nelson, I. E. (2010). Micro-Credit Programme and Poverty Alleviation in Rural Nigeria: A Case Study of Akwa Ibom State.

Impact of Micro-Credit Programmes On Poverty Reduction in Yobe State, Nigeria

- International Journal of Economic Development Research and Investment*, Vol. 1 Nos. 2 & 3 2010.
- Okumadewa, F. (1999). International agencies response to poverty situation in Nigeria. *Central Bank of Nigeria Bullion*, 23(4), 66-70.
- Oladunni, E. B. I. (1999). The dimension of poverty in Nigeria: Spatial, sectoral, gender, et al. *Central Bank of Nigeria Bullion*, 23(4):17-30.
- Oluwatayo, I. B. (2004). Income Risk and Welfare Status of Rural Households in Nigeria. Ekiti State as a Test Case Research Paper No.2004/61; *World Institute for Development Economic Research (WIDER)*.
- Olomola, A. (2000). Effects of Membership Homogeneity on the Design and Performance of Informal Finance Groups in Rural Nigeria. Nairobi: *African Economic Research Consortium*.
- Oni, A. O. & Yusuf, S.A. (2006). Determinants of expected poverty among rural households in Nigeria. *Final report presented at the AERC Biannual Workshop in Nairobi, Kenya*, December.
- World Bank (2003). Nigeria: Poverty in the midst of Plenty, The challenge of Growth with Inclusion, *A World Bank Poverty Assessment*; Washington D.C.
- Sani, A. (2017). Households Vulnerability to Poverty in Yobe State, Nigeria. *Yobe Journal of Economics (YOJE)*; A bi-annual Publication of the Department of Economics, Yobe state University, Damaturu- Nigeria. Vol. 4(1), March, 2017; Pp 64-75. ISSN 2408 – 5103.
- Sani, A., Lawan, S. N., Mustapha, A., Fatimah, B. K. & Alhaji, A. H. (2018). Incidence and Determinants of Poverty in Damaturu, Yobe State: A Probit, and Logit Models Approach. *Dutse Journal of Economics and Development Studies (DUJEDS)*. A bi-annual Publication of the Department of Economics and Development Studies, Federal University Dutse- Nigeria. 4(2): January, 2018; Pp 87- 97. ISSN 2536-6130.
- Sani, A., Ba'aba, F. K., Lawan, S. N., Kolo, K. G. & Alhaji A.H. (2020). Rural Poverty and Educational Development in Geidam, Yobe State, Nigeria. *Dutse International Journal of Social and Economic Research (DIJSER)*. A Bi-Annual Publication of the Center Social and Economic Research; Federal University Dutse-Nigeria. Vol. 4 No. 1 issue, July, 2020; Pp. ISSN: 2645 – 3169.

Impact of Micro-Credit Programmes On Poverty Reduction in Yobe State, Nigeria

Impact of Socio-Cultural Factors On the Performance of a Multinational Company in Nigeria; Evidence from Shoprite Kano

Shettima Alhaji Umar^{*1}, Audu Sani² & Abdullahi Ahmed Tahir³

¹Department of Social Development, Mai Idris Aloomo Polytechnic, Geidam, Yobe State, Nigeria

^{2&3}Department of Business Administration, Mai Idris Aloomo Polytechnic, Geidam, Yobe State.

*+2348022192933

Abstract

*This study presents an investigation of the impact of socio-cultural factors on the performance of multinational companies in Nigeria with a cursory look at a Shoprite Kano Branch. Socio-cultural environment is a combination of economic, political, legal, social, cultural and technological factors. The socio-cultural factors are one of the main environmental factors that significantly affect the economic activity of multinational companies and their performance as well. The study adopts multi-stage random sampling techniques to selected 112 respondents from the three (3) units of the company namely **top management** unit, **middle level** managers, **lower-level** workers of Shoprite Kano. Data were collected through primary and secondary sources, the primary data were collected through questionnaire and personal interview while the secondary data were collected from journals, text books and other relevant literatures. One-sample T-test and simple frequency percentage tables were used for data analysis. The study effectively formulated and tested two hypotheses with the aid of **Chi-square (X^2)** method of analysis. The Findings of the study revealed that socio-cultural factors significantly affected the performance of multinational companies in Nigeria. The study recommend and among other things that Government should develop a holistic approach to provide adequate training and workshops/seminars for the business owners so as to update them with the socio-cultural factors of the Nigerian nation.*

Key words: socio-cultural factors, performance, multinational, Shoprite, language, attitude.

Introduction

Multinational business is continuously recognized as an important source of economic growth, productivity, employment and innovation, and it is widely accepted as a key aspect of economic dynamism in many countries today (Wube, 2010). It is indicated that economic progress has been significantly increased by foreign investors who are entrepreneurial and innovative, able to exploit opportunities and willing to take risks (Histrich, 2005). In Africa, most foreign investors who owned enterprises are confronted with a number of constraints which make them remain micro enterprises. For instance, in Nigeria foreign investors are confronted with difficulty in getting finance, complying with legal requirements, cheap and reliable technology, poor access to market information, education and skills acquisition relevant in the host country (Aderemi *et al.*, 2008).

Multinational companies operate in different host countries around the world and have to deal with wide variety of economic, political, legal, socio-cultural and technological factors. One of the significant components of the business environment is a socio-cultural environment. A socio-cultural environment is a combination of social and cultural factors. Due to the strong interaction that exists between them, it is very difficult to assess their separate influence on the business operation of multinational companies. The socio-cultural factors are one of the main environmental factors that significantly affect the economic activity of multinational companies and their performance as well. Moreover, socio-cultural factors are beyond the control of foreign subsidiaries' managers.

Society and culture have indirectly influence the operation, activities and survival of multinational companies. Because to some extent they determine who control, goods and services to produce and sales and determination of managerial and operational style. Consequently, multinational companies should take in to consideration the predominant attitudes, values and beliefs in their host country Differences in attitudes and values among management of a Mother Company and expatriate managers at the subsidiary level, on the one hand, and managers

and employees in host countries, on the other, can contribute to serious functional problems (Ajami, Cool *et al.*, 2006).

A positive socio-cultural environment is important for multinational companies. There are various socio-cultural factors that significantly affect the economic activity as well as the performance of multinational companies.

Many research dwelled on the impact of socio-cultural factors on small scale enterprises and its effects on the Development of the Nigerian economy. Most of the studies concentrated on the impact of socio-cultural factors on small scale industries to the national development while neglecting some of the challenges that multinational companies are facing. Many people are eager to know the impact as well as the challenges that multinational companies are facing within the economy. Therefore, this paper is aim to bridge the gap existing by identifying the impact of socio-cultural factors on multinational companies as well as the challenges that they faced. The paper is segmented into: introduction, literature reviews, methodology, data analysis discussing, conclusion and recommendations.

Literature Review

Culture is a complex area which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of a society. Sociologists generally talk about the societal process, referring to the influence of parents, friends, education, and the interaction with other members of a particular society as the basis for one's culture. These influences result in learned patterns of behavior common to members of a given society. Culture is an acquired knowledge people use in interpreting experience and generating social behavior (Tyler, 1871).

According to Tayeb (1988), culture is historically developed. It involves values, esteems, attitudes which are being shared by members of a group or society, and have impacts on their lifestyle, be it material or non-material which shapes the two fundamental aspects of culture. This knowledge forms values, creates attitudes, and influences behavior (Luthans and Doh, 2009). According to "Rugman and Collinson (2006)" Culture is the

Impact of Socio-Cultural Factors On the Performance of a Multinational Company in Nigeria; Evidence From Shoprite Kano

sum total of beliefs, rules, techniques, institutions, and behavior that characterize human populations or the collective programming of the mind.

Socio-Cultural Factors and Business Performance

Many studies have examined the relationship between socio-cultural factors and business performance worldwide. Wetherly (2011) describes the socio-cultural environment as consisting of everything that is not contained within the economy or political system. He asserted that socio-cultural setting is made up of collection of activities and the relationship people engage in their personal and private lives which include population features, age, ethnicity, religion, values, attitude, lifestyles, language, level of education and associates.

Jonson *et al.* (2013) examining the effects of socio-cultural realities on the Nigerian SMEs using a qualitative research approach involving 10 SMEs, the findings indicate that socio-cultural realities are key factors affecting their businesses performances. Mashene *et al.* (2014) investigating socio-cultural determinants of entrepreneurial capabilities among the Chagga and Sukuma SMEs in Tanzania using questionnaire survey and case studies involving 254 owner-managers indicate that values, social factors, beliefs, norms and perceptions demonstrate positive effects while attitude show a negative effect on entrepreneurial capabilities. Maziku *et al.* (2014) study on the effects of socio-cultural factors affecting the performance of SMEs in Nigeria using quantitative and qualitative research approaches involving 80 owner-managers, the results show that attitude of people, ethnicity and immobility of SMEs have negative effect on the performance of SMEs while family roles and education were found to have a weak positive effect on the performance of SMEs. Accordingly, Msoka (2013) investigating the influence of entrepreneurship skills on the performance of foreign owned enterprises in Africa using quantitative and qualitative research approaches involving 9 key informants and 73 people involved in micro and small businesses, the findings reveal that there is a relationship between entrepreneurship knowledge and the performance

of multinational businesses. The study recommends that society need training in business planning, marketing skills, accounting knowledge and customer care skills to enable them conduct businesses successfully. In the context of this study, the variables which were used to measure socio-cultural factors included husbands' support, education and training, traditions, language, attitudes toward foreign goods and availability of business information.

People and their societal values have greater effects on every aspect of the international affairs of multinational companies. Most importantly, the socio-cultural factors are important for multinational companies. Mashene *et al.* (2014) and Majenga (2013) viewed that some of the major socio-cultural factors that have significant effect on the operation of the multinational companies are culture, language, religion, level of education, customer preferences, and the attitude of the society towards foreign goods and services. The influence of culture on multinational companies is real and widespread. Multinational companies are affected by more than one cultural factor at a time. Through their subsidiaries located in various countries, they are exposed to different national cultures. Culture in particular country directly, or indirectly, reflect on the achieved performance of multinational companies. On the basis of the results obtained from various surveys, it can be concluded that successful multinational companies develop acceptance and understanding of cultural differences among various country and learn how to take advantage of opportunities, and cope with disadvantages that arise from different national cultures.

Religion is an important social factor that should be taken into consideration when company decides to operate in a given country. Religion, through its effects on people, affects a multinational company and its operations. Consequently, it can be concluded that an appropriate understanding and respecting of religion is extremely important for the efficient *operation* of multinational companies.

From the perspective of the multinational companies, it is very notable to have good knowledge of the local language. Tundui (2012) lamented that failure to recognize the influence of

local language affect the performance of foreign subsidiaries and their managers. Consequently, the language difficulties can be reduced by appointing expatriates on the top managerial positions in the local subsidiary or nationals that have good knowledge of parent company's language and corporate culture. According to Miller, Boehlje and Dobbins (2001) Education has notably impact on international business. In a country where the level of education of local population is higher, it is considered that expectations from multinational companies are proportionally higher. Buyers with a higher level of education require more qualitative products and services, a better price-quality ratio and know their right as customers. Also, well-educated local workforce requires better working conditions, low labour turnover, and greater opportunities for personal development as the business environment changes. (Rao 2006).

3 Methodology

3.1 The Study Area

Shoprite Nigeria Limited Kano Branch is the study point of this study. It's a Mega super market with a root from South Africa. Shoprite's first store in Nigeria opened in Lagos in 2005 and since then the company grown to become a house hold name for many families across Nigeria. However, despite having opened 25 stores across the country in the past 17 years, the company, which has its headquarters at South Africa, seem out of touch to Nigerians. Shoprite opened its first outlet in Northern Nigeria in Kano on 21, March 2014 this is because Kano is one of the commercial city with a high population in the region of over fifteen million people according to (NBS, Census:2006) which provides ample business opportunity to be exploited.

3.2 Research Design

The survey focused on the workers and customers of Shoprite Nigeria Limited Kano Branch which

forms the population of this study. Necessary data were collected to ascertain the extent of the impact of socio-cultural factors on the performance of multinational company in Nigeria a Shoprite Kano approach. To achieve the objectives of the study, primary source of data was employed. The primary source of data was based on the use of Questionnaire distributed and collected from the workers and the customers of the above mentioned company. The target population of study was all the customers and workers of the above mentioned company. Since it is not possible to study the entire Population, a sample of 112 respondents was randomly selected and Administered questionnaire from the company studied. The sampling technique used for this study was stratified random sampling technique in selecting the Sample for empirical examination. The questionnaire was designed in such a way that alternatives were provided for the respondents to choose from and opinions were expected to be expressed. In the questionnaire. The Likert scale measurement of variables was used; this requires the respondents to indicate a degree of agreement or disagreement. A non-parametric statistics (Chi-square) was employed in testing the hypothesis.

3.3 Study Population and Sampling Procedure:

The customers and worker of Shoprite Nigeria Limited Kano Branch makes up the population of this research. There are three levels of management (The top, middle and lower) strata of the company and the super store customers are the target population for this study.

4 Data Presentation and Analysis

4.1 Test of Hypothesis

The two hypotheses earlier formulated will be tested using the chi-square (X^2) method.

4.2 Decision Criteria

The decision rule is that if the calculated values of X^2 is greater than the tabulated value (or critical value), we accept the alternative hypotheses and reject the null hypotheses or vice versa.

Hypothesis 1: Socio-cultural factors does not affect the performance of multinational company in Nigeria

Table 1. Simple frequency percentage table showing responses to Hypothesis 1

Hypothesis	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Total
Responses	41(36.6%))	38(33.9%)	22(19.6%)	09(8.1%)	02(1.8%)	112(100%)

Source: Survey Report, 2022.

Table 2. Analysis of hypothesis 1

	Test Value=0						
	T	Df	Sig. (2-tailed)	Mean Difference	Interval of the Difference Lower Upper		
Customer Awareness	40.811	111	.000	3.95536	3.7633	4.1474	

Source: Survey Report, 2022.

The above result shows that the calculated value of 40.81 is greater than the p-value of 0.000 at 5% significant level (i.e. $D_{cal} = 40.81 > p = 0.000$). Therefore, in compliance with the decision rule, the null hypothesis (H_0), stating that Socio-cultural factors do not affect the performance of

multinational company in Nigeria is rejected (see Table 1 for respondents' responses). This indicates that Socio-cultural factors have immensely affect the performance of multinational company in Nigeria.

Hypothesis 2: Language is not the most important socio-cultural element that affect the performance of multinational companies in Nigeria

Table 3. Simple frequency percentage table showing responses to Hypothesis 2

Hypothesis	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Total
Responses	07(6.3%)	13(11.6%)	19(16.9%)	24(21.4%)	49(43.8%)	112(100%)

Source: Survey Report, 2022.

Table 4. Analysis of hypothesis 2

	Test Value=0						
	T	Df	Sig. (2-tailed)	Mean Difference	Interval of the Difference Lower Upper		
IT & banking performance efficiency	17.862	111	000	2.15179	1.9131	2.3905	

Source: Survey Report, 2022.

Impact of Socio-Cultural Factors On the Performance of a Multinational Company in Nigeria; Evidence From Shoprite Kano

The result above shows that the calculated value of 17.86 is greater than the p-value of 0.000 at 5% level of significance (i.e. $D_{cal} = 17.86 > p=0.000$). Therefore, in compliance with the decision rule, the null hypothesis (H_0) that, Language is not the most important socio-cultural element that affect the performance of multinational companies in Nigeria is rejected (see Table 3 for respondents' responses). It is, therefore, logical to conclude that Language is the most important socio-cultural element that affects the performance of multinational companies in Nigeria.

Discussion of Findings

The study analysis revealed that socio-cultural factors significantly affected the performance of multinational companies in Nigeria. This is in tandem with Azemina (2018) who noted that the socio-cultural factors are one of the main environmental factors that significantly affect the economic activity of multinational companies and their performance as well. Moreover, socio-cultural factors are beyond the control of foreign subsidiaries' managers. The study also revealed that Language is one of the most significant environmental factor that affects the smooth take-off of operations of multinational companies in Nigeria as a host country.

Conclusion

In spite of government policies aimed at providing socio-cultural and technical support for the promotion of foreign investment in Nigeria with a lot of incentives and guided policies to woo in many multinational companies in Nigeria. Upon all these they performed less satisfactorily largely because of operational bottlenecks as a result of socio-cultural factors such as economic, political, legal, social, cultural and technological factors to mention but a few. The agencies which are supposed to provide adequate advice in compliance to government policies usually plays important roles in ensuring confidence to the foreign investors.

Recommendations

The research makes the following recommendations as; Government should provide friendly business environment in terms of adequate infrastructural facilities, good road network, efficient telecommunication system and

uninterrupted power supply to encourage foreign investors in the country. Business firms should develop and implement policies and strategies that will enable them strive and acclimatized the socio-cultural factors in the country they are planning to invest so as to ensure smooth operations of their business activities effectively. Government through its agencies such as Small and Medium Enterprises Development agencies of Nigeria (SMEDAN), Nigerian Investment Promotion Commission (NIPC) etc to develop a holistic approach to provide adequate training and workshops and seminars for the business owners so as to update them with the socio-cultural factors of the country. The enterprises should incorporate the natives of the host country to access suitable people that give assistance so as to broaden the opportunities as well as to ensure the effectively and efficient operation of the businesses.

References

- Aderemi, H. O., Ilori, M. O., Siyanbola, W. O., Adegbite, S. A., & Abereijo, I. O. (2008). An assessment of the choice and performance of women entrepreneurs, *African Journal of Business Management*, 2(10), 165-176.
- Ajami, A.R., Goddard, J.G. (2014). *International Business: A Course on the Essentials*, M. E. Sharpe, Inc., New York, P. 277.
- Azemina, M. (2018). Socio-cultural factors and their impact on the performance of multinational companies, *Integrated Business Faculty - Skopje, Republic of Macedonia*.
- Histrich, R. D. (2005). *Entrepreneurship: New Venture Creation*, 5th edition. Tata Mc Graw Hill, New Delhi.
- Luthans, F., & Doh, J. P. (2009). *International Management*. New York: MacGraw Hill/Irwin.
- Miller, A., Boehlje, M., & Dobbins, C. (2001). Key financial performance measures for farm general managers. *Publication ID-243*, 5.
- Mashene, R. G., Macha, J. G. L., & Donge, L. (2014). Socio-Cultural Determinants of Entrepreneurial Capabilities, *Journal of Economics and Sustainable Development*, 5(17), 90-103.

- Majenga, A. (2013). Assessment of the Impact of Socio-Cultural Factors on the Performance of Women Small and Medium Enterprises in Tanzania:
- National Bureau of Statistics (NBS) (2006). 2006 Population Census Data, Federal Republic of Nigeria, *National Bureau of Statistics*; Archived from the original on 25 March 2009.
- Rao, M.E.T. (2006). *Management Accounting*. New Age International (P) Ltd., Publishers. New Delhi, India.
- Rugman, A. M., & Collinson, S. (2006). *International Business*. England: Pearson Education ltd.
- Tayeb, M. (1988). *Organizations and National Culture: A Comparative Analysis*. London: Sage.
- Tundui, C. S., and Tundui, H. (2012). Survival, Growth Strategies and Performance of Women Owned Micro and Small Businesses in Tanzania. *International Journal of Business and Management*, 7(8), p143.
- Tyler, E. B. (1871). *Primitive Culture*. Encyclopedia Britannica.
- Weatherly, P. (2011). The social and cultural environment. [<http://www.oup.com/uk/orc/bin/pdf>]
- Wube, M. C. (2010). Factors Affecting the Performance of Women Entrepreneurs in Micro and Small Enterprises, *European Journal of Business and Management*, Vol.6, 2010.

Automation as A Panacea to Manual Administration of Polytechnics in Ogun State, Nigeria.

(A Study of Abraham Adesanya Polytechnic, Ijebu-Igbo)

Kuola, Aanu Joseph

Internal Audit Department
Abraham Adesanya Polytechnic,
Ijebu-Igbo, Ogun State, Nigeria.

kuolaaanu@gmail.com

+2347066220545

Abstract

It is challenging and retrospective to find ICT Polytechnics lagging in the full application of automation in their administrations. This study investigated the effect of automation on manual administration of Ogun State Polytechnics, a study of Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State. The study aimed at examining the effect of automation on manual administration of Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State. It further examined the impacts of automation on Abraham Adesanya Poly (AAPoly) students' admission. The study made use of primary data where a well-structured questionnaire containing ten (10) questions was distributed to the staff members in Rectory, Registry, Library and Bursary of the Polytechnic. ANOVA was used to analyse the data collected from the respondents. The finding showed that automation reduces workload and minimizes manpower who are to carry out administrative works. It also revealed that students' admission process would be easy in the application of automation in Polytechnics. The study recommended that the government should implement the policy of applying automation in the manual administration of Polytechnics in Nigeria, train the employees and ensure that application of information communication technology is well funded.

Keywords: Automation, Manual Administration, Students' Admission, Polytechnic.

1.0 Introduction

The world as a global village transfigures in the aspect of technology and this birthed frequent changes in the whole world; particularly, organizations in order to adapt to the new changes the world is bringing. For every organization that aims at performing excellently and meeting targeted goals, administration of such organization has to be standard, effective, adaptive to new changes and be answerable to great innovations. Jaiyeoba (2006) in his study explicated administration as effective coordination of resources and people's efforts for the achievement of organizational goals. As related to education, the primary objective of administration has to do with the integration of all resources for the improvement of teaching and learning. It is also seen as all those techniques and procedures in operating the educational organization in line with established policies and principles.

Apparently, tertiary institutions cannot be without an administration and the activities of institutions demand the existence of some pre-determined elements capable of acting when stimulated. Administration in every organization therefore stands as the process of mobilizing all factor resources for the achievement of goals and objectives. As the paper focuses on Polytechnics in Nigeria, it was observed that, even, with the changes technology has brought to the world, some of these Polytechnics are still using manual ways of carrying out administrative tasks. Obi (2004) explained administration in education as it is concerned with the coordinating of various activities of people in the school system to accomplish teaching and learning. It is the process of using methods, principles and practices to establish, develop and execute the goals, policies, plans and procedures necessary to achieve the objectives of education. In the above context, it is believed that as the population in the world increases, so as the population of students and staff of the tertiary institutions increases. This denotes that, manual way of keeping records, making payments, communication,

teaching, storing files and documents, collecting data of students, running admission of new students, issuing receipts for students and other activities in Polytechnics is obsolete and as well inducing moribundity. For establishment, development and execution of the goals, policies, plans and procedures of Nigerian Polytechnics to be easily ameliorated, automation of systems of operation must take its place.

Automation is a force that has changed many aspects of the way people live. Information is a key resource for undergraduate teaching, learning, research, and publishing. This brings the need for effective methods of information processing and transmission (Nwosu & Ogbomo, 2012). This has paved way for change not only the way society assesses knowledge but also transform and restructure traditional models of tertiary education. Automation is one skill area that is now essential for young people to gain a foot hold in the labour market in developed and increasingly in developing countries (Laura & Brown, 2011). As a matter of alacrity, Nigerian Polytechnics have to focus on e-learning environment, e-administration and much less on traditional methods as a result of the newly acquired capacity for students and staff to have access to the internet any point in time. Information Communication Technology helps staff (both administration and academics) and students become actively engaged together in online collaborative work to enhance traditional learning methods (Oliver, 2011).

Yakubu and Aboho (2015) opined that automation is an umbrella term that includes any communication device or application, encompassing; radio, television, cellular phones, computer and network hardware and software, satellite systems, as well as the various services and applications associated with them; such as video conferencing and distance learning. The use of automation serves as a light that illuminates darkness and wipe away unnecessary efforts as a result of technological aids to carry out a thousand tasks just in less than a minute. This could be traced back to year 2020, when

there was a CoVID-19 pandemic that made some businesses close down and put stop to all operations in the world. It was however known that only the companies and institutions that are already in use of automation could not be held down from operating due to its incessant ravaging. However, this paper ascertains the significant impacts that automation has to make better manual administration of Nigerian Polytechnics, using an Ogun State owned Polytechnic; Abraham Adesanya Polytechnic, Ijebu-Igbo, as a study.

Statement of the Problem

In past years, there has been a great interest on how technology can best be harnessed to ameliorate the efficiency and effectiveness of tertiary education in Nigeria to meet up with the standards of tertiary education in the developing and developed countries. However, ICTs are more than just these technologies; older technologies such as the telephone, radio and television, although now given less attention, have a longer and richer history as instructional tools. For instance, radio and television have for over forty years been used for open and distance learning, although print remains the cheapest, most accessible and therefore most dominant delivery mechanism in both developed and developing countries. Potashnik and Capper (2008) note that the use of computers and the internet is still in its infancy in under-developed and some developing countries due to limited infrastructure and the attendant high cost of accessibility. The problems in manual administration in Nigerian Polytechnics is a number that has no limit. The old (manual) way of filing documents in Nigerian Polytechnics is superannuated as it is exposed to unforeseen incidents which may result to total loss of documents with no backups. Another counter-challenge that is obsolete is the aspect of manual processing of admission for new students which is a total stress for the candidate and leading to excess use of resources. Automation being a diverse set of technological tools and resources used to communicate, and to create, disseminate,

store, and manage information. It is a groundswell of interest for multidimensional improvement in tertiary education. However, some scholars have written on automation and organizational performance; the likes of Darwish, Saki, Sahraei, Zakrifar and Talebi (2014) who wrote on effect of automated office systems (automation) on improve decision-making of staff managers, also Ijov and Wombu (2019) who did a study on impact of information and communication technology on tertiary institutions. Out of the above studies, none of them have written on effect of automation on manual administration of Ogun state Polytechnic, using Abraham Adesanya Polytechnic as a study. The following are the questions to be answered at the end of this study which as well serve as the objective of the study;

- Does automation have significant effect on manual administration of Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State?
- To what extent does automation enhance students' admission of Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State?

The following are the hypotheses to be tested;

H₀₁: Automation has no significant effect on manual administration of Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State.

H₀₂: Automation does not enhance students' admission of Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State.

2.0 Review of Related Literature

2.1 Conceptual Review

Concept of Manual Administration

Manual Administration just like most other concepts has been variously defined by experts and educationists. These definitions are centered on what the experts conceive as what administration should achieve. Herbert A. Simon, Donald Smith and Victor A. Thomson in Ezeocha (1990) defined administration as "when two men co-operate to roll a stone that neither could have moved alone, the rudiments of administration

*Automation as A Panacea to Manual Administration of Polytechnics in Ogun State, Nigeria.
(A Study of Abraham Adesanya Polytechnic, Ijebu-Igbo)*

have appeared". Jaiyeoba (2006) gave his own view on administration as he referred to it as effective coordination of resources and people's efforts for the achievement of organizational goals. In tertiary education; the primary objective of administration has to do with the integration of all resources for the improvement of teaching and learning. It is also seen as all those techniques and procedures in operating the educational organization in line with established policies and principles. However, as several theorists have come up with lists of words they consider as appropriate in describing the administrative functions or process. These processes are frame work that provide guide to administration in tertiary education. The different components of administrative process may be outlined and defined as follows:

Planning: Oriafio (2003) defined planning as "a process of establishing priorities for future actions in an attempt to solve economic problems, which stem from the existence of scarce resources. Planning function has four important goals as; to offset uncertainty and change, to focus attention on objectives, to gain economical operation, and to facilitate control. The implication is that every institution should know where it is going and administrator should engage in planning to give direction to the activities of an institution the dynamic environment confronting organizations, the need to identify and define emerging roles for the organization and the need to relate the organization to various environmental systems that make planning function critical and a matter of high priority. Obi (2003) identified three main features in every plan to include; every plan must be future oriented; it deals with predetermined objectives or decisions; it must be a process or a strategy. There are also three stages that are popular in planning as reiterated by Obi (2003). They include; decision stage, implementation stage and evaluation stage. Good planning backed by sincere effort therefore produces good results in the organization.

Organizing: To organize implies the development of interconnections between the various subsystems and the total organizational pattern. It is a design of methods and determination of activities required to achieve objectives of the organization. In educational institutions, the administrator organizes both the human and material resources. He organizes the work in the school into units with each unit being headed by a specialist. He distributes duties and responsibilities to both academics and non-academic staff alike. School facilities and instructional materials are properly allocated to ensure proper teaching and learning process. Rules guiding the behavior of the entire staff are well defined.

Coordinating: Co-ordination is the task of harmonizing the activities of various aims of the organization. It ensures team work toward realization of objectives. It is the function of the school administrator to co-ordinate all activities of the various units within the school. He schedules activities in such a way as to eliminate conflicts, so that the objectives of teaching and learning may be attained. Since the teachers are interdependent, it is the responsibility of the administrator to co-ordinate their activities.

Commanding or Directing: This is the task of optimizing the productivity of staff. The tertiary institution administrator should therefore have accurate knowledge of his staff, eliminate the incompetent, set a good example, take initiatives and encourage a spirit of belonging among his staff. The term commanding is similar to directing or stimulating. The administrator is expected to provide effective leadership by stimulating his staff to perform and guiding them as to what to do. He as well guides the performance of the students by instructing them on their routine duties. He gives proper information to both staff and students during assemblies.

Controlling: The administrative function of controlling is the measurement and correction of the performance of activities of subordinates in order to make sure that educational objectives

and the plans devised to attain them are being accomplished. The administrator ensures that things are done in accordance with laid down rules and regulations. Control helps in evaluating the output with a view to discovering the weakness that can be rectified for greater school efficiency. Within an organization such as the school, an administrator employs different strategies to ensure that right things are done at the right time and that those under him conform to the expected and desirable behavior. Such control strategies include; policies and rules, organizational design, performance appraisal, budget and technology, personal visits and informal discussions. Government policies and rules such as those contained in the National Policy on Education, the constitution, decrees, edicts and education laws provide guidelines on what should be done and what should not be done (Oyedeji & Fassasi, 2006). These laws are made so as to enable the government to control education. The administrator by his position should be guided by the law and he should as well apply it in guiding others.

Communicating: Communication is one of the basic elements of administrative process and it is central to all functions. It is defined by Amobi and Nnabuike (1999) as the art and science of conveying one's thought, need or information to another person or a group of persons. This can be through verbal utterances or non-verbal expressions. An organization cannot survive unless the administrator develops means of communication among various operating levels. In the light of this, Omenyi (2007) described communication as a means of imparting, exchanging attitudes, ideas and information through human abilities or technological media. Administrators who are skilled in communication have an improved chance of facilitating change within the school building. School leaders who are effective in achieving change communicate frequently and effectively with individuals and with groups and they facilitate communication among group members of their organization. Formal communication addresses task-related

issues and follows the organizations authority chain where the administrator gives direction to the teachers, provides advice to group members as well as offers needed suggestions.

Decision-making: Later writers on school administration introduced "decision-making, and evaluation" as part of the administrative process. The importance of these two elements stems from the fact that decision-making acts as characteristics of organizations behavior. While the main work of the executive is to take decisions and initiate and direct actions based on them, his decisions are based on facts and values that are subject to change over time and therefore require a continuous evaluation or appraisal. This will ensure their authenticity looking at the objectives to achieve. According to Adeleke in Oyedeji & Fasasi, (2006) decision-making is a process of generating and evaluating alternatives and making choice among them. It entails selection of a course of action from alternative courses intended to bring about the future state of affairs envisaged. For each of the administrative functions, decisions are made on specific activities to be performed in the school environment. The school administrator takes decisions on curricular and extracurricular programmes, human and material resources needed for achieving educational objectives. He also takes decisions on finance, information, time for carrying out specific programmes and then environment for executing a particular decision. Methods of teaching, modes of communication and procedures for acquisition and utilization of resources are also decided upon. The output of the decisional process is rules or policies to guide subsequent behavior. The importance attached to decision-making lies in its impact on future behavior in the organization. Ukeje et al (1992) explained that decision-making is a process by itself which takes cognizance of the past history of the organization and the experience of the administrator in relation to the current state of affairs in order to project the future actions to be taken.

In tertiary education, decision-making is a vital element in the administrative process since what the administrator does depends on his choice among alternative paths to his goals as well as how he decides to move along that path by allocating time and resources. Explaining further, Ukeje et al emphasized that a decision is the result of deliberation, calculation, thoughtful response to internal and external conditions of the environment. So the administrator/school head makes wide consultations and deliberations with the ministry of education, staff and student body on issues relating to curriculum, teaching/learning, school discipline and inter-community relations etc. He then makes a choice of all the suggestions given to him and be ready to defend its application. Whatever is his choice must reflect the school's objectives, policies and plans. Administrative process thus refers to the manner through which an institution takes decisions and desired actions to attain its objectives.

Evaluating: Evaluation is a life pattern of organization's daily activities because human beings all over the world have evolved overtime a culture of judgment. At most levels of human action, individuals, groups, organization and government pass judgment about the appropriateness or

inappropriateness, desirability or undesirability of events, decisions performances, processes, objectives, situations and the like. In line with this, Otu (2006) views evaluation as the process of determining the quality, worth, significance of anything be it an activity, events, person, object or programme.

Generally, evaluation is seen as frequent decision-making and judgments which individuals, groups, institutions and governments pass on what affect their lives and those of others. Thus evaluation seeks the most effective use of available resources to ensure that all programmes, events or activities of administration fulfill their goals successfully.

Further, evaluation in educational administration consists of the behavior to make decisions about

an educational programme in relation to set objectives. It is important to point out that the human society is not static, but dynamic. Therefore, educational administration which operates within the confines of the society is ever changing. This demands that the administrator should always evaluate his administrative processes for necessary feedback to enable him define and redefine his goals to accommodate innovations. The school administrator uses evaluation to determine the extent to which educational objectives are either pursued or achieved. To achieve this, certain questions call to mind: How well does administrative process perform with respect to criteria set? How can the process be better improved to attain the set goals? Decision has to be taken on the type of evaluation, when to evaluate and what to evaluate. Evaluation therefore serves as a hub of change and innovation in administrative process that predict the general trend in the development of teaching and learning. As innovation in evaluation entails application of information technology, Nigerian polytechnics are required to ensure that automation is applied in their administrations, management, students' admission process and minimize more of file documents and maximize storing of documents in the cloud.

Automation as a force for positive change

In the study of Nwankwo (2013), he emphasizes that automation has permitted people to participate in a world in which school, work and other activities have been increasingly enhanced by access to varied and developing technologies. Automation tools have helped people find, explore, analyze, exchange, and present information most importantly, without discrimination. When efficiently use, automation can provide quick access to ideas and experiences from a wide range of people, communities and cultures (Kwame, 2010). It also involves the development of effective and integrated tools as well as training modules to enable ICT application through effective teaching and learning. These according to Nwankwo (2013)

*Automation as A Panacea to Manual Administration of Polytechnics in Ogun State, Nigeria.
(A Study of Abraham Adesanya Polytechnic, Ijebu-Igbo)*

positive effects of automation (ICT) can be felt in the following aspects:

Promotion of better-quality research is made possible through ICT. Application of ICT are particularly powerful and uncontroversial in higher education's research function. The steady increases in bandwidth and computing power available have made it possible to conduct complex calculations on large data sets (Balasubramanian, 2009). Through the aid of automation, process of huge amounts of data can now be done extremely fast, accurate and reliable, thus, reducing the burden of manually analyzing data which hitherto was very difficult and cumbersome.

Another important measurement of ICTs in research is the use of online full text data bases and online libraries/virtual libraries which are the direct outcome of the growth in telecommunications networks and technology. These databases and libraries provide researchers with online access to the contents of hundreds of thousands of books from major publishing houses, research reports and peer reviewed articles in electronic journals. Examples includes; the Questia online library which provide access 24/7 to the world's largest online collection of books and journals in the Humanities and Social Sciences, while other related online books and journal library are Academia, Researchgate, Coursera, CodeAcademy, Youtube, GetFreeBooks etc. There is also the online Book page hosted by the University of Pennsylvania libraries which provides free online access to books which includes an index of thousands of online books, links to directories and archives of online texts.

E-registration of courses and details of examination and other services are being offered online, thereby, reducing pressure during course registration. With the use of ICT, students pay school fees online and check their results after every examination. Moreover, the use of the internet could reduce administrative cost because the same information can be sent to all Departments through the internet without having

to do it individually. Therefore, communication both within and outside the department is a lot easier with the use of the internet.

Nexus between Automation and Nigerian Polytechnic

Automation is defined as a "diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information."

These technologies include computers, the Internet, broadcasting technologies (radio and television), and telephony.

Nigerian Polytechnics are patterned to create quality workforce by growing, training and attracting the outstanding talents; support current business and industry, improve learning and teaching through professional and technological innovation; take strong and visible roles in regional initiatives, disseminate research and employ a diverse workforce (Myamoto, 2010). The use of automation in educational settings will act as a catalyst for change in this domain. Automation by their very nature is a tool that encourages sound supports independent learning. Students using ICTs for learning purposes usually become immersed in the process of learning and use computers as information sources and cognitive tools (Reeves & Jonassen, 2006).

The trend towards a knowledge-based economy has emphasized the importance of higher institutions as repositories of valuable human capital to help secure shares in the global market. The accelerating shift to high technology and information technology economies require sustained human resources development and training. Driven by globalization and pressures to teach and train knowledgeable, skilled and competitive professionals, tertiary institutions face a huge challenge to increase access to higher education and improve the quality of higher education against the stark reality of decreasing resources (Amaechina; Chukwuemeka-Okolo & Ekor, 2013).

Theoretical Review

***Automation as A Panacea to Manual Administration of Polytechnics in Ogun State, Nigeria.
(A Study of Abraham Adesanya Polytechnic, Ijebu-Igbo)***

Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA) has its genesis in the social psychology that searches to identify the determinant factors of the consciously intentional behavior (Fishbein & Ajzen, 1979). Define the relations between beliefs, attitudes, norms, intentions and behavior, that is, a determined behavior, for example, technology use or rejection is the result of an intention in making the behavior, and this intention is influenced conjointly by the individual attitudes, been this attitude determined by beliefs and subjective norms in relation to the aimed behavior (Quintella & Pellicione, 2006). For Fishbein and Ajzen (1979) the elements that form the attitudes are the beliefs, that refer themselves to the information that the subject has about a determined object and the subjective norms, that is the perception of an external evaluation about adopting or not determined behavior. According to the TRA, the intention determines the effective behavior that refers to the observable acts (Fishbein & Ajzen, 1979).

We could exemplify the work TRA in the following way: it is imagined that a user who has the conscious intention to use a determined information system, derivative from the use attitude, which may be positive or negative, followed by subjective norms, which are referred to the perception that the user has of the other people's opinion. According to Oliveira Júnior (2006) the people choose to perform a behavior, even not agreeing with it and its consequences, in case they believe that a determined person thinks that this one should be his behavior and if they are motivated to please that person.

Technology Acceptance Model (TAM)

The Technology Acceptance Model, most known as technology acceptance model (TAM), was proposed by Davis (1989), being an adaptation of the model Theory of Reasoned Action (TRA), already mentioned before. However, according to Davis (1989), for being so universal, the TRA was modified specifically, to create models of acceptance in information technology, as in the specific case of TAM.

The intention of the development of the model TAM resulted from an IBM Canada contract with the *Massachusetts Institute of Technology* – MIT, in the 80s to evaluate the market potential to new products of the brand and to make it possible an explanation of the determinants of computers use (Davis, Bagozzi & Warshaw, 1989).

Davis (1989) proposed the TAM to focus in the reason the users accept or reject the information technology and how to improve the acceptance, offering, this way, a support to foresee and explain the acceptance. The validation of the TAM model was based in the acceptance of a software text editor (Davis, 1989; SÁ, 2006).

Silva (2006) adds that Davis (1989) on this sample found out that the perceived use had higher impact in the behavior than the perceived facility. The TAM has the advantage of being specific to information technology and has a strong theoretical base, besides the wide empiric support, as claims Davis (1989).

The model TAM was designed to comprehend the causal relation between external variables of user's acceptance and the real use of computer, trying to understand the behavior of this user through the utility knowledge and use facility perceived by him (Davis, 1989). For Davis (1989) the people tend to use or not certain technology with the objective to improve his performance at work – perceived use. However, even if this person understand that determined technology is useful, its use may be damaged if it is too complicated, in a way that the effort is not worthwhile the use – perceived facility. This way, the TAM is based basically in two constructs: the perceived utility and the perceived facility, seeing that both measured completely the effects of external variables, such as features systems, development process, training, in the use intention (Davis, 1989). The intention of this model is to represent the impact of external factors related to the information system, under those internals of the individual, as the attitudes and use intentions (Davis, Bagozzi & Warshaw, 1989; Davis 1989; Dillon & Morris, 1996; Lee et al., 2003; Venkatesh et al., 2003).

*Automation as A Panacea to Manual Administration of Polytechnics in Ogun State, Nigeria.
(A Study of Abraham Adesanya Polytechnic, Ijebu-Igbo)*

Empirical Review

Akor & Mustapha (2016) investigated the use of internet and online resources by non-academic staff of two universities in Nigeria. The universities considered under this study are federal university of Technology, Minna and Ibrahim Babangida University, Lafia. A survey research design was adopted for this study. Four objectives and four research questions were formulated to guide the study. A stratified random sampling technique was used to select a sample size of 104 junior staff of the two universities. Instruments for data collection included a well-structured questionnaire. One hundred and four copies of questionnaire were distributed to the junior staff of the two universities with a return rate of 46 (48.42%) from the Federal University of Technology, Minna and 49 (51.5%) from Ibrahim Babangida University, Lafia. The study used frequency counts and percentages as statistical measures for data analysis. The results revealed that many non-academic staff of the universities used internet and online resources for communication, searching for information, downloading or uploading documents.

Ijov & Wombu (2019) did a study on the impact of Information and Communication Technology as a veritable tool for global competitiveness in a knowledge-based economy cannot be over-emphasized. This is why the Federal Republic of Nigeria (2014) places emphasis on the provision and utilization of Information and Communication Technology when it states that because of the prominent role of ICT in advancing knowledge and skills necessary for effective functioning in the modern world, there is urgent need to integrate Information and Communication Technology (ICT) into education in Nigeria. The study further discussed the various impacts of ICT on tertiary institutions as well as the major obstacles to the utilization and implementation of ICT in tertiary institutions.

3.0 Methodology

The approach of this paper is descriptive in nature, and primary data has been used in this study.

The study area, Ijebu-Igbo, Ogun State Nigeria, was purposively selected as it is accessible by the researcher for the purpose of the study. The researcher limited this study to Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State as the scope.

The population of the study is One hundred and ninety-nine (199) but the study focuses on four departments (Rectory, Registry, Library and Bursary) in the Polytechnic because the study only concerns the administrators. The total number of the respondents from the four selected departments is 50. The study employed primary and secondary data. The primary sources of data were collected from the staff of Abraham Adesanya Polytechnic, Ijebu-Igbo and secondary source of data was collected from relevant sources such as Journals, Textbooks, Library etc. A well-structured questionnaire was distributed to all the selected respondents. The questionnaire constructed was coined from the research questions which the study tends to answer at the end of the study, to ensure the validity of research instrument and the responses of the respondents were thoroughly checked to ensure the data obtained were reliable.

The well-structured questionnaire was ten (10) close-ended questions with Likert Scale response options; Strongly Agreed, Agreed, Undecided, Strongly Disagreed and Disagreed). The Analysis of Variance (ANOVA) statistical method was employed to analyze the data collected at 5% level of Significance.

4.0 Data Interpretation, Analysis and Results

The researcher distributed 50 questionnaires and was able to retrieve all after confirming that they were filled properly and ready to be compiled for analysis. The percentage of the returned questionnaire is 100% which makes it be free from any objection.

Interpretation of data

Table 1 Questionnaire

S/N	Questions/Variables	SA	Agrd	Undcd.	SD	Dsgrd
1.	Automation of some administrative tasks in Abraham Adesanya Polytechnic has fostered her performance.	19	22	3	5	1
2.	There is computer system and internet access that can be used to send and receive information automatically in your office	27	16	1	2	4
3.	There is a virtual avenue like Zoom and Team, at which meetings are held within the staff of Abraham Adesanya Polytechnic.	21	23	5	1	-
4.	Information Communication Technology has done more good to the administrative functions of Abraham Adesanya Polytechnic.	17	25	1	-	7
5.	Through the aid of automation, process of huge amounts of data can now be done extremely fast, accurate and reliable.	36	8	2	2	2
6.	E-registration of courses and details of examination and other services are being offered online, thereby, reducing pressure during course registration.	41	6	-	-	3
7.	The use of online full text data basis and online libraries/virtual libraries is a development for Abraham Adesanya Polytechnic.	24	16	-	7	3
8.	Abraham Adesanya Polytechnic is an ICT Polytechnic that enables students under the course receive IT Essential certificate in the Polytechnic.	30	12	3	1	4
9.	Automation tools have helped to find, explore, analyze, exchange, and present information most importantly, without discrimination and as well give quick access to information and experiences.	14	33	-	1	1
10.	The use of automated administration is more convenient than manual administration.	24	9	2	7	8

Source: Researcher's Field Survey, 2022 (*All the questions in the questionnaire were constructed by the researcher*).

Hypothesis One

H₀₁: Automation has no significant effect on manual administration of Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State.

ANOVA SUMMARY

Source of Variation	SS	df	MS	F	P-value	F crit
Between	2235.2	4	558.8	23.1483	2.88E-07	2.866081
Within	482.8	20	24.14			
Total	2718	24				

Critical Value of 5% level of significance with degree of freedom 4 to 20 is 2.87

Decision Rule

Since the calculated value is 2.88, is greater than the critical value of 2.87. The alternative hypothesis should be accepted and the null hypothesis (H0) should be rejected.

Therefore, automation has significant effect on manual administration of Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State.

Hypothesis Two

H0₂: Automation does not enhance students' admission of Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State.

ANOVA SUMMARY

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2341.36	4	585.34	12.6478	2.92E-05	2.866081
Within Groups	925.6	20	46.28			
Total	3266.96	24				

Critical Value of 5% level of significance with degree of freedom 4 to 20 is 2.87

Decision Rule

Since the calculated value is 2.92, is greater than the critical value of 2.87. The alternative hypothesis should be accepted and the null hypothesis (H0) should be rejected.

Therefore, automation enhances students' admission of Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State.

Conclusion and Recommendation

The task of managing Nigerian Polytechnics in such an effective manner that it leads to sustainable development cannot be attained if the full use of Information Communication Technology-related educational initiatives that is, e-learning, e-payment and e-administration are not explored. Polytechnics being an institution aimed to provide education that will improve the practical and technical skill of their students, application of technology in their

operations cannot be demoted as the world keeps changing technologically. It is apparent that automation is a necessary and indispensable tool that students, researchers and Polytechnic administrators need for good success in their daily engagements. In the scope of this study, it was deduced that automation has greatly contributed to the development of the Polytechnic. Through the findings, the choice of the respondents revealed that e-registration of courses and details of examination and other services are being offered online, thereby, reduced pressure during course registration for their students. It was further concluded through the choice of the respondents that through the aid of automation, process of huge amounts of data can now be done extremely fast, accurate and reliable. Also it was cognized that automation reduces workload and minimizes manpower who are to

*Automation as A Panacea to Manual Administration of Polytechnics in Ogun State, Nigeria.
(A Study of Abraham Adesanya Polytechnic, Ijebu-Igbo)*

carry out administrative works while it makes easy the process of students' admission in Nigerian Polytechnics.

In related to the conclusion above, the researcher recommends the following;

Government should implement the policy of applying automation in the manual administration of Polytechnics in Nigeria, train the employees and ensure that application of information communication technology is well funded.

Nigerian Polytechnics should plan and have a well-structured programme for confronting the various classes of barriers that can hinder effective plan implementation.

Administrators should be aided in exploring the right techniques that will equip him adequately in attaining the educational objectives and the use of automation in this regard should not be underestimated.

REFERENCES

- Akor, P. U. & Mustapha, H. T. (2016). Assessment of the Use of Internet and Online Resources by Non-Academic Staff of Two Universities in Nigeria. *Journal of Applied Information Science and Technology*, 9 (1)
- Amaechina, O. U. Chukwemeka, O. K., & Ekor, L. (2013). Access to Information and Communication Technology (ICT) for quality delivery of higher education in Rivers State. *The International Journal of Theory Policy*.
- Amobi, D.S.C., & Nnabuife, K.E.N.(1999). *Management operational perspective*. Awka. J'Goshen publisher
- Balsubramanian, K. (2009). ICTs for higher education. Retrieved 12th August, 2013 from <http://www.nayastories.com/2013university.education-nigeria-and-ICT-eduption-prospects-and-challenges>.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, Minneapolis (MN), v.13, n.3, p.319-339.
- Davis, F. D.; Bagozzi, R. P.; Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science*, Ann Arbor (MI), v.35, n.8, p.982-1003.
- Dillon, A.; Morris, M. (1996). User acceptance of new information technology: theories and models. *Annual Review of Information Science and Technology*, Medford (NJ), v.31, p.3-32.
- Ezeocha, P.A.(1990). *Educational Administration and Planning*. Enugu, Optional Computer Solutions Ltd.
- Fishbein, M.; Ajzen, I. (1979). *Belief, attitude, intention, and behavior: an introduction to theory and research*. Boston (MA): Addison-Wesley.
- Hassan Darwish, Naser Saki, Moradhasel Sahraei, Fatemeh Zakrifar and Seid Morteza Talebi (2014). Effects of Automated Office Systems (Automation) on Improve Decision-Making of Staff Managers (At the Airports Company of Country). *Journal of Educational and Management Studies. J. Educ. Manage. Stud.*,4 (3): 554-564.
- Ijov T. M. & Wombu R. N. (2019). Impact Of Information And Communication Technology On Tertiary Institutions. *BSUJEM Vol. I No. 2*
- Jaiyeoba, A.O. (2006). School administration and Supervision. In J.B. Babalola, A.O. Ayeni, S.O. Adedeji, A.A. Suleiman & M.O. Arkewuyo(Eds). *Educational Management: Thoughts and Practice*. Ibadan: (Pp. 219-241). Ibadan: Codat Publications.
- Kwame, D. D. (2010). Information and communication technology in Nigeria: Prospects and challenges for development. Retrieved on 12th August,

*Automation as A Panacea to Manual Administration of Polytechnics in Ogun State, Nigeria.
(A Study of Abraham Adesanya Polytechnic, Ijebu-Igbo)*

- 2013 from http://musejhu.edu/login?Auth_0&iype_summaryuri_journals/Africa.
- Laura, C. & Brown, C. (2011). Using information and communication technology in developing countries. USA: McGrawHill.
- Lee, Y. et al. (2003). The technology acceptance model: past, present, and future. Communications of the Association for Information Systems, Atlanta (GA), v.12, n.50, p.752-780.
- Myamoto, K. (2010). Human capital formation and direct investment in developing countries. USA: McGraw Hill.
- Nwankwo, A. F. (2013). ICT on higher education learning: Prospects and challenges.
- Nwosu, O. & Ogbomo, E. F. (2012). ICT in education: A catalyst for effective use of information, Practice Northwest Library Association. Retrieved August 12th 2013 from <http://www.eprimers.org/>.
- Obi E. (2003). Educational Planning in Contemporary Nigeria. Enugu: computer Edge Publisher.
- Obi, E. (2004). Law and education management. Enugu. Empathy international.
- Oliver, R. (2011). Creating meaningful contexts for learning in Webbased settings. Brisbane: Queensland Press.
- Omenyi, A. S. (2007). Leadership and school management: A problem based approach. Awka. J' Goshen publishers.
- Oriaifo, S.O. (2003). Planning and Implementation of Policies in Nigeria and education: Issues, Problems and Prospects. Benin City: Dasyuva Influence Enterprises.
- Otu, D.O. (2006). The teaching profession. In J.B. Babalola, A.O. Ayeni, S.O. Adedeji, A.A. Suleiman & M.O. Arkewuyo (Eds.) Educational Management: Thought and Practice. (Pp. 175-186). Ibadan: Codat Publications.
- Oyededeji, N.B. & Fasasi, Y.A.(2006). Dynamics of administrative leadership. In J.B. Babalola, A.O. Ayeni, S.O. Adedeji, .A. Suleiman & M.O. Arikewuyo (Eds.) Educational Management: Thoughts and Practice Ibadan, (Pp. 175-186). Ibadan: Codat Publications.
- Potashnik, M. & Capper, J. (2008). Distance education: Growth and diversity. New York Times Relneved, June, 2013. from <https://www.worldbank.org/fandd/english/pdfs/0398/0110298.pdf>.
- Reeves, T. & Jonassen, D. (2006). Learning and technology: using computers as cognitive tools. Handbook of Research on Educational Communications and Technology, 1(2), 93719.
- Ukeje, B.O. Akabogu, G.V. & Ndu, A. (1992). Educational administration. Enugu: Fourth Dimension Publishing Co., Ltd.
- Venkatesh, V. et al. (2003). User acceptance of information technology: toward a unified view. Mis Quarterly, Minneapolis (MN), v.27, n.3, set.
- Yakubu, & Aboho, R. M. (2015). Enhancing innovative transformation in teaching and learning through the use of information and communication technology. Journal of Teacher Perspective, 19 (2), 334 -342.

Automated Audit and Competitive Advantage of Selected Banks in Nigeria

Obasan, Olabowale Taiwo

Department of Accountancy

Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State, Nigeria.

Pemisire0703@gmail.com

+2348034411824

Abstract

This study aims to examine the effect of automated audits on the competitive advantage of the selected banks in Nigeria. The study adopted survey method for the research design. The survey was conducted in 13 selected banks in Nigeria with an approximate total of 1,261 staff. A total of 334 questionnaires were distributed among the thirteen (13) banks. Two-hundred and ninety-nine were retrieved representing 89.5% response rate. The sample was selected based on a stratified and simple random sampling techniques. The dataset was analyzed using the descriptive and inferential (multiple regression) statistics. The study concluded that automated audit has a significant effect on competitive advantage and service quality of the selected banks in Nigeria. The study recommended that the banking sector should improve on the audit skill and information communication technology competency to improve the quality of bank service. This is because innovating the quality of the service according to the needs and demands of the customer is very important in every banking sector.

Keywords: Automated audit, Audit Skills, Information Communication Technology Competence, Competitive advantage and Service Quality

Introduction

The core competencies of the employees and teams play a primitive role in the accomplishment of organizational goals thereby enhancing the competitive advantage of the organization. Issues related to competitive compensation, improving the skill and competencies to main competitiveness are creating major problems for the organization. Hence the need for effective competitive advantage management has emerged. Effective competitive advantage of the performance management system is critical to enhancing organization, to achieve a competitive position in the global marketplace (Franceschini, Galetto, Maisano, & Mastrogiamco, 2010).

Organizations have the power to achieve and maximizing competitive advantage in the aspect of service quality in the banking sectors. In attaining this, the management of the banking sector depends solely on the automated audit system through professional skill or audit skill or the staff, electronic communication system, and information communication technology competence. The management ensures adherence to stipulate the competitive advantage of their banking sector and aid management smooth administration, ensure a good quality of service, and maximum benefit for customers (Dauda & Olawale, (2019); Unegbu & Obi, 2012) by ensuring and measuring an effective auditing system.

Nest, Smidt and Hobber, (2017) regarded automation as one of the basic aspects required to improve organizations through competitive advantage and service quality while automated audit is regarded as the computer-aided process to execute audit objectives. The automated audit is the process of applying any information technology-based system to assist auditors in the planning, performance, control, completion, and administration of audit works.

Recently, the organization adopted the use of audit automation (Debreny, Lee, Neo, and Toh, 2017). Auditing is an independent, objective assurance and consulting activity designed to add value and improve an organizational operation (Albkour & Chaudhary 2017). It helps the organization to achieve its aims by employing a systematic disciplined approach to evaluate and improve the effectiveness of the management process. Automation of basic aspects of financial processes especially audits remains one of the strategies required towards the improvement of organization's competitive advantage (Nest,

Smidt & Hobber 2017). Audit automation is the application of computer-aided processes to execute audit assignments. Today's auditors are faced with an excessive workload, time constraints, and data volume explosion (Adrianto, 2018). Present-day auditors are also besieged with challenges of very high expectations, the continual increase in fraud perpetration, declining efficiency of audit employees, improper training of several auditors due to their refusal to serve audit apprenticeship training, and the pressure of passing their professional examinations. These had created adverse effects not only on profitability and service quality performance of auditors; but also undermined their target realization aspects of audit performances. Other challenges confronted by present-day auditor's poor knowledge of fighting electronic fraud perpetration, poor financial leakage control, and poor internal control (Sjoberg & Johanson, 2016). The general consequences of these challenges are massive increases in fraud perpetration, especially in financial institutions.

Anyanwu, (2010), reported that the 2012 banking sector reform was triggered by the need to address the combined effects of the global financial and economic crises, as well banks' huge exposures to oil/gas and margin loans, which were largely non-performing; corporate mis governance and outright corruption, among operators in the system. Since the reformation of the banks, the banks have undergone some changes, and therefore, it is important to investigate the effect of automated audit on the competitive advantage of thirteen selected banks in Nigeria.

Statement of the Problem

The idea of establishing the sustainability of the competitive advantage is based on the best managerial tools of solving the problem of the poor service quality (Adebayo, Worlu, Moses, Ogunnaike, & Salau, 2021) which are the main causes of failure of problem within the banking sectors in Nigeria. Ibrahim and Daniel, (2019) opined that many organisations have failed due to their ineffective style of management and poor performance in the area of quality of service and customer relations of the workers which led to low productivity in the organisations. It is generally observed that competitive disadvantage

Automated Audit and Competitive Advantage of Selected Banks in Nigeria

and the staff can stop the management from producing new ideas and getting solution to problem of the banking sections, especially in the area of auditing (Ibrahim & Daniel, 2019). The competition of the sectors in the banking sector is usually a reflection of how effectively and efficiently the human and other productive resources of the banking sector managed the decision (Agba, 2018; Methode, Osunsan, Irau, Wandiba, Abiria, & Innocent, 2019).

Observations have shown that automation auditing like ICT competency, communication system, and professional skill; has been a major challenge of achieving competitive advantage in terms of service quality. Stowell, (2021) stated that organizations face difficulties in blending multiple personalities into a cohesive and unified team, and this is an enormous problem because of differences in people's diversity of backgrounds, opinions, views, and experiences before they can attain absolute organizational goals.

Service quality is ineffective as a result of lack of information flowing from the customers to the management and this makes what the customers expect and what management think they expect. There have been problems due to a temporary shortage of resources, a failure to match supply and demand, lack of training, or poor employee motivation. In addition, overpromising or lack of communication to the customers is a significant problem affecting the organization (Sharabi & Davidow, 2010). This is precipitated by the shortage of labour, computer breakdown among other reasons. The lack of empathy by the management of these banks is further worsening the already poor image perception of many of their customers (Berg and Bharati, 2013).

With these, we can conclude that failure to secure automated privacy, constant technology, and infrastructure changes, lack of professional skills auditors affect the banks in the aspects of competitive advantage through service quality effectiveness. Despite various studies conducted within this context; limited studies have investigated the effect of automated audits on competitive advantage in banking sectors. Therefore, these problems and gaps identified necessitated this study to investigate the effect of automated audits on competitive advantage in the banking sector.

Objective of the Study

The main objective of this study was to assess the effect of Automated Audit on the competitive

advantage of selected Banks in Nigeria. The specific objectives were to:

- i) evaluate the effect of automated audits on the competitive advantage of the selected banks in Nigeria.
- ii) examine the effect of automated audit on service quality of the selected banks in Nigeria.

Research Questions

Despite the research objectives stated above, the study answered the following specific questions:

- i) In what way do automated audits affect the competitive advantage of the selected banks in Nigeria?
- ii) What is the effect of automated audits on the service quality of the selected banks in Nigeria?

Research Hypotheses

The following hypotheses were tested in this study:

H₀1: Automated audit has no significant effect on the competitive advantage of the selected banks in Nigeria.

H₀2: Automated audit has no significant effect on the service quality of the selected banks in Nigeria.

2.0 REVIEW OF RELATED LITERATURE

Conceptual Review

Competitive Advantage

One of the keys of business strategy for creating competitive advantages is understanding the data that firms generate in their own business. Information processing has gradually become the basis for achieving competitive advantage. The major development of competitive advantage was based on the unique position of the banking sector developed against the competitors through the patterns of resources deployments. Hofer, (1978) proposed that competitive advantages involved competencies. Dubey and Sangle, (2019) revealed how CRM technology capability have an impact in the banking sector. The research of Kasasbeh, Harada, and Noor, (2017) reviewed a systematic method of competitive advantage and the study of Major, Maggitti, Smith, Grimm, and Derfus, (2016) investigated selective and reflective competitive behavior using a longitudinal sample.

Competitive advantage can be related to the theory of comparative advantage. This theory stated that when comparative advantage suffered from the same weakness like that of Neoclassical theory of the organization. The idea of

competitive advantage gives a robust or explanatory explanation or power of strategy and organization. The success of the organization depends on the sector and its relationship. Therefore, Bagnoli, et al., (2003) reported that competitive advantage could be established by devolving organizational superiority.

Every organization is ahead of the competition with the assistance of its stakeholders, leadership, and superior performance. It can be stated that competitive advantage is proportional to a different department in the organization in all the sectors, especially the banking sector of interest. Two prominent views of competitive advantage in the banking sectors, the first discussed the function of membership in an organization and the second one discussed the organizational performance. The main purpose of organization performance was because of the internal competition of the banking sector. Powell, (1996) in UKEssays, (2018) identified superior performance and competitive advantage are the main factors that increase the performance of the organization in the banking sector.

Service Quality

Adamu, (2017) explained the term service quality as a comparison of expectations with performance used when performing a gap analysis of service quality performance of organization against service quality needs and it is regarded as the most important goal of service industries that link the satisfaction of customer with good service quality (Akpan, 2017). Swick and Baumgartner, (2017) explained service as a comparison of customer price-fixing expectations of service, with the eventful particle serves on the of the service. Service quality is very germane to an organizational survival as it serves as a tool for a competitive performance edge. Service quality also creates patronage, fulfilling customers. It serves as a basis for price-fixing and measure of overall organizational performance, serves as the basis for customers' recommendations increase profitability postal service quality originated from expectancy. Therefore, a business with such high service quality must strive to fulfill customers' expectations and endeavor to exceed them (Oliver, Barry & Barry, 2014).

Service delivery can be achieved through improvement of operational process, issuance, customer needs identification, creation of an organization expected targets, assessing customers' complaints through past encounters,

and expressed opinions (Parasumaman, Berry, Leonard, Zeithanni and Valeries 2011). Service quality is therefore directly related to employee's skills. This includes the employee's hard and soft skills. Employee hard skill depends mainly on qualification and extent of knowledge while soft skill includes quickness of rendering service and general enthusiasm display during service.

Automated Audit

According to Adpta, (2014), an audit is an independent examination of financial records of any entity irrespective of its size or legal for most of the auditor examines an organization financial records books obtain evidence to evaluate them and formulate an opinion of his or her judgment which would later be communicated to the audit report. An audit involves an internal control level of compliance with statutory acts and evaluation of risk management (Vasarterly and Niton, 2018). financial audits are performed to ascertain the reliability of a statement of account ascertain whether these statements are free from Aaron to stop all this report also provide an assessment of an organization internal control and ensure that the represents a true and fair view of the organization financial details.

Berg and Bharati (2013) explained automated audit as an examination of financial information using up-to-date information technology that stops the information obtained is utilized to achieve organizational goals. The American Institute of Internal Auditors defined technology-based such as generalized audit software as computerized audit programs and computer-assisted audits. Internal auditing ascertains the extent an organization applies a disciplined approach to risk management effectiveness and control utilizing control self-assessment techniques. Continuous auditing is an automatic digital method used to execute order teen activities constantly. A continuous audit is an innovative technique technology innovation that helps automate the identification of anomalies in an organization's financial details. The continuous audit ensures the delivery of effective auditing through the application of automated information technology to reducing the rigorous manual auditing process (Abbott, 2013).

Audit Skills

Audit skill is used interchangeably with training needs analysis, and it is referred to as the process of measuring and recording the skills of individuals or groups of employees. Audit skills are desirable human skills that utilize common

sense superb management and communication skills Positive attitude personality traits mindset and career attributes high intelligence quotient to navigate work environment using acquired knowledge or hard skills (Whitemore, 2020). This concept was developed by the United States of America armed forces in 1960 who stop the United States of America armed forces realized that in addition to the application of regimental routines there is a need to deploy emotional creative skills to lead and motivate leaders to win wars and ensure efficiency who stopped the application of skills and compact direct productive personality traits of an individual employee that distinguish an employee in a work environment. (Marcel & Rubies, 2016). Audit skills have an important place in the creation of the public process. It enables employees to blend technical ability for effective fulfillment of organization objectives.

Electronic Communication System

In this modern-day, communication is unique from all the phenomena as electronic communications are referred to as data communication which has both wired and wireless systems. Electronic communications differed from wire communications and are not transmitted by sound waves and cannot be characterized as containing a human voice. An electronic communication system can be categorized into telex communications, electronic mail, non-voice digitized transmissions, and the portion of video teleconferences that do not involve the hearing of voice or oral sounds. Electronic communications can also be explained as the transfer of signs, signals, writing, images, sounds, data, or intelligence of any nature transmitted in whole or in part by a wire, radio, electromagnetic, photoelectronic, or photo-optical system that affects interstate or international commerce, but does not include any wire or oral communications as well as any communication made through a tone-only paging device, or any communication from a tracking device.

Information Communication Technology Competence (ICTC):

In this new era, the development of ICT competence continues to progress in the banking sectors which makes it difficult to separate from technology. ICT has a great impact on this present new technology which makes auditing in the banking sector easier and accessible

(Octabriyantiningtyas, Suryani, & Jatmiko, 2019).

Information and communication technology are based on understanding. Knowledge, attitudes, and skills. Information and communication technologies transform the way of thinking and learn as they support risk-taking and knowledge sharing. These technologies are fast and automated, and interactive and multimodal, and allow control of how and when they learn. Specific requirements change according to the needs of individuals to find solutions to problems or to construct and communicate their learning. Information and communication technology competence is based on sets of relevant understandings, knowledge, attitudes, and skills. Internationally, such competence is typically represented developmentally. In this case, increasing the levels of competence have increasingly sophisticated experiences with the technology.

Theoretical Review

The Agency Theory

This theory was propounded by Jensen and Meckling, 1976 in the 1970s. Although according to Cang-Fu, Hsiangtsai, and Li-Jen, (2015), agency theory first appeared in a report by Berle and Means in 1932. The agency theory identifies the agency relationship as a contract in which one party, the principal, delegates the specific task to the other party, the agent, which performs the task on behalf of the principal. The principal is the one who delegates the task, invests the funds, and expects their return with the increased value. The agent is the one who accepts to perform the task for the principal and he is awarded and paid according to previously defined obligation. Jansen and Meckling (1976) alluded to agency theory as the expert contract under which the principals (investors) connect with the agents (supervisors) to play out some specific administrations for their benefit which involves the assignment of obligations and usage of assets. Perrow (1986) had criticized that positivist agency researchers have only concentrated on the agent side of the 'principal and agent problem', and opined that the problem may also happen from the principal side. He observed that this theory is unconcerned about the principals, who deceive, shirk, and exploit the agents. He believed in another way that humans are noble and work ethically for the betterment of the firm. This argument further persisted in the finance literature and has become a prominent theory

known as stewardship theory (Donaldson, 1990). Shleifer and Vishny (1997) supported the theory and gave their view that ownership concentration could monitor the manager's behavior very closely to reduce the risks in the business.

The Stakeholders Theory

This theory was propounded by Edward Freeman in 1984 whereas the Nobel laureate prize winner Milton Friedman is the most vocal about this theory which major drive is that it is believed that the firm's essential responsibility is to maximize profit and consequently enhancing the economic value of the shareholders. The criticism of the theory is that it is vague and presents ambiguity in its graphical representation. This theory was analyzed by different scholars and have demonstrated its limitations; such lack a widely accepted normative basis (Argandona, 1998; Wijnberg, 2000); it is still weak because some scholars posit that is not fully descriptive, and empirical analysis of the organizational relationship is still a challenge (Gioia 1999; Jawahar & McLaughlin 2001). Finally, this theory is considered as the second-order theory which needs to increase the level of advancement in its development. Preston and Sachs (2002) who acknowledged the criticism of stakeholders' theory propose to distinguish the traditional transaction-based model with one of the relationships that can combine conflicting interests as well as collaborative elements. It is that fact that the same authors promote the development of opportunities for "mutual benefits". It would be quite naive to think all diverging attitudes could be erased with the help of simple contractual agreements. People normally engage in contracts when they find a common point of view and develop shared interests.

The supporters of this theory such as Chen, Zhong, and Chen (2012) explain that stakeholders are groups of constituents in a firm that has a legal claim from the firm in which they have a certain interest. This authority from stakeholders is therefore enforced through an exchange relationship that exists between an organization and its partner. Boatright (2012) went further by giving an example that stakeholders have some interests to be earned because of the positive relationships that tie them to the organization.

Empirical Review

Automated Audit and Competitive Advantage of Selected Banks in Nigeria

Bhat and Darzi, (2016) investigating the role of customer loyalty between CRM and competitive advantage in retail banking. The study used a primary dataset collected from 278 customers of a private bank. In the research, customer loyalty was used as a mediating variable. The result from the structural equation model revealed that the four dimensions of customer relationship management showed a positive significant effect on customer loyalty and the competitive advantage of the bank.

Lubis, Dalimunthe, Absah, and Fawzee (2020) found a significant effect between customer orientation, customer empowerment, complaint resolution, and customer knowledge and customer loyalty. Dubey and Sangle (2019) used a sample size of 324 respondents but were able to obtain 220 questionnaires from the respondents using a qualitative approach. The study suggested that technology is an important factor when compared to people and processes for CRM technology capability.

Ananda and Al Lawati (2018) researched the adoption of digital banking in Oman through primary data collected from 200 banking customers. The study used factor analysis and found five factors (security, usefulness, and ease of use, privacy, and trust, cost-effectiveness, awareness of digital services, and web design features) which showed a significant influence in the adoption of digital banking among the retail banking customers. Ananda and Sonal (2017) revealed that e-banking service is the main factor affecting customer satisfaction.

3.0 METHODOLOGY

The study adopted the use of a survey research design. This design was considered appropriate because it allowed researchers to link and measured the strength of the relationship between the Competitive advantage (service quality) and the automated audits (audit skill and the information communication technology (ICT) competence), as well as testing the hypothesis. The researchers who adopted survey design in relation to the study include Mona, (2018); Lee, (2018), and Alharbi, (2017).

The target population of this study involved all the staff of the management section (internal audit and operational sector), remittance section, and other supervising sectors in the 13 selected banks in Nigeria including Jaiz bank, Sun Trust Bank, Fidelity Bank, Union Bank, United Bank for Africa, First City Monument Bank, First

Bank, Wema Bank, Ecobank, Stanbic IBTC, Sterling Bank, Polaris bank and Standard Chartered bank. The thirteen selected banks had a total staff of about 1,261 staff and were categorized under the International authorization, National authorization, Regional authorization, and Non-interest banks. All the selected banks had their headquarters in Lagos State.

The study made use of a simple random sampling technique to select 334 respondents determined using Taro Yamane sample size determination formula, with a 95% confidence level. The purpose of selecting this specific sampling technique was to cull a smaller sample size from a larger population and it was used to research to generalize about the larger group.

A study population of 1,261 from the dataset was generated from the 13 selected banks and the sample size was calculated using the Taro Yamane sample size formula given as:

$$n = \left(\frac{N}{k + N(e)^2} \right) = \left(\frac{N}{1 + N(e)^2} \right) \text{-----(1)}$$

where N is the population size;

n is the sample size

e is the accepted sampling error (± 0.05)

k is the constant = 1.

$$n = \left(\frac{1,261}{1 + 1,261(0.05)^2} \right) \text{-----(2)}$$

$$n = \left(\frac{1,261}{4.1525} \right) = 303.67 \approx 304$$

$$n = 304.$$

An additional, 10% non-response was added to the sample size which will make a total sample size of $(304 + 30) = 334$

Because of the research design and assessing various research objectives in the study, a

primary source of data (questionnaire) was used in gathering the data through a structured questionnaire administered to the staff, especially the selected sections which help to gathered three hundred and thirty-four (334) responses from the staff of the 13 selected banks in Nigeria. The validity test adopted for this study was content validity.

The data collected from the field survey was analyzed using both the descriptive and inferential methods of data analysis. For this study, the decision rule stated that if the probability value is less than 1% level of significance and 5% level of significance, the null hypothesis was rejected.

4.0 DATA ANALYSIS

4.1.1 Questionnaire Administration

Out of the 334 questionnaires distributed among the employees of the selected banks, only 299 questionnaires were correctly filled and used for the analysis. Thus, the total questionnaires retrieved and used for the analysis is 299 (89.5%).

Competitive Advantage

Competitive advantage is the fourth variable used to measure the organizational performance of the banking sector in Nigeria. This is determined using eight (8) different factors including innovation, continuous product and service development, sales and growth dimensions, organizational competence, market diffusion, training and education, foster improvement, and strategic assets and architecture.

Table 1: Competitive Advantage

Competitive Advantage	Frequency and Percentage Distribution					Weighted Mean Score			
	SA (%)	A (%)	D (%)	SD (%)	N (%)	RS	Statistic	Std. dev	Rank
Market Diffusion	93 (31.1)	81 (27.1)	4 (1.3)	78 (26.1)	43 (14.4)	1004	3.36	1.147	1
Training and Education	10 (3.3)	111 (37.1)	20 (6.7)	94 (31.4)	64 (21.4)	820	2.74	1.070	2
Organizational Competence	19 (6.4)	94 (31.4)	18 (6.0)	107 (35.8)	61 (20.4)	797	2.67	1.173	3
Sales and Growth Dimensions	24 (8.0)	98 (32.8)	10 (3.3)	123 (41.1)	44 (14.7)	787	2.63	1.243	4
Continuous Product and Service Development	11 (3.7)	90 (30.1)	33 (11.0)	109 (36.5)	56 (18.7)	758	2.54	1.170	5

Innovation	22 (7.4)	79 (26.4)	40 (13.4)	112 (37.5)	46 (15.4)	756	2.53	1.267	6
Strategic Assets and Architecture	24 (8.0)	66 (22.1)	34 (11.4)	123 (41.1)	52 (17.4)	731	2.44	1.311	7
Foster Improvements	14 (4.7)	61 (20.4)	30 (10.0)	115 (38.5)	79 (26.4)	726	2.43	1.193	8

Where SD – strongly Disagree, D – disagree; N – neutral; A – agree, and SA – strongly agree, RS – rank-sum, and std. dev – standard deviation.

Source: Researcher’s Field Survey, 2022.

From Table 2, the result of the analysis shows that market diffusion is the main factor that determines competitive advantage revealing the highest weighted mean score of 3.36 with the standard deviation of 1.147 and the rank sum of 1004 being rated “Strongly Agreed” by the mode value (highest frequency and percentage distribution) of 93 (31.1%). This implies that market diffusion, training and education, and organizational competence are the main factor that determines the competitive advantage of the

capacity utilization of an organisation while foster improvement is not a factor that determines the competitive advantage of the banking sectors. A low standard deviation is obtained when compared with the mean value from the result of the analysis. The diffusion of the market rated the highest of all the variable means that every organisation accepts new ideas or new product or services to make their organisation more advantages than others.

Table 2: Service Quality

Service Quality	Frequency and Percentage Distribution					Weighted Mean Score			
	SA (%)	A (%)	D (%)	SD (%)	N (%)	RS	Statistic	Std. dev	Rank
Assurance	31 (10.4)	70 (23.4)	22 (7.4)	119 (39.8)	57 (19.1)	769	3.40	1.299	1
Responsiveness	20 (6.7)	77 (25.8)	14 (4.7)	131 (43.8)	57 (19.1)	738	3.30	1.274	2
Service Dependence and Accuracy	17 (5.7)	73 (24.4)	27 (9.0)	125 (41.8)	57 (19.1)	727	3.22	1.259	3
Empathy	14 (4.7)	56 (18.7)	47 (15.7)	109 (36.5)	73 (24.4)	716	3.07	1.200	4
Tangible	20 (6.7)	45 (15.1)	41 (13.7)	134 (44.8)	59 (19.7)	673	3.04	1.334	5

Where SD – strongly Disagree, D – disagree; N – neutral; A – agree, and SA – strongly agree, RS – rank-sum, and std. dev – standard deviation.

Source: Researcher’s Field Survey, 2022.

From the result obtained, it is displayed that assurance has the highest weighted mean score of 3.40 with the standard deviation of 1.299 showing the rank sum of 769 being rated “Strongly disagree” with the mode value (highest frequency and percentage distribution) of 119 (39.8%). This proves that the staff of the thirteen

(13) selected banks strongly disagree with the service quality of their various banking sector since it has the highest frequency and percentage distribution. Also, the majority but not up to 30% of the respondents agree with the service quality provided in the thirteen (13) selected banks in Nigeria. The respondents responded more to

assurance of service quality because quality assurance ensure high standard of product or services which mainly depends on auditors.

Test of Hypothesis

Research Hypothesis 1: Automated audit has no significant effect on the competitive advantage of the selected banks in Nigeria.

Table 3: Automated Audit and Competitive Advantage

CA	Coeff.	Std. Error	T-value	P-value
Constant	0.409	0.199	2.06	0.041**
AS	0.521	0.057	9.26	0.000***
ICTC	0.115	0.047	2.46	0.014**
Model Summary				
	SS	DF	MS	
Model	133.817	2	33.454	
Error	122.448	294	0.416	F (2, 294) = 80.32
Adj. R square	0.5157	R square	0.5222	Prob > F = 0.000

Where AS indicates Audit skill; ICTC – Information communication technology competence, CA – Competitive advantage, SS – sum of square, DF – degree of freedom, and MS – Mean Square. Also, *** and ** indicates P-value < 0.05 (significant).

Source: Researcher’s Field Survey, 2022.

About 51.57% of the automated audit (AS and ICTC) is explained in the dependent variable (competitive advantage) while 48.43% are loss to error term or the variables not captured in the analysis with the degree of freedom 2 of 294.

Decision: At a level of significance 0.05, the F statistics is 80.32, while the p-value of the F

statistics is 0.000 which is lower than 0.05 significance level adopted. Therefore, the study rejected the null hypothesis which means that automated audit has significant effect on competitive advantage.

Research Hypothesis 2: Automated audit has no significant effect on the service quality of the selected banks in Nigeria.

Table 4: Automated Audit and Service Quality

SQ	Coeff.	Std. Error	T-value	P-value
Constant	0.774	0.210	3.68	0.000***
AS	0.371	0.060	6.22	0.000***
ICTC	0.219	0.049	4.43	0.000***
Model Summary				
	SS	DF	MS	
Model	98.305	2	24.576	
Error	137.091	294	0.466	F (2, 294) = 52.71
Adj. R square	0.4097	R square	0.4176	Prob > F = 0.000

Where AS indicates Audit skill; ECS – Electronic communication system; AR – Automated report; ICTC – Information communication technology competence, SQ – Service Quality, SS – sum of square, DF – degree of freedom, and MS – Mean Square. Also, *** indicates P-value < 0.05 (Significant).

Source: Researcher’s Field Survey, 2022.

Table 4 shows the regression analysis and the model summary of the effect of automated audit on service quality. The Adj R² of 40.97% shows the composition of automated audit in service quality while the remaining 59.03% constitutes factors not considered in this study.

This indicates that as audit skill (AS) and information communication technology competency (ICTC) increase, the service quality of the banking sector also increases.

Decision: At a level of significance 0.05, the F statistics is 52.71, while the p-value of the F statistics is 0.000 which is lower than 0.05 significance level adopted. Therefore, the study rejected the null hypothesis which means that automated audit has significant effect on service quality.

5.0 CONCLUSION AND RECOMMENDATION

The study investigated the effect of automated audits on the competitive advantage of the selected banks in Nigeria. To solve the problem of the automated audit, thirteen banks were selected out of the listed banks in the Nigeria stock exchange. The thirteen banks were stratified into four authorization including international authorization, national authorization, Regional authorization, and Non-interest banks. The questionnaires were analyzed using descriptive and inferential statistics. The descriptive statistics used frequency, percentage, weighted mean score, standard deviation, and ranking to analyze the socio-demographic information of the respondents as well as the getting the number of respondents for each Likert scale of the variable used for the inferential

statistics. The result from the inferential statistics was analyzed using multiple linear regression.

For hypothesis 1, it is revealed that automated audit has a significant effect on competitive advantage. Hypothesis 2 also showed that automated audit has a significant effect on service quality. Based on the findings of this research, the study, thereby, concluded that automated audit is statistically significant with the competitive advantage of the selected banks in Nigeria.

The main purpose of the study is to put recommendations of practical nature in place. Therefore, the following recommendations are proposed based on the findings from the research work.

The banking sector should continue to improve their automated audit such as audit skills and information communication technology competence as these will give them a better edge to compete with other banking sectors. Today, banks' performance is highly competitive and it is an essential element for improving the performance of the organization. Meanwhile with the help of automated audit in the banking sector, which is an important factor in improving the competitive advantage of the banks and in determining the success of the banking sector.

The banking sector should improve on the audit skill and information communication technology competency to improve the quality of bank service. This is because innovating the quality of the service according to the needs and demands of the customer is very important in every banking sector. The banking sector must think in terms of the result of its service quality innovation. The focus must not be on the current situation alone rather the focus be on the long-run terms.

References

- Adamu, R. (2017). A usability evaluation of mobile banking applications in Nigeria. *International Journal of Technology and Engineering Studies*, 3(1), 29-37.
- Adebayo, O. P., Worlu, R. E., Moses, C. L., Ogunnaike, O. O., & Salau, O. P. (2021). An Organisational Diagnostic model for a Sustainable Organizational Performance. *In IOP Conference Series: Earth and Environmental Science*, 655(1), 012 – 026.
- Adrianto, Z. (2018). Auditing in the era of big data: literature review; *Journal Akuntaa, Dan Kauangan*, 17(1), 7- 22.
- Agba, M. S. (2018). Interpersonal relationships and organizational performance: the Nigerian public sector in perspective. *Indian Journal of Commerce and Management Studies*, 9(3), 78-86.
- Akpan, S. J. (2017). The influence of atm service quality on customer Satisfaction in the banking sector of Nigeria. *Global Journal of Human Resource Management*, 4(5), 65-79.

- Albkour ASI, Chaudhry A. (2017). Effect of Internal Audit on Organizational Performance of Jordanian Banks. *International Research Journal of India*, 2(7). Available at: <http://irji.in/>
- Ananda, S., & Al Lawati, S. D. A. M. (2018). An Empirical Study on Adoption of Digital Banking in Oman. *OFFICIAL*, 12(1), 16 – 24.
- Ananda, S., & Sonal, Devesh. (2017). Service quality dimensions and customer satisfaction: empirical evidence from retail banking sector in Oman. *Total Quality Management & Business Excellence*, 2 (11), 17 – 26.
- Bhat, S. A., & Darzi, M. A. (2016). Customer relationship management: An approach to competitive advantage in the banking sector by exploring the mediational role of loyalty. *International Journal of Bank Marketing*, 2(1), 6 – 13.
- Dauda, A., & Olawale, B. V. (2019). The Place of Auditing in Organizational Performance of Public Sector: Evidence from some selected Local Government in Zamfara State, Nigeria. *Journal of Accounting and Financial Management ISSN*, 5(2), 10 – 17.
- Dubey, N. K., & Sangle, P. (2019). Customer perception of CRM implementation in banking context: Scale development and validation. *Journal of Advances in Management Research*, 3(4), 64 – 70.
- Franceschini, F., Galetto, M., Maisano, D., & Mastrogiacomo, L. (2010). Clustering of European countries based on ISO 9000 certification diffusion. *International Journal of Quality and Reliability Management*, 27(5), 558-575.
- Ibrahim, A. U., & Daniel, C. O. (2019). Impact of leadership on organisational performance. *International Journal of Business, Management and Social Research*, 6(2), 367-374.
- Kasasbeh, E. A., Harada, Y., & Noor, I. M. (2017). Factors influencing competitive advantage in banking sector: A systematic literature review. *Research Journal of Business Management*, 11(2), 67-73.
- Lee, S. (2018). Employee turnover and organizational performance in US federal agencies. *The American Review of Public Administration*, 48(6), 522-534.
- Lubis, A., Dalimunthe, R., Absah, Y., & Fawzee, B. K. (2020). The Influence of Customer Relationship Management (CRM) Indicators on Customer Loyalty of Sharia Based Banking System. *Lubis*, A(1), 84-92.
- Major, D. L., Maggitti, P. G., Smith, K. G., Grimm, C. M., & Derfus, P. J. (2016). Reflexive and Selective Competitive Behaviors—Inertia, Imitation, and Interfirm Rivalry. *Organization Management Journal*, 13(2), 72-88.
- Marcel, M., & Robles, J. (2016). Executive Perceptions of the top ten soft skills needed in today's workplace: *Journal of Business Communication Quarterly*, 75 (4) 453 – 465.
- Method, K., Osunsan, O. K., Iraw, F., Wandiba, A., Abiria, P., & Innocent, B. (2019). Effect of organizational change on employee performance among selected commercial banks in Bujumbura. *Burundi East African Scholars Journal of Economics, Business and Management*, 2(4), 8 – 21.
- Mona, J. M. A. (2018). Computer Audit Programs (Software) And A New Variables Sampling Concept A Proposed Approach Empirical Study. *International Journal of Applied Engineering Research*, 13(7), 5491-5500.
- Nest, D., Smidt, L., & Hobber, D. (2017). The use of generalized audit software by internal audit functions in a developing country: a maturity level assessment. *Journal of Risk Governance and Control Financial Markets and Institutions*, 7 (4) 189 - 202.
- Octabriyantiningtyas, D., Suryani, E., & Jatmiko, A. R. (2019). Modeling customer satisfaction with the service quality of E-money in increasing profit of Pt. Telekomunikasi Indonesia. *Procedia Computer Science*, 161(2), 943-950.
- Oliver, F.L., Barry, P., & Barry, B. (2014). Outcome satisfaction in Negotiation. A

test of expectancy disconfirmation.
Journal of Organizational Behavior and
Human Decision Processes, 60 (2) 252 –
275.

Parasuraman, A., Berry, L., Leonard, L., &
Valeria, A. (2011). Understanding
customer expectations of service, Sloan
Management Review 32 (3), 39 – 48.

Sjöberg, P., & Johansson, M. (2016). Shaping the
future of the auditing profession in
Sweden: a study of the expected role of
digitalization. Digitala Vetenskapliga
Arkivet, 2(37), 1 – 16.

Unegbu A.O and Obi B.C. (2012): Auditing
Hipuks. Additional Press Uwani Enugu,
1(1), 7-
15.

Whitemore, P. (2020). Soft skills definition,
behavior model analysis, training
procedures, paper presentation.

Financial Management and Profitability of Selected Deposit Money Banks in Ogun State, Nigeria

¹Oloyede, Isaiah Abidemi & ²Atere, Akinsogo

Dept. of Accountancy

Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State

oloyedeabidemi@yahoo.com.

08092919850, 08064472005

²aterekinsogo2015@gmail.com

Phone number: 08029413415

Abstract

This study examined the financial management and profitability of selected deposit money banks in Ogun state, Nigeria. The major aim of the study was to find empirical evidence of the relationship between capital structure management and profitability, and how capital structure affects the profitability of selected deposit money banks. The study adopts an ex-post facto research design. Five (5) deposit money banks in Ogun state were selected for this study and they are Access Bank Plc, First Bank Plc, Guaranty Trust Bank, United Bank of Africa, and Zenith Bank Plc. The data used for the study were obtained from online annual financial report of the Selected banks covering a period of 2015 –2019. The data obtained were analysed using descriptive and inferential statistics. The findings of the study show that all explanatory variables show a moderate mean and acceptable standard variability. Similarly, $R^2 = 0.8799307$, $F\text{-value} = 42314.635$; $P < 0.05 = ROA$, $R^2 = 0.96714366$, $F\text{-value} = 68.24986$; $P < 0.05 = ROE$ indicates a significant positive relationship between capital structure and profitability because their proxy bank ROA and ROE showed a significant relationship with the explanatory variables. The study concluded that there is a positive significant relationship between capital structure management and profitability and that capital structure affects the profitability of the selected deposit money banks. It was recommended that management of the selected deposit money banks pay greater attention to those factors that determine their optimal capital structure and optimise the level of profitability of their core business operations and therefore, the wealth of shareholders. And that deposit money banks should develop stringent measures aimed at curtailing the problem associated with their non-performing loan, provision for loan, liquidity ratio, and inflation rate in order to improve their profits.

Keywords: Financial management, Organizational profitability, Capital structure, Deposit money banks

Introduction

Financial management practices play a vital role in the growth of organisations. The determination of profit margins and investment appraisals increase the business's performance (Butt, Rehman, & Hunjra cited in Wasonga, Omillo, Kimutai, & Omwenga, 2020). Financial management practices provide insightful information that firm owners or managers use investment decisions, compute accurate tax information and make decisions (Jindrichovska, 2013 cited in Wasonga et al., 2020).

Organisations rely on financial information generated by businesses to determine their credit-worthiness. They also use information gathered from business concerning financial management to formulate tax and economic policies for business organisations and computation of the organisation's profitability. Financial management being a critical component plays a very important and pivotal role on the overall business growth (Nthenge & Ringera, 2020). Financial management practices normally are measured using different capital structures (Yogendrarajah, Kengatharan, & Suganya, 2019). Financial management is the cornerstone in the sustainability and profitability of business including cash flow control and capital investment with proper record management in these areas. However, ineffective financial management has been singled out as one of the key causes of the myriad of underlying problems that bedevil small and medium enterprises (Jindrichovska, 2013 cited in Wasonga et al., 2020). Most of the practitioners who commence a business enterprise fail to undertake important financial matters that are very critical in the business. This is because they lack the requisite knowledge about recording financial transactions in addition to the compilation, proper analysis and interpretation of financial statements. In some instances, organisations tend to lean extensively towards other fields of business like human resource management, sales, purchases and inventory at the expense of managing finances.

A study in South Africa by Kwame (2020) states that major cause of failure in the organisation is the use of financial management practices in a careless manner. The author further shows that it does not matter if the organisation is using its internal

manager or a hired manager, if the decisions made concerning the management of finance are wrong, then most definitely the profitability of the company will be negatively affected. The other cause of lower productivity is the inefficient management of finance. Lakew and Rao (2014) cited in Akinyi, Nambuswa, & Namusonge (2020) asserts that when a manager lacks knowledge when it comes to managing the finance in an effective manner, then the profitability of the company will lower. Uncertainty of the organisation environment makes a company to depend much on equity and keep high liquidity which are some of the attributes that negatively affect the performance of an organisation.

In Nigeria, Kieu cited Akinyi et al., (2020) conducted a study on business and found out that effective practices such as financial reporting and analysis, managing of the working capital, accounting information system, managing fix assets, good planning of finance and good profitability in financial attributes like the company activities and liquidity have a significant effect on the performance of the company.

Financial management remains a key pillar for any organisation wishing to have sound perform well financially including the company. Organisations which demonstrate financial management skills in their daily operations are on the right path to better financial performance. To remain relevant in today's business environment, wise decision-making is very critical to the success of businesses. Organisations need to have effective financial management as well as information technology (IT) skills to help them in making effective financial decisions. Despite the role plays by financial management in organisations, financial mismanagement has caused a gross decline in the profitability of some organisations especially the banking sector and this has invariably results in panic as they seemingly approach distress.

Purpose of the study

This study sought to establish the relationship between financial management and profitability of deposit money banks in Ogun state, Nigeria. The specific objective was to determine the effect of each of the components of capital structure (non-performing, loans and advances, provision for loan losses, capital adequacy, liquidity ratio, interest

Financial Management and Profitability of Selected Deposit Money Banks in Ogun State, Nigeria

rate, inflation rate) on the profitability of deposit money banks.

Research hypotheses

Ho1: There is no significant relationship between non-performing loans and the profitability of deposit money banks (ROA, ROE).

Ho2: There is no significant relationship between loans and advances and the profitability of deposit money banks (ROA, ROE).

Ho3: There is no significant relationship between provision for Loan losses and the profitability of deposit money banks (ROA, ROE).

Ho4: There is no significant relationship between capital adequacy and advances and the profitability of deposit money banks (ROA, ROE).

Ho5: There is no significant relationship between liquidity ratio and the profitability of deposit money banks (ROA, ROE).

Ho6: There is no significant relationship between interest rate and advances and the profitability of deposit money banks (ROA, ROE).

Ho7: There is no significant relationship between inflation rate and advances and the profitability of deposit money banks (ROA, ROE).

Literature Review

Pecking Order Theory

The pecking order theory of capital structure as introduced by Donaldson (1961) is among the most influential theories of corporate leverage. It goes contrary to the idea of firms having a unique combination of debt and equity finance, which minimize their cost of capital. The theory suggests that when a firm is looking for ways. This theory stated that companies prefer internal financing (income, amortisation) and only in a situation when internal cash flow is insufficient for activity financing, they reach for external capital (loans, credits. e.t.c). To serve as a last resort, companies launch own external financing, for instance conducting shares issuance. Pecking Order theory tries to capture the costs of asymmetric information which states that companies prioritize their sources of financing (from internal financing to equity) according to the principle of least effort, or of least

resistance, preferring to raise equity as a financing means of last resort. Hence, internal funds is used first, and when that is exhausted, debt is issued, and when it is not sensible to issue any more debt, equity is issued.

Profitability

Profitability has been described in different ways. Hofstrand (2009) describes profitability as either Accounting Losses (Net Income) or Economic Profits. Accounting Profit offers a short-term view of business profitability, while economic losses provide a longer-term view of revenue. The profitability of a bank entails the capability to generate income that surpasses liability (Olagunju, Adeyanju, David & Oluwayinka, 2012). Potential investors are concerned with the bank dividend and the appreciation in the market price of the stock so they pay more attention to the profitability ratios. Low-profit margin would discourage the investors from investing, as such managers are interested in measuring the operating performance in terms of profitability so that effective management could be in place to build the confidence of the potential investors in order to ensure success and the survival of the banking business. Also, equity investors are more concerned with the bank's ability to generate, maintain and increase income, the stakeholders expect the banks to increase lending in order to give them maximum return on money invested while the depositors expect the banks to keep much idle cash in order to meet their demand (Ibbih, 2018).

According to Machdar Abebe, and Abera (2019), profitability is the ability to make a profit from all the business activities of an organisation, company, firm, or enterprise. It reveals how efficiently the management can make a profit by using all the resources available in the market. Nibedita (2018) postulated that profitability is the ability of a given investment to earn a return from its use, but that profitability is not synonymous with the term, efficiency, rather, profitability is an index of efficiency to guide management for greater performance. The study further argued that profitability is one of the most important objectives of financial management since one goal of financial management is to maximise the owner's wealth and profitability is a very important

determinant of performance. A business that is not profitable cannot survive. Conversely, a business that is highly profitable has the ability to reward its owners with a large return on their investment. Similarly, the study by Derbali and Jamel (2018) asserts that profitability is the ability to earn a satisfactory income. The study further avers that as a goal, profitability competes with liquidity for managerial attention for the reason that liquidity assets, although important, are not the best profit producing resources. Cash, for example, means purchasing power but a satisfactory profit can be made only if purchasing power is used to buy profit-producing (and less liquid) assets, such as inventory and long-term assets.

Bank's profitability is of vital importance to investors, stakeholders and the economy at large. The profitability of banks lies in their ability to achieve its objectives using its available resources. The available resources such as money, men, machines, capabilities, and skills need proper appraisal and evaluation which is done systematically in determining the achievements of the company's objectives (Amelia, 2002). For financial institutions like banks, the indicators of their profitability are cost-to-income ratio, return on asset (ROA), return on equity (ROE), interest rate spread etc. This is because they are the most sustainable measure of efficiency and they are also suitable in revealing how effectively and efficiently a bank utilises the total asset at its disposal. Bank profitability of an organisation does not just play a function raising the market value of that particular organisation but also direct development of the financial sector which finally leads to success of market specifically, for banking business and its function as an engine of financial development. In relation to this work, ROA and ROE are used to represent profitability.

Capital structure

An efficient capital structure management is a vital component of the success and survival of any business enterprise in terms of both profitability. For banks to grow and survive, they usually operate in a very competitive atmosphere both at a national and global level to expand their operational horizons for new investment

opportunities (Noorani & Panahi 2013). Capital structure decision is one of crucial decision since the profitability of an enterprise is directly affected by such a decision. Kajanathan (2012), Velnampy & Aloy Nireesh (2012) indicates that the successful selection and use of capital is one of the key elements of firms' financial strategy and that profitability should be re-invested into the business for its' survival (Velnampy, 2006), where, profitability is the most prominent issues in the world of corporate finance literature, and the ultimate goal for any firm is to maximise profitability. Banks also extend liquidity on demand to depositors via current accounts and loans to their customers through different forms of credit (Kashyap, Rajan, & Stein 1999). Capital structure decision is the mix of equity and debt that a firm uses to finance its business operations (Damodaran, 2001). Generally speaking, capital structure of a firm denotes its mix of Debt-Equity Ratio, i.e., how much debt and how much equity the firm uses or proportion of various other long term sources of funds used to finance a firm's investment and operating activities. The capital structure of a given firm reflects its financing decisions. The proportion of the various sources of funds depends upon their cost structure, their availability and the amount of funds required by the firm.

The objective of capital structure decisions is the judicious use of different sources of long term funds such that the overall cost of capital of the firm is optimised, thereby maximising the value of the firm and its shareholders. In other words, by capital structure decisions, firms aim at minimising their cost of capital. The capital structure at which the overall cost of capital of the firm is minimum is known as optimal capital structure. An appropriate capital structure is a critical decision for any business organisation.

Chiang Yat Hung, Chan Ping Chuen Albert & Hui Chi Man Eddie (2002) show the inter-relationship between profitability, cost of capital, and capital structure among property developers and contractors in Hong Kong. The data for the study was collected from data stream, an electronic financial database. The analysis of the study shows

that gearing is positively related to asset but negatively with profit margins.

Empirical Review

A number of studies have been conducted on financial management using capital structure as yardstick across different sectors of the economy with mix results. For instance, Ebaid (2009) analysed the impact of capital structure decision on firm performance. Data of 64 listed firms on the Egyptian stock exchange market for 1997 – 2005 period was used. Multiple regressions analysis was used and the results ranged from a weak to no impact. Also, Farhad & Aliasghar (2013) examined the relationship between capital structure and profitability using data from 252 non-financial companies in the period from 1999 to 2008 in Tehran Stock Exchange. The study found a positive association between the return on equity (ROE) and short-term debt. This suggests increasing short-term debts with low interest rate will lead to increase in profitability. Furthermore, the results revealed a negative association between ROE and long-term debt. So, when firms increase long-term debts, this results to decrease in profitability. The conclusion of the results shows a positive relationship between ROE and total debt.

Mehdi, Farimah, Forough, Seyed & Jamshid (2013) examined the relationship between the capital structure and the profitability of pharmaceutical 30 top Iranian companies in Iran. The financial data were gathered for the period of 2001-2010. The study stated that funding combination is the most important issue for the companies while they know the amount of required capital. In the study, the net margin profit and debts to asset ratio were used as indicators of profitability and capital structure, respectively and sales growth was used as a control variable. Their results showed that there was significant negative relationship between the profitability and the capital structure which means that the pharmaceutical companies have established a Pecking Order Theory and the internal financing has led to more profitability.

Chhapra & Asim (2012) measured capital structure determinants in textile industry in Pakistan for the period of 2005-2010. The results revealed that

fixed assets and leverage were negatively related; large firm size had no significant impact on leverage. Whereas, profitability also revealed that there was no significant effect on financial leverage. In addition, there was negative relationship between leverage and taxes of firms. Ramadan and Ramadan (2015) employed capital structure variables that included short-term debt to total assets, long-term debt to total assets and total debts to total assets on the performance of Jordanian firms. The study employed pooled ordinary least squares and realised a negative impact of capital structure variables on return on equity using data of seventy-two firms for the period 2005 – 2013. Furthermore, in banking industries, Goyal (2013) also investigated the impact of capital structure on profitability of public sector banks in India listed on national stock exchange during 2008 to 2012. Panel data and multiple regression models were used to find out the association between capital structure characteristics and banks performance in the context of India. The findings of study validated a strong positive dependence of short term debt to capital (STDTC) on all profitability measures (ROA, ROE and EPS). Whereas, long term debt to capital (LTDTC) & TDC having a negative relationship with return on assets (ROA), return on equity (ROE) and earnings per share (EPS). Firm size (SIZE) experienced an optimistic connection with variables (ROA, and EPS) and negative with ROE. Assets growth (AG) proposed a positive relationship with return on asset and return on equity and earnings per share.

Mendell, Sydor, and Mishra (2006) conducted a cross sectional study by using a sample of 20 forest industry firms traded on a US stock exchange for the years 1994-2003. Through regression analysis, the study found a negative relationship between profitability and debt. Muhammad Muzaffar Saeed et al (2013) analysed the impact of capital structure on performance of Pakistani banks. The study extended to empirical work on capital structure determinants of banks within country over the period of five years from 2007 to 2011 by utilising data of banks listed at Karachi stock exchange. Multiple Regression Models are applied to estimate the relationship between capital structure

and banking performance. Performance is measured by return on assets, return on equity and earnings per share. Determinants of capital structure include long term debt to capital ratio, short term debt to capital ratio and total debt to capital ratio. They found that the study validated a positive relationship between determinants of capital structure and performance of banking industry.

Umar, Zaighum, Saeed & Muhammad (2012) used data on 100 listed firms over a period of 2006–2009 and observed a significant positive association between the performance of a firm and capital structure. They used ROA, Earnings Per Share (EPS) and net profit margin as proxies to measure the performance and short-term debt obligations to total asset (STDTA), long-term debt obligations to total asset (LTDTA), and total debt obligations to total asset (TDTA) as the capital structure variables. The authors claimed, on the basis of exponential generalised least squares approach, that their findings support the trade-off theory.

Skopljak (2012), using data of Australian 15 Deposittaking Institutions (ADIs) over the period 2005 – 2007, study the effects of capital structure on performance in the financial sector in Australia, discovered a robust relationship between capital structure and firm's performance. He discovered that at relatively low levels of leverage an increase in debt leads to increased profit efficiency hence superior bank performance; at a relatively high level of leverage, increased debt leads to decreased profit efficiency as well as bank performance. The implications of this finding is that there is an optimal level of debt and that a bank can help optimize the performance of management and general bank performance by simply choosing a capital structure which optimizes managerial incentives while keeping financial distress relatively low.

Salteh, Heydar , Elham, Vahid, Taghizadeh & Mohsen. (2012) investigated the impact of capital structure on the performance of the profitability twenty-eight firms from Tehran stock exchange. The study employed data for 2005–2009 and realised positive impacts of capital structure variables such as long-term debts to total assets, short-term debt to total assets and total debt to total assets on the performance proxies of return on

equity and Tobin's Q. Al-Taani (2013) investigated the relationship between capital structure choices with the profitability of Jordanian firms. He employed data from 2005 to 2009 and realised no statistically significant association between capital structure (debt ratio) and profitability (ROA). Abor (2005) investigated the relationship between capital structure and profitability of listed firms on the Ghana Stock Exchange (GSE) during a five-year period (1998-2002). Panel data methodology and regression analysis were used in the estimation of functions relating the return on equity (ROE) with measures of capital structure. And, the finding revealed a significantly positive relation between the ratio of short-term debt to total assets and ROE. However, a negative relationship between the ratio of long-term debt to total assets and ROE was found. This implies that an increase in the long-term debt position is associated with a decrease in profitability. With regard to the relationship between total debt and return rates, the results show a significantly positive association between the ratio of total debt to total assets and return on equity.

Gill, Amarjit, Nahum Biger, & Neil Mathur, (2011) examined the effect of capital structure on profitability by examining the effect of capital structure on profitability of the American service and manufacturing firms. The study used a sample of 272 American firms listed on the New York Stock Exchange for the years (2005-2007). They applied correlations and regression analyses to estimate the functions relating to profitability that were measured by return on equity with measures of capital structure. Empirical results show a positive relationship between debt to total assets and profitability and between total debt to total assets and profitability in the service industry. Also, the findings of the study show a positive relationship between debt to total assets and profitability in the short-run, long-term debt to total assets and profitability, and between total debt to total assets and profitability in the manufacturing industry.

Noulas and Genimakis (2011) explore the capital structure assurance of firms recorded on the Athens Stock Exchange, utilising both cross-sectional and

nonparametric measurements. The initial segment of their investigation evaluates the degree to which influence relies on a more extensive arrangement of capital structure determinants, while the last gives proof that capital structure changes essentially over a progression of firm characterizations. Their outcomes archive experimental regularities as for elective proportions of obligation that are predictable with existing speculations. Especially, their outcomes bolster the hierarchy speculation. Khan (2012) studied the relationship of capital structure decisions with the firm's performance using 36 engineering firms in Pakistan listed on the KSE as sample for the period 2003 -2009 using the panel econometric technique, Pooled Ordinary Least Square regression. His findings show that financial leverage measured by short term debt to total assets (STDTA) and total debt to total assets (TDTA) has a significant negative relationship with the firm's performance measured by Return on Assets (ROA), Gross profit margin (GM) and Tobin's Q.

Methodology

This study adopts an ex-post-facto research design. Descriptive and inferential statistics were used to analyse the effect of capital structure management on deposit money banks' profitability in Ogun state, Nigeria, with inclination on five purposively selected deposit money banks which are: Access

- ROA_x = f(NLP_x LAD_x PLL_x CAQ_x LQR_x INR_x IFR_x)i
- ROE_x = f(NLP_x LAD_x PLL_x CAQ_x LQR_x INR_x IFR_x)ii
- Financial management practice = β₀ + β₁ Profitability..... iii

Where:

ROA = Return on Asset; ROE = Return on Equity; NPL= Non-performing loans; LAD = Loans and advances; PLL = Provision for Loan losses; CAQ = Capital Adequacy; LQR = Liquidity Ratio, INT=Interest rate; IFR = Inflation rate; β₀ = Constant parameter/Intercept; μ = Error Term; β₁ - β₇ = Coefficients of independent variables.

The simple regression linear form is specified below:

$$P_x = \beta_0 + \beta_1 NLP + \beta_2 LAD + \beta_3 PLL + \beta_4 CAQ + \beta_5 LQR + \beta_6 INR + \beta_7 IFR + \mu \dots \dots \dots iv$$

Bank Plc, First Bank Plc, Guaranty Trust Bank, United Bank of Africa, and Zenith Bank Plc. The data used for the study were obtained from online annual financial report of the selected deposit money banks and cover a period of of 5 years (2015 - 2019).

The secondary sources were chosen because of their credibility at producing available, sufficient, accurate, and reliable data over the primary data. Furthermore, the study made use of an econometric procedure in estimating the relationship between independent and dependent variables. The summary of statistics was carried out with the aid of the Statistical Package for Social Science (SPSS). In this study, two profitability indicators, ROA and ROE, were chosen as dependent variables. They are the measures of banks' profitability in this study. They refer to how much profit firms earn based on their asset investments, and how effectively managers use investors' funds. The independent variables are non-performing loans (NPL), loans and advances (LAD), Provision for Loan losses (PLL), capital adequacy (CAQ), liquidity ratio (LQR), interest rate (INT), inflation rate (IFR) and are the determinants of capital structure.

The functional relationship between financial management and profitability is as follows:

Empirical Findings and Discussion

Table 1: Descriptive Statistics

Variable	Mean	Standard Deviation	Min	Max
ROA	1.6242908	0.701212	0.231	4.18
ROE	20.94627	8.021377	6.721	50.842
NPL	0.957457	0.09276	0.734899	1.078158
LAD	0.863224	0.102122	0.583631	0.990158
PLL	0.153765	0.097765	0.012621	0.42149
CAQ	4.997808	0.759409	2.242006	7.067551
LQR	12.28931	4.862728	3.404455	34.24
INR	0.306056	0.142126	0.036054	0.948017
IFR	6.815344	0.610166	5.549638	7.7645

Table 1 presents the variable considered in this study. According to Table 1, the mean ROA of the sample deposit money banks is 1.6242908 which means that the sampled banks earned a return of 1.62% of total assets with the highest value of 4.18 and the lowest value of 0.23 where standard deviation, which reflects the variability involved is 0.701212. Similarly, the mean value of ROE is 20.94627 and standard deviation of 8.02 which indicates a reasonable deviation amongst the tested banks. This means that the sampled banks had a return of 20.94% of total equity with the minimum value of 6.72 and maximum of 50.84.

For the explanatory variables of interest, that is, NPL, LAD, PLL, CAQ, LQR, INT, and IFR. The observed mean of these variables are of NPL, LAD, PLL and CAQ are 0.957457, 0.863224, 0.153765 and 4.997808 respectively, and the standard deviations of 0.09276, 0.102122, 0.097765, and 0.759409 respectively, which

suggest that these banks operate with a significant level of debt, and there is also a low deviation from the mean value. Furthermore, the observed mean of LQR, INT, and IFR are 0.306056, and 6.815344 respectively with their standard deviation as 0.142126 and 0.610166 respectively. Amongst the bank specific control variables, in the case of liquidity, it was assumed that the firms with low liquidity will experience high profitability while those with high liquidity will low profitability. In this case, we observed a mean value of 12.28931 a minimum value of 3.404455 with a maximum value of 34.24 and a standard deviation of 4.862728. The average interest rate of the sample deposit money banks is observed to be 0.306056. It confirms a moderate level deviation of 0.142126, minimum value of 0.036054 and maximum value of 0.948017 respectively. Last variable, inflation rate has a mean of 6.815344 a standard deviation of 0.610166 over the period of 2014–2018.

Table 2. Pooled Regression Result showing the relationship between the independent variables and the dependent variable

Dependent Variable: ROA				
Least Square Variable	Coefficient	Std. Error	t-Statistic	Prob.
NPL	-12.6520284	5.8116432	2.3947154	0.03476
LAD	7.069535	2.3214235	2.7840736	0.00253
PLL	5.8572734	0.0308913	274.25717	0.0000
CAQ	0.2579621	0.1238061	2.2919556	0.04884
INR	0.2978459	0.1797477	1.8227297	0.12749
IFR	-0.068761	0.0565961	-1.214943	0.2651
C	-4.3559901	3.3093665	-1.4478871	0.2056
R-squared	0.8799307	Mean dependent var		35.517405
Adjusted R-squared	0.8139021	S.D. dependent var		71.931299
F-statistic	42314.635	Durbin-Watson stat		2.0658693
	0.000000			

Source: Author’s computation using SPSS.

Table 2 presents regression results showing the relationship between the independent variables and the dependent variable. It shows the results of the tested hypotheses 1-7 with respect to ROA. The value for the coefficient of non-performing loan (NPL) (i.e, β_1) is -12.6520284. This implies that holding all other factors constant, a unit increase in non-performing loan (NPL) will lead to a -12.65 decrease in return on asset, the value for the coefficient of loan and advances (LAD) (i.e β_2) is 7.069535, implying that holding all other factors constant, a unit increase in loan and advances (LAD) will lead to 7.069 increase in return on asset. The value for the coefficient for provision for loan losses (PLL) (i.e β_3) is 5.8572734, this implies that holding all other factors constant, a unit increase in provision for loan losses (PLL) will lead to a 5.85 increase in return on asset. The value for the coefficient for capital adequacy ratio (CAQ) (i.e, β_4) is 0.2579621, this implies that holding all other factors constant, a unit increase in capital adequacy ratio (CAQ) will lead to 0.257 increase in return on asset. The value for the coefficient of liquidity ratio (LQR) (i.e, β_5) is -1.7915315, this implies that holding all other factors constant, a unit increase in liquidity ratio (LQR) will lead to 1.791 decrease in return on asset.

The value for the coefficient of interest rate (INR) (i.e, β_6) is 0.2978459, this implies that holding all other factors constant, a unit increase in interest rate (INR) will lead to a 0.297 increase in return on asset. The value for the coefficient for inflation (INF) (i.e β_7) is -0.068761, this implies that holding all other factors constant, a unit increase in Inflation rate (INF) will lead to a 0.068 decrease in return on asset while the constant intercept, β_0 is -4.3559901 which is c and it represents return on asset without the explanatory variables.

R-squared (R^2) of 0.8799307 indicates the percentage of variation in return on asset explained by the explanatory variables (non-performing loans, loans and advances, provision for loan losses, capital adequacy, liquidity ratio, interest rate, and inflation rate). By implication, the Adjusted R-squared value of 0.8139021 indicates that about 81.3% of the total variation in return on asset is accounted for by the explanatory variables, while 18.7% is explained by other factors outside the model. This represent a good model fit.

The F-value (42314.635) is significant at a 0.5 level significant which shows that non-performing loan, loan and advances, provision of loan losses, capital adequacy ratio, liquidity ratio,

interest rate and inflation rate jointly influenced the profitability of deposit money banks. It can be concluded that non-performing loan, loan and advances, provision of loan losses, and capital adequacy ratio in combination significantly affect the profitability of selected deposit money banks

in Ogun state. However, a closer look at the results on the table show that non-performing loan, liquidity ratio and inflation rate have negative effect on profitability of selected deposit money banks.

Table 3. Pooled Regression Result showing the relationship between the independent variables and the dependent variable

Dependent Variable: ROE				
Least Square Variable	Coefficient	Std. Error	t-Statistic	Prob.
NPL	-0.06609	0.04108	-1.76963	0.13871
LAD	0.385999	0.068267	6.21962	0.000000
PLL	-0.02212	0.000158	-0.82967	0.5071
CAQ	0.033157	0.000635	0.273327	0.88737
LQR	0.047678	0.005273	9.945032	0.000000
INR	0.003417	0.000922	4.077292	0.00198
IFR	-0.01146	0.00029	-1.75266	0.14245
C	-0.07132	0.016969	-4.62335	0.00066
R-squared	0.96714366	Mean dependent var		0.022955
Adjusted R-squared	0.95155611	S.D. dependent var		0.015099
F-statistic	68.24986	Durbin-Watson stat		2.055198
	0.000000			

Source: Author’s computation using SPSS.

Table 3 presents regression results showing the relationship between the independent variables and the dependent variable. It shows the results of the tested hypotheses 1-7 with respect to ROE. The value for the coefficient for the non-performing loan (NPL) (i.e, β_1) is -0.06609. This implies that holding all other factors constant, a unit increase in non-performing loan (NPL) will lead to 6.60% decrease in return on equity (ROE), the value for the coefficient of loan and advances (LAD) (i.e, β_2) is 0.385999, this implies that holding all other factors constant, a unit increase in loan and advances (LAD) will lead to 38.59% increase in return on equity (ROE). The value for the coefficient for provision for loan losses (PLL) (i.e, β_3) is -0.02212, this implies that holding all other factors constant, a unit increase in provision for loan losses (PLL) will lead to 2.21% decrease in return on equity (ROE), the value for the coefficient of capital adequacy ratio (CAQ) (i.e, β_4) is 0.033157, this implies that holding all other

factors constant, a unit increase in capital adequacy ratio (CAQ) will lead to a 3.31% increase in return on equity (ROE). The value for the coefficient for liquidity ratio (LQR) (i.e β_5) is 0.047678, this implies that holding all other factors constant, a unit increase in liquidity ratio (LQR) will lead to a 4.76 increase in return on equity (ROE).

The value for the coefficient for interest rate (INR) (i.e, β_6) is 0.003417, this implies that holding all other factors constant, a unit increase in interest rate (INR) will lead to 0.34% increase in return on equity (ROE). The value for the coefficient for inflation (INF) (i.e. β_7) is -0.01146, this implies that holding all other factors constant, a unit increase in Inflation (INF) will lead to a 1.14 decrease in return on equity (ROE) while the constant intercept, β_0 is -0.071 which is c and it represents the return on asset (ROA) without the explanatory variables. R-squared (R^2) of 0.96714366 indicates the percentage variation in return on asset (ROE) explained by the explanatory

variables (It can be concluded that non-performing loan, loan and advances, provision of loan losses, and capital adequacy ratio in combination significantly affect the profitability of selected deposit money banks in Ogun state. However, a closer look at the results on the table show that non-performing loan, liquidity ratio and inflation rate have negative effect on profitability of selected deposit money banks.). This implies that given the adjusted R-squared value of 0.95155611, the combine explanatory variables accounted for about 95.1% of total variation in return on equity (ROE) while 4.9% is explained by other factors outside the model. An indication of strong model fit.

The F-value (68.24986) is significant at a 0.5 level of significance suggests that all the explanatory variables jointly influenced the dependent (ROE). Therefore, it can be inferred that non-performance loan, loan and advances, provision for loan losses, capital adequacy ratio, liquidity ratio and interest rate significantly influenced the profitability of the selected deposit money banks in Ogun state. However, the result show that non-performing loan, provision for loan losses and inflation rate reduces return on equity. This implies that the three dimensions of capital structure reduce the profitability of the selected deposit money banks in Ogun state.

The findings of this study indicate that efficient financial management practices have effects on the profitability of selected money banks in Ogun state, Nigeria. The research used some relevant measures of capital management structure to assess the profitability of deposit money banks.

The regression coefficient revealed a significant correlation between non-performing loans (NPL), loans and advances (LAD), provision for loan losses (PLL), capital adequacy (CAQ), liquidity ratio (LQR), interest rate (INT), inflation rate (IFR) and bank profitability measured by return on assets (ROA) and return on equity (ROE). However, the results of the study revealed that non-performing loan (NPL), liquidity ratio (LQR) and inflation (INF) lead to decrease in return on equity (ROE). This implies that those factors have negative effects on the profitability of selected deposit money banks within the period under investigation.

Conclusion and Recommendations

This study focused on the capital structure and profitability of listed deposit money banks in Nigeria with the aim of ascertaining the relationship between the capital structure and profitability of those selected deposit money banks. The findings of this study show that there is positive significant relationship between capital structure management and profitability and that capital structure affects the profitability of selected deposit money banks in Ogun state. However, non-performing loan, liquidity ratio and have negative influence on the ROA and ROE, hence the profitability of the banks. Therefore, there is a need for these banks to improve on their non-performing loan, liquidity ratio and inflation so that they can as well contribute positively and significantly to the overall profitability of banks.

In line with the findings of this study, the following recommendations were made: Deposit money bank managers should seriously prioritise the implementation of efficient capital structure practices and observing robust and effective funding decisions when formulating the organisation's strategies. Also, management of the selected deposit money banks pay greater attention to those factors that determine their optimal capital structure and optimise the level of profitability of their core business operations and therefore, the wealth of shareholders. Furthermore, banks management should give due consideration to reduce their debts in a way that reduce its negative impact on profitability of core business operations, and increase loan advances keeping the profitability of their loan portfolio in line with prescribed objectives and hence generate more interest income from loan advances.

An appropriate mix of capital structure should be adopted in order to increase the profitability of banks. The top management of every banking firm should make prudent financial decisions in order to remain profitable and competitive

Similarly, banks should focus critically on loans and advances by developing strategies and observing monetary policies and framework that will curtail the problem of non-performing loan, provision for loan losses, liquidity ratio, and inflation rate.

Moreover, deposit money banks should develop stringent measures aimed at curtailing the problem associated with their non-performing loan, provision for loan, liquidity ratio, and inflation rate in order to improve their profits.

Finally, banks should incorporate the risk of inflation (in terms of purchasing power) in their operational activities to enable them to make returns.

References

- Abebe, A. K., & Abera, M. T. (2019). Determinants of financial performance; Evidence from Ethiopia insurance companies. *Journal of Accounting, Finance, and Auditing Studies*, 5 (1), 155-172.
- Abor, J. (2005). The effect of capital structure on profitability: an empirical analysis of listed firms in Ghana. *The Journal of Risk Finance*, 6(5), 438 - 445.
- Ahmad, T. (2014). Impact of Capital Structure on Profitability: An Empirical. *Research Journal of Finance and Accounting*.
- Akinyi, F. O., Nambuswa, E., Namusonge, G. (2020). Effect of financial management practices on savings and credit cooperative societies performance in Kisumu County, Kenya. *International Journal of Recent Research in Commerce Economics and Management (IJRRCEM)*, 7(3), (36-58).
- Altaani, K. 2013. The relationship between capital structure and firm performance, evidence from Jordan, *Journal of Finance and Accounting*, 1(3): 41 – 45.
- Amelia, M. R. (2012). Effect of firm characteristics, financial performance and environmental performance on corporate social responsibility disclosure intensity on manufacturing firm listed in the Indonesia Stock Exchange. *Journal of money, credit and banking*. 20(34), 56-67.
- Chetty, S., Naidoo, R., & Seetharam, Y. (2020). *The impact of corporate social responsibility on firms' financial performance in South Africa*.
- Derbali, A., & Jamel, L. (2018). Determinants of performance of Tunisia insurance companies: Case of life insurance. *Journal of Business and Insurance*, 2 (1), 25-39.
- Damodaran, A. 2001. *Corporate finance, theory and practice*. 2nd Edition. Wiley.
- Donaldson, G. (1961). Corporate debt capacity: a study of corporate debt policy and the determination of corporate debt capacity. Harvard Business School, Boston.
- Ebaid, E. I. (2009). The impact of capital structure choice on firm performance: Empirical evidence from Egypt. *The Journal of Risk Finance*, 10(5), 477–487.
- Farhad, A., & Aliasghar, A. (2013). The Relationship between Capital Structure and Profitability (Case Study in Tehran Stock Exchange). *Technical Journal of Engineering and Applied Sciences*, 3(16).
- Gill, Amarjit, Nahum Biger, Neil Mathur, (2011). The effect of capital structure on profitability: Evidence from the United States. *International Journal of Management*, Vol. 28, No. 4, Part 1, pp. 3-15.
- Goyal, A. (2013). The impact of capital structure on Performance of Listed Public Sector Banks in India. *International Journal of Business and Management Invention*, 2(10), 35-43.
- Hofstrand, D. (2009). Understanding profitability. Iowa State University, 24, 1-5.
- Ibbih, J. (2018). Relationship between liquidity and profitability in commercial banks in Africa. *International Journal of Advanced Research*, 3(2): 95-112.

Kajananthan R (2012). Effect of Corporate Governance on Capital Structure, Case of the Sri Lankan Listed Manufacturing Companies: Journal of. Arts, Science & Commerce, Vol. 3 No. (4) pp: 63-71.

Kashyap, A. K., Rajan, R. & Stein, J. C. 1999. *Banks as liquidity providers: an explanation for the co-existence of lending and deposit-taking*. NBER Working papers series, 6962. NBER.

Khan A.G. (2012). The Relationship of capital structure decision with firm performance: A study of the engineering sector of Pakistan”, International Journal of Accounting and Financial Reporting, 2, (1) 305-360.

Mehdi, M., Farimah, R., Forough, R., Seyed M.A & Jamshid, S. (2013). The Effect of Capital Structure on the Profitability of Pharmaceutical Companies. The Case of Iran School of Pharmacy, Shahid Beheshti University of Medical Sciences, Tehran, Iran. Tarbiat Modares University, Management, Tehran, Iran. Faculty of Pharmacy, Tehran University of Medical Sciences, Tehran, Iran.

Mendell, B.C., Sydor, T., & Mishra, N., 2006. Capital structure in the United States forest products industry: The influence of debt and taxes. *Forest Science*, 52(5), pp. 540-548.

Muhammad, M.S, Ammar, A.G, Muhammad, Y.R & Muhammad M.S. Impact of Capital Structure on Banking Performance (A Case Study of Pakistan).

Noorani, B. & Panahi, D. 2013. *The relationship between financial ratios and stock returns of different non-smoothers and smoothing companies*. Financial Research, 24.

Noulas, A., & Genimakis, G. (2011). The determinants of capital structure choice: Evidence

from Greek listed companies. *Applied Financial Economics*, 21(6), 379-387. Available at: <https://doi.org/10.1080/09603107.2010.532108>.

Nthenge, D. M., & Ringera, J. (2020). Effects of financial management practices on financial performance of SMEs. *American Based Research Journal*, 6-32.

Olagunju, A., Adeyanju, O., David, O. & Oluwayinka, S. (2012). Liquidity management and commercial banks' profitability in Nigeria. *Research Journal of Finance and Accounting*, 2(8): 24-38

Salteh, H.M, Elham, G., Vahid, T.K & Mohsen A.K. 2012. Capital structure and firm performance: Evidence from Tehran stock exchange. *International Proceedings of Economics Development & Research* 43: 225–30.

Skopljak, V. (2012), “Capital Structure and firm performance in financial sector: evidence from Australia,” *Asian Journal of Finance and Accounting* 4, (1). 278 -298.

Ukaegbu, B. (2019). The significance of working capital management in determining firm profitability: Evidence from developing economies in Africa. *Research in International Business and Finance*, 31, 1-16.

Velnampy.T,(2006), An Empirical study on Application of Altman Original Bankruptcy Forecasting Model in Sri Lankan Companies, *Journal of Management*, Sai Ram Institute of Management, Sai Ram Engineering College, India

Velnampy. T. and Aloy Niresh. J. (2012), Corporate governance and performance. *Global Journal of Management and Business Research*, 12(13) 66-73.

Financial Management and Profitability of Selected Deposit Money Banks in Ogun State, Nigeria

Wasonga, O. W., Omillo, F.O., Kimutai, G., & Omwenga, M. O. (2020). Effect of financial management practices on the growth of selected small and medium enterprises in Eldoret town. *International Research Journal of Accounting and Taxation (ITJAT)*, 1(1), 001-015.

Yogendrarajah, R., Kengatharan, L., Suganya, J. (2019). Financial management practices on the performance of SMEs in Sri Lanka: Evidence from Jaffna District. *International conference of contemporary management*, (pp. 61- 74). Jaffna.

Effect of Cloud-Based Accounting On Manufacturing Firms in Nigeria A study of Twinstar Industries Ltd., Ogun State

*¹Obasan, Olabowale Taiwo ²Kuola, Aanu Joseph

¹Department of Accountancy
Abraham Adesanya Polytechnic,
Ijebu-Igbo, Ogun State, Nigeria.

*Pemisire0703@gmail.com

+2348034411824

²Internal Audit Department
Abraham Adesanya Polytechnic,
Ijebu-Igbo, Ogun State, Nigeria.

Abstract

The study examined the effect of Cloud-Based Accounting on Manufacturing firms in Nigeria, a study of Twinstar Industries Ltd., Ogun State. The aim of the study is to ascertain the effect of Cloud-Based Accounting on manufacturing firm policies and operations and to examine the effect of Information Technology on the performance of Manufacturing firms in Nigeria. The survey was conducted in a manufacturing firm in Ogun state, Nigeria with an approximate total of 261 staff. A total of 261 questionnaires were distributed to the staff of Twinstar Industries Limited, Ogun state. Two-hundred and twenty-nine were retrieved representing 87.7% response rate. The dataset was analyzed using the Analysis of Variance statistics. The study concluded that immediate information access helps to get a clear picture of how your business is doing, and also to prepare for the market's future demands. It showed that Cloud-Based Accounting has significant impact on manufacturing firm policies and operations. It was recommended that there should be insights into the policymakers to better understand and enable them to implement suitable strategies to minimise potential damaging factors and improve current trends in their development.

Keywords: Cloud, Cloud Accounting, Productivity Improvement, Firm Policies and Operations

Introduction

Nigeria being a giant of Africa, blessed with numerous natural resources has industries dealing with different kinds of manufactured products. Manufacturing industries are businesses that use raw materials, parts, and components to assemble finished goods. Manufacturing industries are those that engage in the transformation of goods, materials or substances into new products. The transformational process can be physical, chemical or mechanical. Manufacturers often have plants, mills or factories that produce goods for public consumption (Walter, 2018). Productivity improvement has a crucial role in raising GDP per capita. Firms adapting and using IT can improve the production process and labour productivity. IT is a key driver of productivity and pioneer to accelerate the industry in economic growth. ICT is a General-Purpose Technology (GPT) that has a wide range of effects throughout the entire economy, reshaping the whole systems of production and distribution (the information technology and innovation foundation, 2014).

IT diffuses throughout the economy; they engender extensive spillovers in the forms of externalities and technological complementarities, and their evolution and diffusion span for decades (the information technology and innovation foundation, 2014). Moreover, GPTs undergo rapid price declines and performance improvements and become pervasive as an integral part of most industries, products and functions. They enable downstream innovations in products, processes, business models and business organization (Satapathy and Mishra 2013).

Cloud computing is a new model of computation that can bring significant benefits to consumers, businesses and government, creating new threats and challenges. "In the cloud" data processing came to be called a model of the IT systems in which the server installation location does not matter. "Cloud computing" model can be simply defined as the storage, processing and use of data to be accessed over the Internet, on a different location computer. This means that users can request to have almost unlimited computing power that do not require significant capital investment in order to meet their needs and that they can access their data from any location

where they are connected to the Internet (Elzbieta & Dorota, 2015).

A firm is as good as the structure of the fundamentals of its environment. The effect of the manufacturing sector as the key driver for important economic growth cannot be over emphasized. This relationship is characterized by the fact that a group of sound firms will build-up a healthy economy. Therefore, the management of an organization must make a concerted effort in the emergence, and continuous improvement in the firm policies and operations in order to improve the financial performance of their firm (Abidde, 2021).

The Internet is the basis for the whole economy in a growing part of the world. ICT contributed to 40% of overall productivity growth in the economy in 1994-2004. The network effect enables acceleration and global diffusion of innovation. Subsequent changes in the economy, as well as in the lives of the citizens were remarkable. The variety and multitude of applications and business models supported by the Internet also largely affects its nature and structure (Internet traffic increases by 60% per year). We could say that the Internet infrastructure has become mature and exhausted its innovation and growth potential. We are at the beginning of a new phase of the Internet, which will drive innovation and growth. However, you have to think about what to do to unleash this potential, which is even more necessary in times of economic downturn. To get out of the economic crisis, we need to encourage stable and sustainable growth of business in the goods and services that respond to the real needs of the market with high value. Europe needs to make full use of the economic potential of a single market, which is still locked in fragmented national markets. Internet-based services should be used primarily, because their nature has a cross-border dimension (Reding, 2009).

Accounting information is very important for the planning, controlling and making of both short and long term decisions in manufacturing companies. For smaller companies, traditional method is used effectively at a high cost. But this is not the case for larger companies with large information base, encumbering the accounting system. Cloud computer based accounting has been a very useful tool in this regard, enabling performance appraisal of listed

Effect of Cloud-Based Accounting On Manufacturing Firms in Nigeria A study of Twinstar Industries Ltd., Ogun State

manufacturing companies, so as to increase stakeholder's confidence in the organization and encourage them in investing more in the organization. In order for an organization to appraise

its performance, it needs some important information that must be timely, accurate and useful to the users. The information must allow for quick comparison between current and previous years' data, offer financial statement for use by both managers and stakeholders etc. Hence, the need for cloud based accounting system to enhance accuracy, speed and cost minimization which will ultimately lead to profit maximization (Abidde, 2021).

Accounting having advanced reliably over the previous decades, with each new expansion and development making it shockingly better and testing while at the same time giving fulfilment and accommodation to the users, current accounting has arrived at the current stage in the wake of experiencing slow changes throughout the years; by staying up with the quick developing innovative headways (Owolabi & Izang, 2020). Therefore, the study focuses on effect of Cloud-based accounting on manufacturing firms in Nigeria.

Statement of the Problem

Lately, powerless inside control and fake exercises among others that are obvious inside organizations has prompted a temperamental accounting related detailing proclamation to its clients. Accounting information quality in Nigeria stays powerless contrasted with many propelled locales. This brought about hampering of the development of effective value markets. A typical grievance among speculators in Nigeria is that financial information on organization execution is either inaccessible or, whenever gave, needs dependability (Shehu, 2011). The Nigerian settings as far as accounting announcing characteristics, structure, and corporate administration are relied upon to appear as something else and better as far as headway and consistence (Shehu and Ahmad, 2013).

Past studies carried out have recommended cloud accounting as one of the ways for curbing such irregularities in the accounting system. Perminov and Egorova (2005) have found that the growth rates in ICT-producing and ICT-using industries are much higher than non-ICT

industries in Russia, though an essential delay of ICT spreading still takes place in Russia compared with developed countries. Some studies have focused on the intensity of using IT in industries. They believe that the impact of IT is related to its intensity in industries, so that the productivity growth is higher in industries using IT than the other industries. These trending technologies are being used by large scale enterprises. This study seeks to investigate effects of cloud-based accounting on manufacturing firms in Nigeria.

The following are the objective aimed to achieve at the end of this study;

1. To ascertain the effects of Cloud-Based Accounting on manufacturing firm policies and operations.
2. To examine the effects of Information Technology on the performance of Manufacturing firms in Nigeria.

The following are the research questions to be answered at the end of this study;

1. To what extent does Cloud-Based Accounting impact manufacturing firm policies and operations?
2. What is the relationship between Information Technology and the performance of manufacturing firms in Nigeria?

The tentative statements formulated to be tested in the course of this study are stated below;

H0₁: Cloud-Based Accounting does not impact manufacturing firm policies and operations.

H0₂: There is no relationship between Information Technology and the performance of manufacturing firms in Nigeria.

2.0 REVIEW OF RELATED LITERATURE

Conceptual Review

Concepts of Cloud Based Accounting

António, Fernando & Raquel (2016) "reflected on the role of Business Process Management and associated technologies on supporting/evolving current Accounting Information Systems. Although traditional Accounting Information Systems fulfil the need for financial reporting, collecting data from central databases and consolidating it, so that the information can be easily consumed by decision makers, they were not created bearing in mind the idea of performing business process-oriented accounting". "Organizations have always worked in a business process-

oriented way either implicit or explicit. Business Process Management adoption as a management practice has been gaining popularity in recent years, making sense evolution of Accounting Information Systems towards a business process-oriented accounting supported on a Business Process Management Suite”, (António, Fernando, & Raquel, 2016). Still in their submission, “the benefits of this evolution include, among others, the flexibility and agility in business process redefinition, the empowerment of knowledge workers, the implementation of control points for data collection to produce real-time reports and alerts relating the use of financial and non-financial information, so that decision-makers can act on”, (António, Fernando, & Raquel, 2016).

Buttelt (2010) sees “cloud computing as a means of “moving your computer applications and programs from the office desktop to the internet”.

Khanom, (2017) reviewed a theoretical perspective of cloud “practice of accounting to have been improved significantly by the emergence of accounting software using the cloud technology, which is one of the tremendous IT innovations over the last decade”. He sees that “today the ever-changing business world is becoming more and more competitive and sophisticated with the advancement of cloud technology. Like other sectors of business, accounting has also embraced cloud computing solutions in order to provide relevant and particular information as

well as a real-time overview of business for all stakeholders”. To him, “although cloud accounting is becoming more and more common day-by-day, many business owners and professionals are not quite sure about what it is, what its benefits are or how it will shape future accounting”, (Khanom, 2017).

Accountants will be more focused on benefits such as data protection, privacy and reliability of data, when using cloud accounting. There have been doubts about using cloud computing for accounting as a repository of critical data in an organization as depicted by Gill (2011). Still cloud-based accounting has been always supported as an enhancement to information flow within an organization.

Concept of Cloud

There is not a unified definition of cloud computing until now, as it is a metaphor for the internet. In the cloud computing all the resources are arranged together in the cloud storage center, where users can enjoy unlimited resources and computing power as long as they use a terminal to attach the internet. The concept of ‘cloud accounting’ was first put forward by Ping and Xuefeng (2011). Cloud accounting has been defined by them as the utilization of cloud computing in internet to build a virtual accounting information system, i.e.; cloud computing plus accounting equals cloud accounting.[Zhang and Gu, 2013]

All cloud services are provided “as a service” and are offered in three forms- SaaS, PaaS and IaaS(Fig.2).

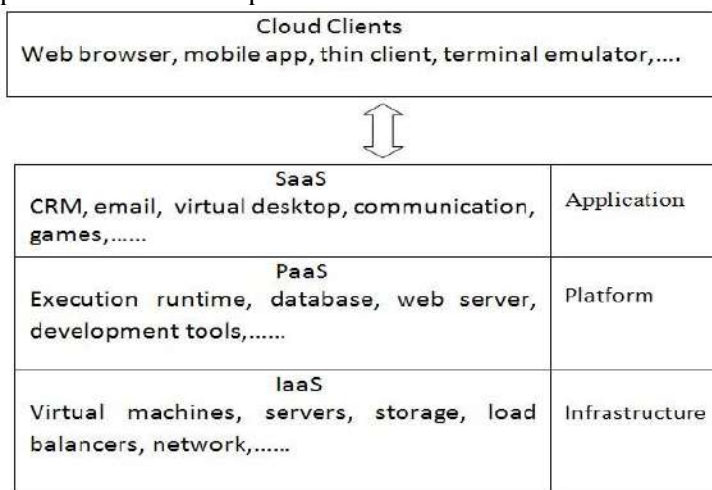


Figure 1: presentation of cloud services types

SaaS (Software as-a-Service): The software deployment model, which is the highest form of services that deliver special purpose software to the consumer to use the provider's applications running on a cloud infrastructure through the internet is referred to as Software as-a-Service. It is sometimes referred to as "ondemand software" and is usually priced on a pay-per-use basis. This eliminates the need to install and run the application on the cloud user's own computers, which simplifies maintenance and support. SaaS providers generally price applications using a subscription fee. The main drawback of SaaS is that the users' data are stored on the cloud provider's server.

PaaS (Platform as-a-service): The software deployment model whereby a computing platform is provided as an on-demand service upon which applications can be developed and deployed is referred to as platform as-a-service. It is built on the top of IaaS and joins with software as a service (SaaS) and infrastructure as a service (IaaS), where application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers.

IaaS (Infrastructure as-a-Service): The software deployment model where the basic computing infrastructure of server, software, and network equipment's are provided as an on-demand service upon which a platform can be developed and execution of applications can be established is referred to as Infrastructure as-a-Service. Its main purpose is to avoid purchasing, housing, and managing the basic hardware and software infrastructure components, and instead obtain those resources as virtualized objects controllable via a service interface.

There are four types of deployment models of cloud technology

Private Cloud: The cloud infrastructure that is managed and operated for one organization only, so that a consistent level of control over security, privacy, and governance can be maintained is called private cloud. It is also known as Internal Cloud or on-premises Cloud. It may be managed by the organization or a third party and may exist on premise or off premise.

Public Cloud: The cloud infrastructure that is made available to the general public or a large

industry group and is owned by an organization selling cloud services is called public cloud. It is also known as external cloud or multitenant cloud.

Community Cloud: The infrastructure which is referred to as special purpose cloud computing environments shared and managed by a number of related organizations participating in a common domain or vertical market is called community cloud. It may be managed by the organizations or a third party and may exist on premise or off premise.

Hybrid Cloud: The cloud infrastructures that is composition of two or more distinct cloud infrastructure (private, community or public) but are bound together by standardized technology that enable data and application portability is called hybrid cloud. It provides benefits of multiple deployment (Mohammadi and Mohammadi, 2014).

Reasons For Using Cloud Services

There are a number of reasons that influence a company to use cloud services. These are:

1. **Maintaining Focus on the Business:** Businesses are realizing that running an IT department is not their core competency, they are better lawyers, doctors or plumbers. Buying cloud services, either in the form of a single application or their entire data center is often more cost effective, more reliable and lets them reallocate their limited resources to growing their business.
2. **Business Agility:** Businesses with significant technology investments can find themselves unable to take advantage of shifts in the market or respond to competitive pressures because the capital, people or time are not available in the measure needed to react. Cloud services remove these barriers, allowing businesses to continually adapt their technology needs to their business without the costs that would normally have to be considered with an onsite datacenter.
3. **Reduced Capital Expenditures:** Large capital investments can be minimized or eliminated altogether in favor of small monthly payments. Capital can be protected as keeping capital and operational expenses to a minimum can be very important to small and medium businesses alike.
4. **Scale:** Businesses that have peak seasons or different seasonal staffing demands can benefit from cloud services by letting them temporarily

dial up more capacity for the seasonal business peaks, without purchasing the hardware or software that would otherwise go unused during the slower times of the year.

5. **Access from Anywhere:** Being able to do business without borders is one of the major benefits of cloud services. Access to the applications and data is available to authorized users anywhere there is Internet access.
6. **Staffing Efficiency:** Cloud services can help maintain an efficient technology staff, outsourcing key technical specializations or technology staff as it makes sense for the business.

Importance Of Cloud Technology In Accounting

Cloud accounting can be advantageous in many ways in today's business world, which may be summarized as:

Less costs

One of the first areas where cloud accounting outscored traditional accounting is the cost. With a cloud-based system, businesses do not make a lump-sum purchase of a program, or buy and set up a server to host it. This minimizes IT professional fees and helps to avoid installation fees altogether. As accounting rules and tax regulations change, one won't have to purchase and install updates. Instead, the monthly or annual subscription cost includes the updating cost, and these are completed by the provider as needed [paychex.com, May 05, 2017].

Real-Time Information Updating

One of the common problems with traditional accounting systems involved updating accounting information. When one figure needed to be changed, it meant manually recording the change in each location where the figure appeared, including forms, ledgers, and other documents. With cloud accounting, when new data is entered, it populates each location where it is required. This saves time, money, and potential headaches that could arise if any locations are missed [paychex.com, May 05, 2017].

24/7 Accessibility to All Accounting Information

With traditional accounting, access to the business's detailed financial information was limited by when the accounting professional was available, or when one could get to the

office to review the paper-based records or even the desktop computer holding the information. Cloud computing outweighs conventional method in this regard. As long as one has internet access, his/her accounting records are as close as the mobile device. [paychex.com, May 05, 2017]

Security of Financial Information

Cloud accounting is also important, because it keeps all financial information secured. A person may think- by storing on one desktop, will keep the data safe, but this is likely to cause problems in the long run.

Team-Wide Availability

Cloud accounting benefits entire business teams because the data is available to all authorized users at all times. It is easily scalable. Adding new users is simple—just by setting up an authorized profile and password. Even better, it makes collaboration easier.

Immediate Fixes

During the previous paper-based systems, if there were any problems with the program, users were required to wait patiently for the next version for the bugs to be fixed. Among the benefits of cloud accounting, fixing software issues immediately is among the most important.

Allows for Better Cost Efficiency in the Workplace

No matter how professional or efficient a business is, there is always room for improvement. Whether seeking ways to better stay in touch with the customers, or trying to keep the business more secure, cloud accounting helps with some of the drawbacks that come with owning a business. For example, many business tools have to be paid for in full. One of the best things about cloud accounting, however, is that one can enjoy the benefit of 'pay as you go'. A monthly plan can even be set up, and it is a great way to compensate if someone on a tight budget.

Automatic Data Back Up and Restoration

Another area where cloud accounting trumps traditional accounting is when it comes to automatic data back up and restoration. It was not that long ago that daily, weekly, and/or monthly data backup had to be scheduled into the workweek. And then someone had to manually backup the recent accounting information. Cloud accounting allows

automatic data backup, removing the possibility of forgetting to do it, and reducing the opportunity to make human errors. Instead, accounting information is backed up automatically and saved to an offsite location. This helps secure the information in the event of a break-in, fire, or other incident that could put sensitive and important information at risk. And should the business experience one of these incidences, the cloud-based service provider can help to restore the data, getting the business back up and running quickly to minimize the impact and inconvenience to the customers.

Positivity of Cloud-Based Accounting on Manufacturing Firms

According to Abdullah (2017) who reviewed the theoretical literature that talked about cloud computing, information technology, accounting information systems and how it affects business organizations, it has been confirmed that cloud based accounting has multiple effects which are presented as follows:

a) Accounting Entity

The meaning of accounting unit is that the entity has its own personality dependent from its owners. Cloud accounting means they are dealing with an entity with its own rules and not with individuals. The cloud system helps accomplishing a variety of jobs including accounting, management, and helps employees and stakeholders access to applications through computers and cellular devices (Lobana, 2013).

b) Financial Transactions

These operations are reflected for all activities of internal and external events of the entity of a financial nature. As shown in Lobana (2013), cloud based accounting will enable the organization to provide service in a timely manner.

c) Financial Documents

By definition of (Kassem, 2012), the financial documents are documents that contain a set of basic and important financial data of the registration process of accounting. The overall objective of the document is to contain important data which can be dispensed in cloud computing because it ensures self-service to the customer. This means that the customer can ask for what they want as products through resources provided by cloud computing over

the internet by using the established system applications.

These applications are stored within the cloud (Office of the Privacy Commissioner of Canada, *d) Accounting Books*

They are used regularly as e-accounting books, for example, to record all daily operations of the facility (Jordanian Trade Act, 1966, Article 16). This means that the financial statements of these transactions in the form of accounting entries associated with the accounts are affected by the financial process recording. The use of cloud computing is similar to an electronic system that dispenses accounting books because cloud computing applications provided by Software as a Services (SAAS) (Mell and Grance, 2011) that allows the registration of all financial data entry bonds and bills of exchange and capture other applications that allow perform specific functions or processes (Chan et. al, 2012).

e) Financial Reporting

The final product is the financial reporting system of accounting information and these reports are the means by which information is communicated to users. It has been shown by Ebenezer et. al. (2014) that cloud computing can still be applied successfully for accounting purposes.

f) Procedures

The actions of all the steps involved in the conduct of the transactions and processing of financial operations and reporting of the data (Abdullah et al., 1990). Thus, the customer can see the products offered through the provision of special applications from which to choose the products they want and submit sales orders.

g) Users

Kassem (2012) explains that they are the ones who are dialoguing with the system through terminals by Application Software. According to Lobana (2013) cloud based accounting allows employees such as accountants Connects to the central information-sharing resources throughout the facility.

h) Software and hardware or physical components

It was stated formerly that the software are all the programs that enable an individual to use the computer to perform multiple tasks and accomplish a given work. (Laberta, 2011). And that physical devices or hardware are all the

physical components of the computer and its related devices. (Laberta, 2011).

Theoretical Review

System theory

System theory expresses that organizations ought to be treated as an open framework that changes contributions to yields inside the conditions (outside and interior) whereupon they are reliant (Miller and Rice 1967). System theory is the premise of the info procedure yield result model of overseeing execution, which evaluates the whole commitment that an individual makes inside the framework in doing their assigned activities, not simply the yields. Data sources contain the skills and information that an individual brings to a vocation. Aptitudes and information are estimated to survey improvement and adapting needs of workers. This theory will be adopted in this work because organization relies upon the globe for its data sources, yet for the acknowledgment of yields. Thusly, they should create implies for adapting to natural requests. Basically, there is no way a company will survive without its interaction with its internal and external environment especially when it comes to adopting new technologies like cloud accounting.

Innovation Diffusion Theory

Innovation Diffusion Theory's primary intention is to provide an account of the manner in which any technological innovation moves from the stage of invention to widespread use (or not). Though not concerned with information technology exclusively, diffusion theory offers a conceptual framework for discussing acceptance at a global level. Diffusion theory speculates five characteristics of innovations that affect their diffusion: relative advantage (the extent to which a technology offers improvements over currently available tools), compatibility (its consistency with social practices and norms among its users), complexity (its ease of use or learning), trialability (the opportunity to try an innovation before committing to use it), and observability (the extent to which the technology's outputs and its gains are clear to see). Each of these characteristics on its own is insufficient to predict either the extent or the rate of diffusion, but studies have demonstrated that innovations

giving advantages like compatibility with existing practices and beliefs, low complexity, potential trialability, and observability, will be more extensively and rapidly diffused than an innovation with the cluster of opposite characteristics (Dillon & Morris, 1996). Innovation diffusion theory suggests that factors at the level of the individual user are also important. Early studies have divided technology or innovation adopters into five categories depending on their speed of uptake: innovators, early adopters, early majority, late majority, and laggards (cited in Dillon & Morris, 1996).

Empirical Review

Mugenyi (2018) explored on the reception of Cloud Computing Services by Commercial Banks in Uganda for Sustainable Development. The investigation found that business banks in Uganda are consistently expanding in number of branches, sizes and operational exercises over the most recent two decades. This augmentation has pulled in high operational costs identified with buy and upkeep of IT framework and in any event, requiring bigger spaces to oblige them, which is constantly joined by helpless information stockpiling and the board. Cloud computing proffer the best and most recent answer for check the issues distinguished in the business banks, as featured in this examination if and when embraced. Haslinda, Mohd and, Norhaiza (2017) researched on Cloud Computing Adoption in Organizations. The examination surved writing on distributed computing appropriation in associations to distinguish its compelling components and its operationalisation in earlier writing. The scientists arrange the variables that impact the distributed computing reception utilizing the three settings recommended by the Technology Organization-Environment (TOE) system, to be specific, innovation, association, and condition. The finding from the examination recommends that the impacts of these elements differ across studies and a large portion of the investigations have operationalised distributed computing appropriation utilizing aim to embrace distributed computing or double factor, as opposed to the real utilization of the innovation.

3.0 METHODOLOGY

Effect of Cloud-Based Accounting On Manufacturing Firms in Nigeria A study of Twinstar Industries Ltd., Ogun State

The research seeks to know the effect of cloud based accounting on manufacturing firms in Nigeria, covering the activities of Twinstar Industries Ltd., as a manufacturing firm situated in Ogun State. The structure of the process and procedure is descriptive and this is under the survey research design. The total population of the study is 261. However, the population was restricted to the various units/departments in Twinstar Industries Ltd, Ogun State. The questionnaire was well-structured which is made up of ten (10) close-ended questions with five (5) Likert scale response (Strongly Agreed,

Agreed, Undecided, Strongly Disagreed and Disagreed). The Analysis of Variance (ANOVA) statistical method was employed to analyze the data collected at 5% level of Significance.

4.0 RESULTS

A total of 261 copies of the questionnaire were issued by the researcher to the staff of Twinstar Industries Ltd. in Ogun State, out of which 229 representing 87.7% were attended to and returned, which were used for analysis.

Interpretation of data

Table 1: Questionnaire summary

S/N	Questions/Variables	SA	Agrd	Undcd.	SD	Dsgrd
1.	Twinstar Industries Ltd. is more satisfied with the services of Cloud based accounting.	110	72	5	27	15
2.	There are many challenges encountered when accounts are prepared manually which do not exist in the use of cloud based accounting	122	65	7	25	10
3.	Cloud based accounting is simple and easy to use and as well saves time.	119	74	10	19	7
4.	There are errors in the previous method of computing in Twinstar Industries Limited.	115	69	7	21	17
5.	The management of Twinstar Industries Ltd. Organizes training for staff in order to be adapted to the use of cloud based accounting.	111	77	18	5	17
6.	Information technology has enhanced the performance of Twinstar Industries Limited.	113	89	10	10	7
7.	Not only the senior staff are familiar with the use of cloud based accounting.	121	78	16	6	8
8.	The cloud accounting makes the records of Twinstar Industries Ltd. be safe and free from loss	115	66	10	15	23
9.	Cloud accounting has helped in the aspect of awareness creation for Twinstar Industries Ltd.	117	88	7	11	6
10.	Cloud based accounting enhanced operations of Twinstar Industries Ltd. both internally and externally	114	57	11	25	22

Source: Field Survey, 2022 (some of the questions in the questionnaire were adopted and others were constructed by the researcher).

**Effect of Cloud-Based Accounting On Manufacturing Firms in Nigeria
A study of Twinstar Industries Ltd., Ogun State**

Hypothesis One

H0₁: Cloud-Based Accounting does not impact manufacturing firm policies and operations

ANOVA SUMMARY

Table 2: ANOVA Summary for Ho1

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	42920.96	4	10730.24	317.6507	8.66E-18	2.866081
Within Groups	675.6	20	33.78			
Total	43596.56	24				

Critical Value of 5% level of significance with degree of freedom 4 to 20 is 2.87

Decision Rule

Since the calculated value is 8.66, is greater than the critical value of 2.87. The alternative hypothesis should be accepted and the null hypothesis (H0) should be rejected.

Therefore, Cloud-Based Accounting does impact manufacturing firm policies and operations

Hypothesis One

H0₂: There is no relationship between Information Technology and the performance of manufacturing firms in Nigeria.

ANOVA SUMMARY

Table 3 ANOVA Summary for Ho2

Source of Variation	SS	Df	MS	F	P-value	F crit
Between	45768	4	11442	168.2647	4.29E-15	2.866081
Within	1360	20	68			
Total	47128	24				

Critical Value of 5% level of significance with degree of freedom 4 to 20 is 2.87

Decision Rule

Since the calculated value is 4.29, is greater than the critical value of 2.87. The alternative hypothesis should be accepted and the null hypothesis (H0) should be rejected.

organization. From the findings of this study, it was concluded that cloud accounting has significant effect on the policies and procedures of manufacturing firms. It can further be concluded that cloud based accounting is a solution when effectively used provides benefits to the business enterprise in the aspect of Safe storage of financial data, Sync data automatically, Pay as you grow, Multi user access, Data accuracy, Prevent unauthorized access and Minimal downtime. The study noted that immediate information access helps to get a clear picture of how your business is doing, and also to prepare for the market's future demands. It showed that Cloud-Based Accounting has significant impact on manufacturing firm policies and operations.

Therefore, there is a relationship between Information Technology and the performance of manufacturing firms in Nigeria.

Conclusion and Recommendation

Based on result of the analysis derived from this study, it can be concluded that cloud based accounting serves as a way paver and performance enhancement in Manufacturing firms in Nigeria. The application of cloud based accounting in manufacturing firm is indeed a problem solver and tasks burdened easier thereby ensuring that the manufacturing firms' performances are improved with the aid cloud based accounting gave the policies and procedures of the firms.

From the above conclusion, the study recommends the following;

The use of cloud based accounting should be harmonized with management accounting functions and management accountants should

The application of cloud based accounting is an important strategy to drive down cost in the

***Effect of Cloud-Based Accounting On Manufacturing Firms in Nigeria
A study of Twinstar Industries Ltd., Ogun State***

be trained for the use of cloud accounting system in the manufacturing firms.

There should be insights into the policymakers to better understand and enable them to implement suitable strategies to minimise potential damaging factors and improve current trends in their development.

The management of manufacturing firms should organize training, seminars and conferences for staff in order to be adapted to the use of cloud based accounting.

REFERENCES

- Abdullah, A. (2016). A Knowledge Management Based Cloud Computing Adoption (Doctoral dissertation). Staffordshire University.
- Abidde, M. O. (2021). Cloud Computer Based Accounting and Corporate Financial Performance: A Study of Some Listed Manufacturing Companies in Nigeria. *IOSR Journal of Business and Management (IOSR-JBM)* e-ISSN: 2278-487X, p-ISSN: 2319-7668. Volume 23, PP 12-19
- António, T., Fernando, B. and Raquel, P. E., (2016). Accounting information systems: evolving towards a business process-oriented accounting, *Procedia Computer Science*, 100(2016), 987 – 994. doi: 10.1016/j.procs.2016.09.264
- Buttell, A. E. (2010). Six reasons to switch to cloud computing, *Journal of Financial Planning, Practice Management*, 3(7), 6-7.
- Chan W., Leung E. and Pili H., (2012), Enterprise risk Management for cloud computing, *Committee Of Sponsoring Organizations of the Treadway Commission (COSO)*, Crowe Horwath LLP.
- Dimitriu, O. and M. Matei, Cloud accounting: A new business model in a challenging context, *Procedia Economics and Finance*, 32,2015, 665-671.
- Ebenezer E. E. S., Omane-Antwi K. B. and Kyei M. E., (2014), Accounting in the Cloud: How Cloud Computing Can Transform Businesses (The Ghanaian Perspective), *Proceedings of the Second International Conference on Global Business, Economics, Finance and Social Sciences (GB14Chennai Conference)* ISBN: 978-1-941505-14-4 Chennai, India 11-13 July 2014 Paper ID:CF440.
- Gill, R. (2011), “Why cloud computing matters to finance”, *Strategic Finance*, January, pp. 43-47
- GMLCPA (2017). <http://www.gmlcpa.com/category/accounting-blog/page/2/> accessed on May 15, 2017
- Haslinda, H., Mohd, H.M.N., and Norhaiza, K. (2017), Cloud Computing Adoption in Organisations: Review of Empirical Literature, *SHS Web of Conferences* 34, 02001
- Jordanian Trade Law, No. 12 of 1966, Article 16.
- Laberta, C., (2011), *Computers are your future*, Ed.11, Pearson Education Inc, Publishing as Prentic.
- Lobana, J. (2013), *Cloud Computing for Not-for Profit Organizations – Questions for Directors to Ask*, Chartered Professional Accountants Canada.
- Khanom, K., (2017). Cloud accounting: a theoretical overview, *IOSR Journal of Business and Management*, 19(6), 31-38. doi: 10.9790/487X-1906053138
- Mell P. and Grance T., (2011), *The NIST Definition of Cloud Computing*, Recommendation National Institute of standard and Technology.
- Mohammadi, S. and A. Mohammadi, Effect of Cloud Computing in Accounting and Comparison with the Traditional Model, *Research Journal of Finance and Accounting*, , 5(23), 2014, 104-114.
- Mugenyi, R. (2018), Adoption of Cloud Computing Services for Sustainable Development of Commercial Banks in Uganda, *Global Journal of Computer Science and Technology: B Cloud and Distributed*, 18(1), 1-9. ISSN: 0975-4172.
- Owolabi, S.A, Izang, J.U. (2020). Cloud Accounting and Financial Reporting. *International Journal of Research Publications. IJRP 2020*, 60(1), 21-28; doi:10.47119/IJRP100601920201411
- Paychex (2017). <https://www.paychex.com/articles/finan>

Effect of Cloud-Based Accounting On Manufacturing Firms in Nigeria A study of Twinstar Industries Ltd., Ogun State

- ce/benefits-of-cloud-over-traditional-accounting/ accessed on May 05, 2017.
- Perminov S, Egorova E (2005) ICT impact on labor productivity and employment in Russia, TIGER working paper series, no 30
- Reding, V. (2009), Member of the European Commission responsible for Information Society and Media Internet of the future: Europe must be a key player, Brussels, 2 February 2009, http://www.esinternet.imasdtic.es/CLI_AETIC/ftpportalweb/documentos/discurso_reading_020209.pdf
- Satapathy S, Mishra P (2013) A customer oriented systematic framework to extract business strategy in Indian electricity services. J Ind Eng Int 9:33
- Walter Johnson (2018). Manufacturing firm. Reviewed by: Michelle Seidel, B.Sc., LL.B., MBA Updated November 08, 2018
- Zhang, L. and W. Gu, The Simple Analysis of Impact on Financial Outsourcing Because of The Rising Of Cloud Accounting, Asian Journal of Business and Management, 5(1) ,2013, 140-143.

Impact of Child Abuse On Academic Performance of Secondary School Students in Geidam Local Government Area of Yobe State

Shettima Alhaji Umar

Department of Social Development, Mai Idris Aloomo Polytechnic, Geidam, Yobe State.

Abstract

*This study examines the Impact of Child Abuse on Academic Performance of Secondary School Students in Geidam local government area of Yobe State, using four (4) Secondary Schools in Geidam. The four (4) Secondary Schools are: **Government Secondary school Geidam, Government Science and Technical College Geidam, Geidam Academy and Success Foundation Academy Geidam.** The study used both primary and secondary data (questionnaire and interview). 40 respondents were chosen as sample from both staff and students. Two hypotheses were tested with the aid of Chi-Square and the data collected were tabulated and analyzed using simple percentage. The result of the analysis revealed that there is a significant relation between child maltreatment and students' academic performance in secondary school in Yobe State. It also showed that there is a significant relationship between emotional abuse and students' academic performance in secondary schools in Yobe state. The study recommended that Government should employ more counselors to help and guide parent/guardians on how to treat their children/wards to avoid child maltreatment. Parents and guardians should adopt good parental care, love and concern for their children; this could help them to perform better in schools and among others.*

Keywords: Child Abuse, Child Maltreatment, Academic Performance, Secondary School, Students

Introduction

Students' academic performance is determined by number of factors within and outside the classroom, which include home, environments and some circumstances like economic, culture etc (Ramez, Widom, Browne, Fergusson, Webb & Sinow 2009). Therefore, conducive home environments, economic stability and favorable cultural pattern of the child parent may enrich children's school experiences, while unconducive home environments, unstable economic and unfavorable cultural pattern of the child's parent may have detrimental effects on both students' academic performance and classroom behaviours. This means that students' home environment, economic status, cultural pattern either positive or negative, could have bearing on their academic performance. According to Ramez et al (2009), the most devastating of the environmental factors is child abuse.

Child abuse refers to any situation dangerous to physical or emotional health as a result of parents, guardian or other caretakers' behavior. (Obekpa, 2001). According to Taylor and Steward (2011), child abuse is any action or inaction on the part of a parent, guardian or caretaker that may result in death, serious physical or emotional injury, sexual abuse, or exploitation; or an act or failure to act which presents an imminent risk of serious harm. McCoy and Keen (2013) view child abuse as action or inaction of parent, guardian or caregiver that causes injury, death, emotional harm or risk of serious harm to a child. Child abuse, therefore, can be defined as any behavior displayed by the parent, guardian or caregiver, either intentionally or by the negligence of parents or guardians that can lead to loss of life, physical or psychological harm, sexual harassment and others to an innocent child.

The increasing rate of child abuse in our contemporary time is a thing of concern to the researchers, parents Government humanitarian organization and educationists. However, in most of Africa country children plays significant roles in the survival of their families; they assist their parent, guardian or caregiver in farming, and

hawking goods, cooking, washing and engage in other house activities according to Onyango (2013), children always work in the traditional African societies and that the notion of child abuse as a social problem, is a recent development. Nonetheless, child abuse is not peculiar to Nigeria or the study area. According to UNICEF (2013), every year more than 3 million reports of child abuse were reported in America alone.

There are different forms of child abuse ranging from physical, sexual, emotional, and mental neglect (Crosson, 2008). Physical abuse is any touch on the child's body such as pushing, hitting, beating and others which might result in an injury. Emotional abuse refers to the use of embarrassing words such as bastard, good for nothing, blocked head, constant condemnation by parent or caregiver which might be capable of causing the child serious cognitive, mental or behavioural disorders. Emotional abuse means constantly blaming the child, belittling or berating the child, being unconcerned about the child's welfare and overtly rejection of the child by parents or caretakers or caregivers (Mba, 2003).

Child abuse has become a global issue and it has been established that many children in the developed world, especially in America, are abused annually. This has extended to African countries like Nigeria (UNICEF, 2012). The researchers observed that most children in Makurdi metropolis are being used by parents/guardians in hawking goods like groundnuts, oranges, mangoes among others on the streets during school hours instead of being in school. Some of these children are seen looking pale, exhausted with scars on their bodies resulting from beatings meted on them by parents /guardians (UNICEF, 2012).

However, violation of child's rights in form of child abuse is under-reported and under-punished; resulted to high occurrence of child abuse. More so, the researchers observed that - studies have not been carried out on child abuse and academic performance in the Secondary schools in the study area. Hence, this study is

Impact of Child Abuse On Academic Performance of Secondary School Students in Geidam Local Government Area of Yobe State

aimed at filling this research gap and specifically physical and emotional abuses on academic performance were considered. Parents' inability to adequately provide for the needs of some family members are heavy burden and leading to street hawking activity on their children which causes academic set back through repetition, withdrawal from school or dropout due to failure and shame which is another form of child abuse. While Nseabasi and Oluwabamide (2010) identified unemployment, poverty loss of parents among others as the major causes of child hawking, Udoh and Joseph (2012) found that poverty is the main cause of street hawking.

The main purpose of this study is to examine the impact of child abuse on academic performance in secondary school students' in Geidam Local Government area of Yobe State. While the Specific objective of the study are:

- i. To determine the impact of physical abuse on academic performance of secondary school students in Geidam Local Government Area of Yobe state.
- ii. To determine the impact of emotional abuse on academic performance of secondary school students in Geidam Local Government Area of Yobe state.

Literature Review

Child abuse is any act or failure to act on the part of a parent or guardian to provide basic need of the child such as food, shelter, clothing, health, safety and educational services which results in death, serious physical or emotional injury, sexual abuse or exploitation or an act or failure to act which presents an imminent risk of serious harm.

The form of child abuse different to each state since any state is responsible to provide its own definition, form and some laws to be adopted by the State. Most States recognize four major types of abuse that is physical abuse, neglect, sexual abuse, and emotional abuse. Additionally, many States identify abandonment, parental substance use, and human trafficking as abuse or neglect. Some of these types of abuse may be found separately, or in combination.

The term child abuse is considered as any maltreatment or neglect of the child by the parent or caregiver that result in non-accidental harm or injury and which cannot be easily identified (Axmaher 2004). According to (Crosson, 2008), the commonest consequences of child abuse is how it affects child's performance in school and interferes with the foundation a child needs to be achieved throughout his/her school career. The prolonged abuse could affect the child's overall development. Children who have been abused tend to perform lower than his/her peers with regard to cognitive capacity, language development, and academic achievement (Crosson, 2008). Hence, child abuse may have negative influence on the academic performance of an individual and as well disrupt the basis of his successful career development in the future.

Turton (2008) in his study revealed that negative influence of child abuse and poor academic performance and classroom functioning for school age children significantly affect the child future life chances.

Similarly, Staff (2013) viewed that the rate of continuous child abuse and neglect has been increasing within the Country. According to Asamaigbo (2004) children who have been physically abused might undergo a wide range of personality disorders such as increased fears, anxiety, anger, depression, hostility and aggression. Moreso Australian Childhood Foundation (2008), asserted that, child abuse is contributing to poor academic performance, high social disorder, substance abuse, and other behavioural problems that usually result in poor educational and economic outcomes later in life. People who experienced abuse were slightly less likely to participate in the labour force and to be employed full time, and slightly more likely to be unemployed or be employed part time.

According to a study by Tyler and Brownridge (2008) founded that child abuse increases the possibility of lower academic performance and poor school performance. Shonk and Cicchetti (2001) revealed that children who are constantly insulted, beaten, belittled among others usually scores poor grade in school, which is a sign of

Impact of Child Abuse On Academic Performance of Secondary School Students in Geidam Local Government Area of Yobe State

poor academic performance. Similarly, Sladea and Wissow (2007) viewed that childhood maltreatment is related with emotional and behavioural problems throughout childhood which might result in unwanted academic result in school. Eweniyi (2003), Bukoye (2004) and Mba (2003) in their studies viewed that children who are emotionally abused could manifest increased depression, anger, hostility, aggression and may lack interest in school activities. These children might lack concentration in activities like reading and writing. These Challenges on children might have negative effect on their overall performance in school. Alokun and Olatunji (2014) in their study opined that abused children lack concentration in school activities which in turn may have negative effect on their performance.

However, the study is agreed on attachment theory propounded by Bowlby (1958). The theory stated that if a child was separated from his/her mother within the first five years of life, it could affect the child's emotional development and social difficulties in later life. The theory emphasizes the physical aspect of mother child bonding and sees the attachment as an instructive; genetically determine two ways and a symbolic process. The theory is related to this study because it encourages parents to love and care for their children, instead of humiliating and torturing their young minds with all sort of abuse. This will enable the child to interact freely, thereby improving their academic performance.

3 Methodology

Study Area

Geidam is one of the seventeen (17) local Government areas of Yobe state. The Local Government was created in the year 1976 by the local Government act of 1976 during General Murtala Ramat Mohammed's regime. The local Government was among the eighteen (18) local Government areas of the former Borno state. The local government is located in the northern part of Yobe state, it bordered with Yunusari local Government to the north, Tarmuwa local government to the south, Bursari local

Government to the west and Gubio local Government of Borno state to the east. The local Government is about 180 km away from Damaturu the state capital of Yobe state. It covers an area of about 3892 kilometers squares with the population of about 157,295 people according to 2006 population census (NPC, Census 2006). The local government is made up of eleven (11) wards comprises of Asheikri, Kolori, Hausari, Gumsa, Kusur, Ma'anna-Dagamdi, Borko, Zuru-Ngulaiya, Dejina/Fukurdi, Futchimiram, Balle-Kelluri, and Jororo-Kalgeri.

Research Design

The survey focused on the staff/teachers and students of four (4) Secondary Schools in Geidam town namely: Government Secondary school Geidam, Government Science and Technical College Geidam, Geidam Academy and Success Foundation Academy Geidam which forms the population of this study. The Necessary data were collected to ascertain the extent of the Impact of Child Abuse on Academic Performance of Secondary School Students in Geidam Local Government area of Yobe state. To achieve the objectives of the study, primary source of data was employed. The primary source data was based on the use of questionnaires distributed and collected from the Teachers/staff and the Students of the above mentioned Schools. The target population of study was all the Staff and Students of the above mentioned Schools. Since it is not possible to study the entire Population, a sample of 40 respondents was randomly selected and Administered questionnaires from the Schools studied. The sampling technique used for this study was stratified random sampling technique in selecting the Sample for empirical examination. The questionnaire was designed in such a way that alternatives were provided for the respondents to choose from and opinions of options were expected to be expressed. In the questionnaire, the Likert scale measurement of variables was used; this requires the respondents to indicate a degree of agreement or disagreement. A non-parametric statistics (Chi-square) was also employed in testing the hypothesis.

Study Population and Sampling Procedure:

Impact of Child Abuse On Academic Performance of Secondary School Students in Geidam Local Government Area of Yobe State

The study population consists of Staff and Students of Government Secondary school Geidam, Government Science and Technical College Geidam, Geidam Academy and Success foundation Academy Geidam; that makes up of the population of this research.

Research Questions:

The following research questions were used to help in conducting the research work:

- i. What are the impact of physical abuse on academic performance of secondary school students in Geidam Local Government Area of Yobe state?
- ii. What are the impact of emotional abuse on academic performance of secondary school students in Geidam Local Government Area of Yobe state?

Hypotheses

The following hypotheses were formulated to guide the study at 0.05 alpha levels:

- i. Physical abuse has no any impact on academic performance of secondary school students in Geidam Local Government Area of Yobe state.
- ii. Emotional abuse has no any impact on academic performance of secondary school students in Geidam Local Government Area of Yobe state.

Data Presentation and Analysis

Test of Hypothesis

The two hypotheses earlier formulated will be tested using the chi-square (X^2) method.

Decision Criteria

The decision rule is that if the calculated values of X^2 is greater than the tabulated value (or critical value), we accept the alternative hypotheses and reject the null hypotheses or vice versa.

Hypothesis One

Ho₁: There is no significant relationship between physical abuse and students’ academic performance in secondary schools in Geidam.

Table I

Alternatives	Responses	Percentage (%)	Aggregate
Strongly agree	22	55	80
Agree	10	25	
Undecided	2	5	5
Disagree	4	10	15
Strongly disagree	2	5	
Total	40	100	100

Source: Field Survey Report, 2022.

Table II. Contingency Table

Alternatives	O _i	E _i	O _i -E _i	(O _i - E _i) ²	(O _i - E _i) ²
	E _i				
Strongly agree	22	8	14	196	24.5
Agree	10	8	2	4	0.5
Undecided	2	8	(6)	36	4.5
Disagree	4	8	(4)	16	2
Strongly disagree	2	8	(6)	36	4.5
X² cal					36

Impact of Child Abuse On Academic Performance of Secondary School Students in Geidam Local Government Area of Yobe State

$E_f = \text{Total Frequency}$

Number of Responses

$$40/5 = 8$$

Level of significance (α) = 5% (0.05)

Critical Value = $(\mu - 1), \alpha$

Where; μ = No of options

$$= (5 - 1), 0.05$$

$$= 8 (0.05)$$

$$X^2 \text{ Tab} = 15.51$$

Decision: Since X^2 calculated is greater than the X^2 tabulated, ($36 > 15.51$) we accept alternative

hypothesis and reject the null hypothesis. Hence, we conclude that there is significant relationship between physical abuse and students' academic performance in secondary Schools in Geidam. This entails that abuse seriously hinders students' academic performance.

Hypothesis Two

Ho₂: There is no significant relationship between emotional abuse and students' academic performance in secondary schools in Yobe State.

Table III

Alternatives	Responses	Percentage (%)	Aggregate
Strongly agree	14	35	75
Agree	16	40	
Undecided	4	10	10
Disagree	2	5	15
Strongly disagree	4	10	
Total	40	100	100

Source: Field Survey Report, 2022.

Table IV: Contingency Table

Alternatives	O _i	E _i	O _i -E _i	(O _i - E _i) ²	(O _i - E _i) ²
					E _i
Strongly agree	14	8	6	36	4.5
Agree	16	8	8	64	8
Undecided	4	8	(4)	16	2
Disagree	2	8	(6)	36	4.5
Strongly disagree	4	8	(4)	16	2
X² cal					21

$E_f = \text{Total Frequency}$

Number of Responses

$$40/5 = 8$$

Level of significance (α) = 5% (0.05)

Critical Value = $(\mu - 1), \alpha$

Where; μ = No of options

$$= (5 - 1), 0.05$$

$$= 8 (0.05)$$

$$X^2 \text{ Tab} = 15.51$$

Decision: Since X^2 calculated is greater than the X^2 tabulated, ($21 > 15.51$) we accept and reject the null hypothesis. Hence, we conclude that there is significant relationship between

emotional child abuse and students' academic performance in secondary schools in Geidam, Yobe state. This entails that emotional child abuse seriously hinders students' academic performance.

Findings

The first hypothesis showed significant relation between child abuse and students' academic performance in secondary school in Geidam, Yobe State. The finding is in agreement with some of the literature reviewed such as Asamaigbo and Asamaigbo in Akpende, Umuren and Ukpebi (2010) who agreed that children who

Impact of Child Abuse On Academic Performance of Secondary School Students in Geidam Local Government Area of Yobe State

have been abused might face a wide range of personality disorders, such as increased fears, anxiety, anger, depression, hostility and aggression. Alok and Olatunji (2014) are of the same line of thought, confirmed that child abuse result in lack concentration in the class; and as a result, it has a negative influence on students' academic performance.

The second hypothesis also showed significant relationship between emotional abuse and students' academic performance in secondary schools in Geidam, Yobe state. The finding is agreed with some of the studies of Eweniyi (2003), Mba (2003) and Bukoye (2004) who confirmed in their studies that children who are emotionally abused might lack concentration in academic activities such as reading and writing as a result of depression, anger, hostility and aggression. Crosson (2008) who stresses that those children who have been abused tend to score lower which turn to have negative effects on their academic performance. Australian Childhood Foundation (2008) confirmed that child abuse leads to poorer academic performance. These assertions are in tandem with the findings of this study.

Conclusion

The study finally established that child Abuse has a serious negative influence on academic performance of secondary schools students of some selected schools in Geidam local Government area of Yobe State Nigeria. The researchers therefore concluded that, there is a negative or inverse relationship between child abuse and students' academic performance. Where the relationship entails; as child abuse increases so also the students' academic performance decline and vice versa

Recommendations

In view of the study findings, the following recommendations were made by the researchers to address the impact of child abuse on students' academic performance in secondary schools in Geidam Local Government area of Yobe State. The recommendations are viz: Government should employ more counselors to help and guide parent on how to treat their children/wards to

avoid abuse. Parents and guardians should adopt a good parental care, love and concern for their children and wards; this could help them to perform better in schools and alternately reduces abuse. Head teachers should refer cases of child abuse to school counsellors for expertise action and if need arise to higher appropriate authorities. Government should also provide social amenities and infrastructures or improve on the existing ones so as to improve the standard of living of the people in order to reduce poverty which is the main cause of child abuse.

References

- Alok, F.B. & Olatunji, I.C. (2014). Influence of child abuse on classroom behaviour and
- Nseabasi, A. & Oluwabamide, A. J. (2010).The menace of child abuse in Nigeria; a case study Academic performance among primary and secondary school students. *European Scientific Journal*, LSJ, 10 (10).
- Australian Childhood Foundation (2008). *The cost of child abuse in Australia*. Australia: University.
- Apebende, E., Umoren, G. & Ukpepi, B. (2010). The influence of child abuse on the Academic Performance of primary school pupils in primary schools in Cross River State, *An International Multi-Disciplinary Journal*, 3(2): 49-51.
- Axmaher, L. W. (2004). Causes of child abuse health plus: Vanderbit family and staff well programme.
- Bukoye, R. O. (2004). Attitude towards child abuse and neglect among women: Implication for counselling. *The Counsellor*, 20 (1) 144 – 152.
- Bowlby, J. (1958). Attachment New York: Basic Books.

- Crosson, C. (2008). *Understanding Child Abuse and Neglect*. Boston, MA: Pearson Education.
- Elisa Romano et al (2014). TRAUMA, VIOLENCE, & ABUSE 2015, Vol. 16(4) 418-437.
- International Labour Organisation (2013). *Statistical report: global child labour Trends 2008 to 2012. ILO, 2013*. Retrieved from www.ilo.org, on 12/04/2014.
- Eweniyi, G. B. (2003). Child sexual abuse and the right of the Nigerian child. *The Counsellor*, 18 (1) 166 – 172.1.
- Mba, A. I. (2003). The problems of child abuse in Nigeria. Edited conference proceedings. 77-82
- McCoy, M. L. & Keen.S.M. (2013). Child abuse and neglect (2nd end.). New York, NY: Psychology Press.
- Obekpa, I. A. (2001). Child abuse: Consequences and effects on education and society. *International Journal of Continuing Education*, 2(2) 136– 147.
- Ramez, G., Widom, S., Browne, C., Fergusson, D., Webb, E. & Sinow, J. (2009). Burden and consequences of child maltreatment in high-income countries. *The Lancet*, 373 (9657): 68- 81.
- Shonk, S.M. & Cicchetti, D. (2001). Maltreatment, competency deficits, and risk for academic and behavioural maladjustment. *Developmental Psychology*. 37(1):3-17.
- Sladea, E. & Wissow, L. (2007). *The influence of childhood maltreatment on adolescents' academic performance. Economic Education Review*, 26(5): 604–614.
- Staff, F. (2013). Rates of abused and neglected children on the rise in Australia. *Journal of health* 4(2):67-69.
- Theoklitou, D., Kabisis, N. & Kabisi, (2012). Physical and emotional abuse of primary school children by teachers. *Child Abuse Neg.* 26(1), 64- 70.
- Turton, J. (2008). *Child abuse, gender, and society*. New York: Routledge
- Tyler, J. & Brownridge, S. (2008). Child abuse. *Journal of Youth and Adolescence*, 37(5): 50-56 street hawking in Uyo, Akwa Ibom State, Nigeria. *Journal of Social Science*, 24(3), 189-192.
- Udoh, N. A. & Joseph, E. U. (2012). Behavioural problems of juvenile street hawkers in Uyo metropolis, Nigeria. *World Journal of Education*. 2(1). Retrieved from www.sciedu.ca, 08/03/2019.
- UNICEF (2012). Violence against Kenyan children excessive. Nairobi: UNICEF
- UNICEF (2013). Rampant child abuse. New York: UNICEF.

Forecasting Quarterly Exchange Rates Using Fuzzy Time Series: A Catalyst for Business Projections Amidst Global Pandemic

Maigana Alhaji Bakawu*¹, Ahmed Buba Tarajo² & Abdulrahman Malik³

^{1&3}Department of Statistics, Mai Idris Aloomo Polytechnic Geidam, Yobe State

²Department of Statistics, The Federal Polytechnic Damaturu, Yobe State

*¹Corresponding author: maiganabk@gmail.com

Abstract

In the phase of global pandemic, a knowledge of exchange rates movement remains an indispensable tool for international business projections. However, projections amidst global pandemic requires forecasting methods that works adequately with an incomplete information for which Fuzzy Time Series method is appropriate. Hence, this paper proposes a novel fuzzy time series model for forecasting quarterly average Inter-bank Foreign Exchange Market (IFEM) rates of Nigeria Naira against United States Dollar derived from monthly average rates over the periods 2004 to 2020 made available at www.cbn.gov.ng/rates/exrates.asp by the Central Bank of Nigeria. The effectiveness of the proposed model based on performance metric (MAPE) indicates that the proposed fuzzy time series method is suitable for forecasting the Naira's parity with the United States Dollar.

Keywords: Foreign Exchange Rate; Fuzzy; Naira; Time Series; USD

1. Introduction

The current global financial crisis due to COVID-19 pandemic has created more fears in the international business space particularly in the emerging economy. In Nigeria, this fear is further aggravated by dwindling foreign exchange (Forex) rates particularly in the parallel market. The turmoil in the Forex market may be attributed to crash in global crude oil prices among other factors in the early phase of the COVID-19 pandemic and the slow price appreciation currently the global oil market is experiencing. This scenario is posing great challenges in the international business decisions. The key interests in such atmosphere most not be in short of a framework for forecasting the movement of the future Forex indices. One indispensable tool in this regard is the conventional Time Series models. Autoregressive (AR), Autoregressive Moving Average (ARMA) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) are the common conventional Time Series models found in the literature of forecasting foreign exchange rates. However, the application of these methods are predetermined by some assumptions, for instance (Leu, Lee, & Jou, 2009) opined that in applying ARMA method one needs to make sure that the residue is normally distributed. Additionally, forecasting problems in which the historical data are not in precise sense cannot be handled by these methods. Furthermore, in the words of (Korol, 2014) the fluctuation of exchange rates might not be understood completely due to a lack of information and the movement of exchange rates is affected by many factors (economic, political, psychological, etc.) that cannot be precisely and unambiguously defined. Therefore, the search for technique that is insensitive to these constraints and that might work efficiently in forecasting exchange rates for which Fuzzy Time Series (FTS) is ideal is inevitable.

The concept of Fuzzy Time Series was built on the characteristics of fuzzy set theory, the theory was introduced by Zadeh (Ghosh, Chowdhury, & Prajneshu, 2016; Alves et al., 2018) and it has been applied to several diverse areas (Sasu, 2010). Accordingly, Song and Chissom proposed the concept of FTS as noted in (Hosseini, Fard, & Baboli, 2011; Olatayo &

Taiwo, 2014). Similarly, (Garg, Sufyan Beg, & Ansari, 2013) noted that substantial work has been done on forecasting problems using fuzzy time series since its preposition. Areas such as university enrolments, stock index forecasting, market assets, economic indicators, exchange rate, electric load, temperature forecasting and tourism forecast are notable areas among many others that were subjected to fuzzy time series application over the years.

Fuzzy Time Series forecasting methodology consists of defining universe of discourse (UOD), fuzzification of time series data points, assigning relationships between consecutive data points and defuzzification to get back the forecasting results in real domain (Pal & Kar, 2019).

In this paper, we aim to model the amount of Nigeria Naira (NGN) that one requires to buy one United States Dollar (USD) using fuzzy time series approach based on quarterly parity rates between the two currency for the period 2004 to 2020 second quarter. To make the NGN to USD currency rate forecasting methodology and the data analyses self-acquainted, definitions of related concepts were reproduced under review of literature.

2. Review of Literature

Parity forecasting between currencies has been researched in many studies over years, this claim is visible in the work of (Tlegenova, 2015), who opined that there are lots of works done on time series based on prediction modelling of foreign currency rates in literature. Fuzzy time series methodology is one popular time series approaches in the literature that has attracted the attention of researchers in forecasting foreign exchange rates. For instance, (Efendi, Ismail, & Deris, 2013) noted that the fuzzy logic methods are found to be suitable due to its ability in pattern recognition and handling of the non-probabilistic uncertainties type in the forex data. Similarly, (Korol, 2014) created a model with high efficiency based on the fuzzy logic model that uses average quarterly exchange rates of JPY/USD, GBP/USD and CHF/USD as experimental data. Additionally, (Boiroju &

Rao, 2015), developed fuzzy time series model for daily exchange rate of the Indian rupees against US Dollar. Furthermore, (Leu et al., 2009) and (Permana & Fitri, 2020) respectively studied the currency rates between Riyal to Rupiah and New Taiwan Dollar (NTD) to USD using fuzzy time series model.

A reproduced summary of definitions for fuzzy time series concept found in (Song & Chissom, 1993), (Chou, 2016), (Garg et al., 2013), (Lee & Chou, 2004), (Sah & Degtiarev, 2005) are accordingly provided below:

Definition 1

Let $Y(t)$ ($t = \dots, 0, 1, 2, \dots$), a subset of \mathbb{R}^1 , be the universe of discourse on which fuzzy sets $f_i(t)$ ($i = 1, 2, \dots$) are defined and $F(t)$ is a collection of $f_i(t)$ ($i = 1, 2, \dots$). Then $F(t)$ is called fuzzy time series on $Y(t)$ ($t = \dots, 0, 1, 2, \dots$).

Definition 2

The universe of discourse $U = [D_L, D_u]$ is defined such that:

$$D_L = D_{min} - st_{\alpha,n}/\sqrt{n} \text{ and } D_u = D_{max} + st_{\alpha,n}/\sqrt{n}, \text{ when } n \leq 30 \text{ or } D_L = D_{min} - \sigma z_{\alpha}/\sqrt{n} \text{ and } D_u = D_{max} + \sigma z_{\alpha}/\sqrt{n}, \text{ when } n > 30;$$

Where: $t_{\alpha,n}$ is 100(1 - α) percentile of the t distribution,

z_{α} is 100(1 - α) percentile of the standard normal distribution

s & σ denotes sample and population standard deviations respectively.

D_{min} and D_{max} are respectively minimum and maximum values of the data in question

Definition 3

Let $F(t - 1) = A_i$ and $F(t) = A_j$. Relationship between two consecutive observations, $F(t)$ and $F(t - 1)$, referred to as a fuzzy logical relationship (FLR), can be denoted by $A_i \rightarrow A_j$ where A_i is called the left-hand side (LHS) and A_j is the right-hand side (RHS) of the FLR.

Definition 4

Assuming that there are m linguistic values under consideration, let A_i be the fuzzy number that represents the i th linguistic value of the linguistic variable, where $1 \leq i \leq m$. The support of A_i is defined to be:

$$D_l + (i - 1) \frac{D_u - D_l}{m}, \quad D_l + \frac{i(D_u - D_l)}{m}, \quad 1 \leq i \leq m - 1$$

$$D_l + (i - 1) \frac{D_u - D_l}{m}, \quad D_l + \frac{i(D_u - D_l)}{m}, \quad i = m$$

(1)

Definition 5

If there exists a fuzzy relationship $R(t, t - 1)$, such that $F(t) = F(t - 1) \times R(t, t - 1)$, where symbol \times is an operator, then $F(t)$ is said to be caused by $F(t - 1)$. The existing relationship between $F(t)$ and $F(t - 1)$ can be denoted by the expression $F(t - 1) \rightarrow F(t)$

3. Methodology

The stepwise outline of the proposed forecasting process in accordance with the (Pal & Kar, 2019) description of fuzzy time series forecasting methodology earlier noted for quarterly average Inter-bank Foreign Exchange Market (IFEM) rates of Nigeria Naira against United States Dollar is presented as follows:

- Step 1. Determine universe of discourse on IFEM rates of NGN to USD as, $U = [D_L, D_U]$
- Step 2. Partition the universe of discourse U into several even and equal length intervals. Thus, $U = \cup_{i=1}^m u_i$, letting m the number of disjoint intervals.
- Step 3. Determine the fuzzy sets A_i : some linguistic values represented by fuzzy sets of the interval of the universe of discourse such that its membership function is as follows:

$$u_{A_i}(x) = \begin{cases} 1 \text{ for } x \in \left[D_l + (i - 1) \frac{D_u - D_l}{m}, D_l + \frac{i(D_u - D_l)}{m} \right), \\ \quad \text{where } 1 \leq i \leq m - 1; \\ 1 \text{ for } x \in \left[D_l + (i - 1) \frac{D_u - D_l}{m}, D_l + \frac{i(D_u - D_l)}{m} \right), \\ \quad i = m; \\ 0 \text{ otherwise.} \end{cases}$$

(2)
- Step 4. Then, $F(t) = A_i$, if $IFEM(t) \ni \text{supp}(A_i)$, where $\text{supp}(\cdot)$ denotes support. Note that $\forall t \ni k/k = Q1, Q2, Q3 \text{ \& } Q4$
- Step 5. Identify fuzzy linguistic relationships (FLR's) among linguistic time series values, $A_i \rightarrow A_j$.

- Step 6. Establish fuzzy relationship groups (FLRGs): identification of $A_i \rightarrow A_j$ (FLR's) having the same LHS.
- Step 7. Establish forecasting rule.
- Step 8. Determine the forecast values based on the established rule.
- Step 9. Forecast evaluation using performance metrics

4. Experimental Results

To test the proposed model, the empirical analysis of the Inter-bank Foreign Exchange Market (IFEM) rates of Nigeria Naira against United States Dollar in accordance with the outlined procedures presented in section 3 is demonstrated in this section. The selected data set for this demonstration includes 66 records of quarterly IFEM rates of NGN against USD derived from monthly average rates over the periods January, 2004 to June, 2020. A comparative assessment of the forecasted values alongside the observed records is given at the end of this section. Additionally, the evaluation of the proposed model in terms of performance metric (MAPE) is also reported. Onward in the section, let $Q_{t_{FX}}$ represent the quarterly IFEM rates of NGN against USD data set, and in order to improve accuracy of our forecast, natural logarithm of the $Q_{t_{FX}}$ is taken. Hence;

$$\ln(Q_{t_{FX}}) = q_{t_{fx}} \equiv \exp(q_{t_{fx}}) = Q_{t_{FX}}$$

$$u_{A_i}(x) = \begin{cases} 1 & \text{for } q_{t_{fx}} \in [4.220 + (i - 1)(0.251), 4.220 + i(0.251), \\ & \text{where } 1 \leq i \leq m - 1; \\ 1 & \text{for } q_{t_{fx}} \in [4.220 + (i - 1)(0.251), 4.220 + i(0.251)] \text{ ,} \\ & i = m; \\ 0 & \text{otherwise.} \end{cases} \quad (3)$$

Where A_1 = very very low, A_2 = very low, A_3 = low, A_4 = no change, A_5 = high, A_6 = very high and A_7 = very very high. Hence, the supports are: $\text{supp}(A_1) = [4.220, 4.471)$, $\text{supp}(A_2) = (4.471, 4.722)$, $\text{supp}(A_3) = (4.722, 4.973)$, $\text{supp}(A_4) = (4.973, 5.224)$, $\text{supp}(A_5) = (5.224, 5.475)$, $\text{supp}(A_6) = (5.475, 5.726)$, and $\text{supp}(A_7) = (5.726, 5.977]$. The mid-points of the intervals computed as average of the lower and upper limits of each linguistic value are obtained as: $\bar{u}_1 = 4.346$, $\bar{u}_2 = 4.597$, $\bar{u}_3 = 4.878$, $\bar{u}_4 = 5.099$, $\bar{u}_5 = 5.350$, $\bar{u}_6 = 5.601$ and $\bar{u}_7 = 5.852$.

- Step 4. The Fuzzy time series $F(t)$ on $Q_{t_{FX}}$ is A_i , if $q_{t_{fx}} \in \text{supp}(A_i)$. Thus, $F(Q_{12004}) = A_3$, $F(Q_{22004}) = A_3, \dots, F(Q_{22020}) = A_7$. These transformation of the $Q_{t_{FX}}$ into fuzzy values is given in Table 1.
- Step 5. In accordance with definition 3, the Fuzzy Logical Relationships are as follows: $A_3 \rightarrow A_3$, $A_3 \rightarrow A_3, \dots$ and $A_7 \rightarrow A_7$ as shown in table 1.

From our data set, the following statistics from table 1 were observed: $n = 66, s = 0.365$, $q_{t_{fxmin}} = 4.308$, and $q_{t_{fxmax}} = 5.889$. The forecast values derivation in line with the section 3 outlines can be demonstrated as follows:

Step 1. From definition 2, the universe of discourse $U = [D_L, D_u]$, since $n > 30$, a $100(1 - \alpha)$ percentile of the standard normal distribution is considered. Therefore, letting $\alpha = 0.05$, $z_{0.05} = 1.96$, $D_L = q_{t_{fxmin}} - \sigma z_\alpha / \sqrt{n} \cong 4.220$ and $D_u = q_{t_{fxmax}} + \sigma z_\alpha / \sqrt{n} \cong 5.977$. Thus, $U = [4.220, 5.977]$.

Step 2. The partitioning of the universe of discourse into m even and equal length intervals is as follows: m is set to 7, because it is the usual practice as noted in (Ghosh, Chowdhury, & Prajneshu, 2016). Therefore, $u_1 = [4.220, 4.471)$, $u_2 = (4.471, 4.722)$, $u_3 = (4.722, 4.973)$, $u_4 = (4.973, 5.224)$, $u_5 = (5.224, 5.475)$, $u_6 = (5.475, 5.726)$, and $u_7 = (5.726, 5.977]$.

Step 3. Assuming that the followings linguistic values describe the quarterly Naira-USD parity rates: very very low, very low, low, no change, high, very high, very very high such that the membership function is given as:

Table 1: Fuzzified Values for IFEM Rates Data

Year/ Quarter	Actual IFEM Rates	Fuzzified IFEM Rates	IFEM Rates FLRs	Year/ Quarter	Actual IFEM Rates	Fuzzified IFEM Rates	IFEM Rates FLRs
2004Q1	4.915	A ₃		2012Q2	5.069	A ₄	A ₄ → A ₄
2004Q2	4.907	A ₃	A ₃ → A ₃	2012Q3	5.071	A ₄	A ₄ → A ₄
2004Q3	4.896	A ₃	A ₃ → A ₃	2012Q4	5.059	A ₄	A ₄ → A ₄
2004Q4	4.893	A ₃	A ₃ → A ₃	2013Q1	5.061	A ₄	A ₄ → A ₄
2005Q1	4.891	A ₃	A ₃ → A ₃	2013Q2	5.067	A ₄	A ₄ → A ₄
2005Q2	4.895	A ₃	A ₃ → A ₃	2013Q3	5.084	A ₄	A ₄ → A ₄
2005Q3	4.902	A ₃	A ₃ → A ₃	2013Q4	5.070	A ₄	A ₄ → A ₄
2005Q4	4.873	A ₃	A ₃ → A ₃	2014Q1	5.093	A ₄	A ₄ → A ₄
2006Q1	4.862	A ₃	A ₃ → A ₃	2014Q2	5.089	A ₄	A ₄ → A ₄
2006Q2	4.856	A ₃	A ₃ → A ₃	2014Q3	5.090	A ₄	A ₄ → A ₄
2006Q3	4.855	A ₃	A ₃ → A ₃	2014Q4	5.148	A ₄	A ₄ → A ₄
2006Q4	4.855	A ₃	A ₃ → A ₃	2015Q1	5.253	A ₅	A ₄ → A ₅
2007Q1	4.855	A ₃	A ₃ → A ₃	2015Q2	5.283	A ₅	A ₅ → A ₅
2007Q2	4.850	A ₃	A ₃ → A ₃	2015Q3	5.283	A ₅	A ₅ → A ₅
2007Q3	4.840	A ₃	A ₃ → A ₃	2015Q4	5.283	A ₅	A ₅ → A ₅
2007Q4	4.791	A ₃	A ₃ → A ₃	2016Q1	5.283	A ₅	A ₅ → A ₅
2008Q1	4.765	A ₃	A ₃ → A ₃	2016Q2	5.340	A ₅	A ₅ → A ₅
2008Q2	4.768	A ₃	A ₃ → A ₃	2016Q3	5.714	A ₆	A ₅ → A ₆
2008Q3	4.768	A ₃	A ₃ → A ₃	2016Q4	5.721	A ₇	A ₆ → A ₇
2008Q4	4.815	A ₃	A ₃ → A ₃	2017Q1	5.722	A ₇	A ₇ → A ₇
2009Q1	4.591	A ₂	A ₃ → A ₂	2017Q2	5.723	A ₇	A ₇ → A ₇
2009Q2	4.308	A ₁	A ₂ → A ₁	2017Q3	5.723	A ₇	A ₇ → A ₇
2009Q3	5.029	A ₄	A ₁ → A ₄	2017Q4	5.723	A ₇	A ₇ → A ₇
2009Q4	5.013	A ₄	A ₄ → A ₄	2018Q1	5.723	A ₇	A ₇ → A ₇
2010Q1	5.014	A ₄	A ₄ → A ₄	2018Q2	5.723	A ₇	A ₇ → A ₇
2010Q2	5.018	A ₄	A ₄ → A ₄	2018Q3	5.724	A ₇	A ₇ → A ₇
2010Q3	5.019	A ₄	A ₄ → A ₄	2018Q4	5.726	A ₇	A ₇ → A ₇
2010Q4	5.022	A ₄	A ₄ → A ₄	2019Q1	5.726	A ₇	A ₇ → A ₇
2011Q1	5.034	A ₄	A ₄ → A ₄	2019Q2	5.727	A ₇	A ₇ → A ₇
2011Q2	5.046	A ₄	A ₄ → A ₄	2019Q3	5.727	A ₇	A ₇ → A ₇
2011Q3	5.036	A ₄	A ₄ → A ₄	2019Q4	5.727	A ₇	A ₇ → A ₇
2011Q4	5.077	A ₄	A ₄ → A ₄	2020Q1	5.748	A ₇	A ₇ → A ₇
2012Q1	5.070	A ₄	A ₄ → A ₄	2020Q2	5.889	A ₇	A ₇ → A ₇

Step 6. From the FLRs identified in step 5, ten FLR groups were derived by identifying FLRs having the same LHSs. These ten groups are as follows: $G_1: A_1 \rightarrow A_4$, $G_2: A_2 \rightarrow A_1$, $G_3: A_3 \rightarrow A_2$, $G_4: A_3 \rightarrow A_3$, $G_5: A_4 \rightarrow A_4$, $G_6: A_4 \rightarrow A_5$, $G_7: A_5 \rightarrow A_5$, $G_8: A_5 \rightarrow A_6$, $G_9: A_6 \rightarrow A_7$ and $G_{10}: A_7 \rightarrow A_7$.

Step 7. The proposed forecasting rule for the $Q_{t_{FX}}$ data set is as follows:

Forecasting Quarterly Exchange Rates Using Fuzzy Time Series: A Catalyst for Business Projections Amidst Global Pandemic

- a) Let $F(t) = A_i$
- a) Select FLR groups where fuzzy value A_i is a transition.
 - b) Define:
 - 1) $Z_L = \{y/ \text{ } y \text{ is LHS of the selected FLRG}(s)\}$
 - 2) $Z_R = \{y/ \text{ } y \text{ is RHS of the selected FLRG}(s)\}$
 - c) Let $W = Z_L \cup Z_R$

To demonstrate this rule, let $t = 2004Q1$, this implies that $F(t) = A_3$. Thus, the FLRGs where the fuzzy value A_3 is transition are $G_3: A_3 \rightarrow A_2$ and $G_4: A_3 \rightarrow A_3$. The set of LHS and RHS of the selected FLRGs are respectively:

$$\begin{aligned} Z_L &= \{A_3, A_3\} \\ Z_R &= \{A_2, A_3\} \\ W &= \{A_2, A_3\} \end{aligned}$$

Table 2: Forecasted IFEM rates

Year/Quarter	Forecasted IFEM Rates	Year/Quarter	Forecasted IFEM Rates	Year/Quarter	Forecasted IFEM Rates
2004Q1	4.738	2009Q3	4.932	2015Q1	5.350
2004Q2	4.738	2009Q4	4.932	2015Q2	5.350
2004Q3	4.738	2010Q1	4.932	2015Q3	5.350
2004Q4	4.738	2010Q2	4.932	2015Q4	5.350
2005Q1	4.738	2010Q3	4.932	2016Q1	5.350
2005Q2	4.738	2010Q4	4.932	2016Q2	5.350
2005Q3	4.738	2011Q1	4.932	2016Q3	5.601
2005Q4	4.738	2011Q2	4.932	2016Q4	5.727
2006Q1	4.738	2011Q3	4.932	2017Q1	5.727
2006Q2	4.738	2011Q4	4.932	2017Q2	5.727
2006Q3	4.738	2012Q1	4.932	2017Q3	5.727
2006Q4	4.738	2012Q2	4.932	2017Q4	5.727
2007Q1	4.738	2012Q3	4.932	2018Q1	5.727
2007Q2	4.738	2012Q4	4.932	2018Q2	5.727
2007Q3	4.738	2013Q1	4.932	2018Q3	5.727
2007Q4	4.738	2013Q2	4.932	2018Q4	5.727
2008Q1	4.738	2013Q3	4.932	2019Q1	5.727
2008Q2	4.738	2013Q4	4.932	2019Q2	5.727
2008Q3	4.738	2014Q1	4.932	2019Q3	5.727
2008Q4	4.738	2014Q2	4.932	2019Q4	5.727
2009Q1	4.607	2014Q3	4.932	2020Q1	5.727
2009Q2	4.681	2014Q4	4.932	2020Q2	5.727

Step 8. The in-sample forecast value is:

$$\hat{q}_{t_{fx}} = \frac{1}{l}(X\mu_{(t)}^p),$$

where: $\mu_{(t)}^p = (\bar{u}_{11} \bar{u}_{21} \dots \bar{u}_{l1})$, an $(l \times 1)$ matrix,

\bar{u}_{i1} is mid-point of A_i , such that $A_i \in W, i = 1, 2, \dots, m$,

X , is an $(1 \times l)$ matrix with unit elements, $l \leq m$,

$$\forall t \exists k/k = Q1, Q2, Q3 \& Q4$$

Therefore, for $t = 2004Q1, \mu_{(t)}^p =$

$$\begin{pmatrix} 4.597 \\ 4.878 \end{pmatrix}, X = \begin{pmatrix} 1 & 1 \end{pmatrix};$$

Hence, $\hat{q}_{2004Q1_{fx}} = 4.738$; the forecasting results based on this rule for the periods in question are presented in table 2.

Step 9. Forecast evaluation

Statistical measures of the Actual IFEM (AIFEM) and Forecasted IFEM (FIFEM) values were presented in Table 2 in order to evaluate the performance of our proposed model. It can be realised that the actual and forecasted values statistics are approximately equal with slight differences. A pictorial comparison of these measures is shown in

figure 1 and figure 2 to further highlight the accuracy of the proposed model. Furthermore, the MAPE value consolidated this statement of equality of these measures as the value of the metric is within ten percent error, which is an indication of high accuracy as noted by (Akincilar, Temiz, & Şahin, 2011).

Table 2: Descriptive Statistics of Actual and Forecasted IFEM Rates

Measures	Max	Min	Mean	S	MAPE
IFEM	5.889	4.308	5.162	0.365	
Forecast	5.727	4.607	5.093	0.396	1.874

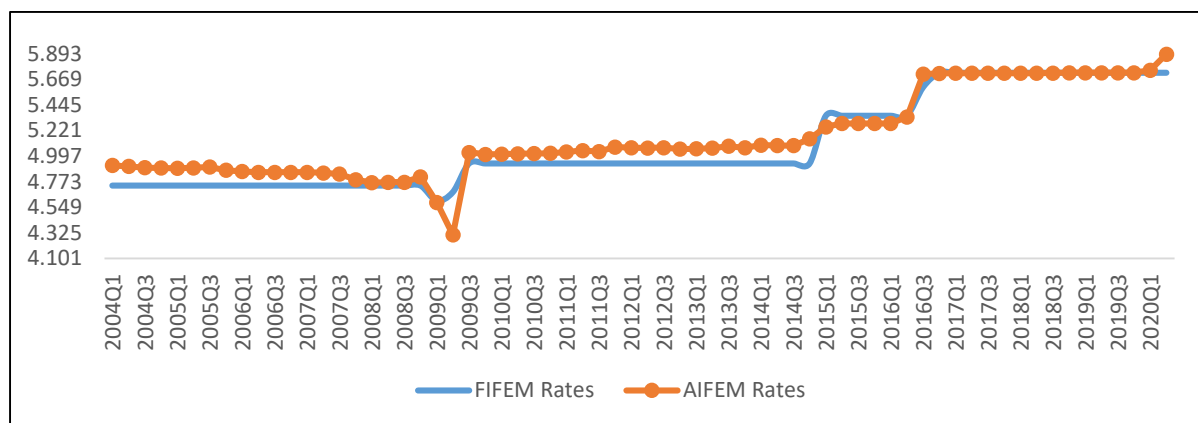


Fig. 1: AIFEM and FIFEM rates trends

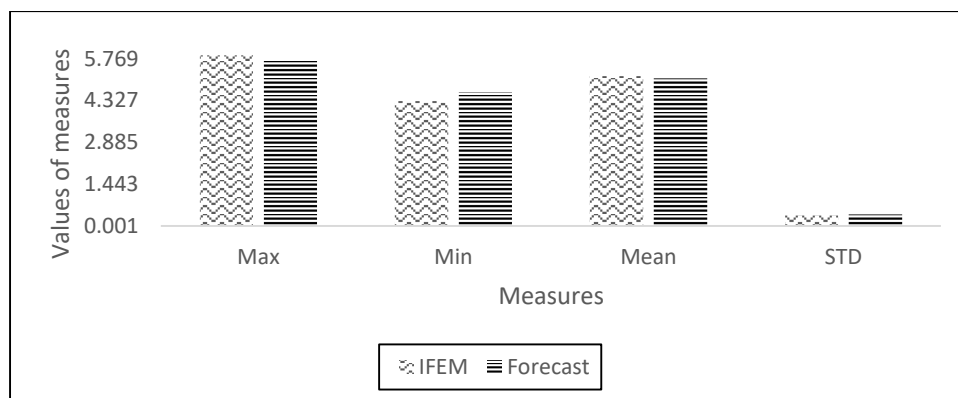


Fig. 2: Comparative view of descriptive statistics of Actual and Forecasted IFEM Rates

5. Conclusion

The development of optimal business decisions is a challenging task due to its sensitivity to the movement of foreign exchange rates particularly in an emerging economy.

Therefore, the search for currency rates forecasting framework in the midst of global pandemic cannot be over emphasized. This paper proposes a fuzzy time series forecasting model for quarterly average Inter-Bank Foreign Exchange Market (IFEM) rates of Nigeria

Forecasting Quarterly Exchange Rates Using Fuzzy Time Series: A Catalyst for Business Projections Amidst Global Pandemic

Naira against United States Dollar. The results of our analysis yielded a simplified Naira against US Dollar parity rates forecasting model with a MAPE (Mean Absolute Percentage Error) value of 1.87%, indicating that the model worth recommendation for prediction practice. However, the application of the proposed model may be biased due to frequent exchange rate policies, hence, need for caution.

References

- Akincilar, A., TemIz, I., & ŞahIn, E. (2011). An application of exchange rate forecasting in Turkey. *Gazi University Journal of Science*, 24(4), 817–828.
- Alves, A. M., de Lima e Silva, C. P., Severiano Junior, C. A., Gadelha, F. G. L. G. V., & Sadaei, H. J. (2018). An extension of nonstationary fuzzy sets to heteroskedastic fuzzy time series. *ESANN 2018 - Proceedings, European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning*, (April), 591–596.
- Boiroju, N. K., & Rao, M. V. (2015). *Forecasting Foreign Exchange Rates Using Fuzzy Time Series*. (January 2011).
- Chou, M. (2016). Fuzzy Time Series Theory Application for the China Containerized Freight Index. *Applied Economics and Finance*, 3 (3)(April), 127–135. <https://doi.org/10.11114/aef.v3i3.1568>
- Efendi, R., Ismail, Z., & Deris, M. M. A. T. (2013). *Improved weight fuzzy time series as used in the exchange rates forecasting of us dollar to Ringgit Malaysia*. (May 2014). <https://doi.org/10.1142/S1469026813500053>
- Garg, B., Sufyan Beg, M. M., & Ansari, A. Q. (2013). Fuzzy time series model to forecast rice production. *IEEE International Conference on Fuzzy Systems*, (March). <https://doi.org/10.1109/FUZZ-IEEE.2013.6622509>
- Ghosh, H., Chowdhury, S., & Prajneshu. (2016). An improved fuzzy time-series method of forecasting based on L–R fuzzy sets and its application. *Journal of Applied Statistics*, 43(6), 1128–1139. <https://doi.org/10.1080/02664763.2015.1092111>
- Hosseini, S. M., Fard, M. Y., & Baboli, S. M. (2011). A new method for stock price index forecasting using fuzzy time series. *Australian Journal of Basic and Applied Sciences*, 5(12), 894–898.
- Korol, T. (2014). Knowledge-Based Systems A fuzzy logic model for forecasting exchange rates. *Knowledge-Based Systems*, 67, 49–60. <https://doi.org/10.1016/j.knosys.2014.06.009>
- Lee, H., & Chou, M. (2004). Fuzzy forecasting based on fuzzy time series. *International Journal of Computer Mathematics*, 81:7(November 2013), 781–789. <https://doi.org/10.1080/00207160410001712288>
- Leu, Y., Lee, C., & Jou, Y. (2009). Expert Systems with Applications A distance-based fuzzy time series model for exchange rates forecasting. *Expert Systems With Applications*, 36(4), 8107–8114. <https://doi.org/10.1016/j.eswa.2008.10.034>
- Olatayo, T. O., & Taiwo, A. I. (2014). Statistical Modelling and Prediction of Rainfall Time Series Data. *Global Journal of Comuter Science and Technology*, 14(1).
- Pal, S. S., & Kar, S. (2019). Fuzzy time series model for unequal interval length using genetic algorithm. *Advances in Intelligent Systems and Computing*, Vol. 699, pp. 205–216. https://doi.org/10.1007/978-981-10-7590-2_15
- Permana, D., & Fitri, I. A. (2020). Application of Fuzzy Time Series-Markov Chain Method in Forecasting Data of Exchange Rate Riyal-Rupiah. *Journal of Physics: Conference Series*, 1554(1), 012005. <https://doi.org/10.1088/1742-6596/1554/1/012005>
- Sah, M., & Degtiarev, K. Y. (2005). *Forecasting Quarterly Exchange Rates Using Fuzzy Time Series: A Catalyst for Business Projections Amidst Global Pandemic*

Forecasting Enrollment Model Based on First-Order Fuzzy Time Series. *World Academy of Science, Engineering and Technology Volume, 1*(January), 375–378.

Sasu, A. (2010). An Application of Fuzzy Time Series to The Romanian Population. *Bulletin of the Transylvania University of Brasov* • Vol, 3(52), 125–132.

Song, Q., & Chissom, B. S. (1993). Fuzzy time series and its models. *Fuzzy Sets and Systems*, 54(3), 269–277. [https://doi.org/10.1016/0165-0114\(93\)90372-O](https://doi.org/10.1016/0165-0114(93)90372-O)

Tlegenova, D. (2015). *Forecasting Exchange Rates Using Time Series Analysis: The sample of the currency of Kazakhstan*. 1–8.

Comparative Evaluation and Analysis of Hardware/Software Partitioning Algorithms for Embedded System

Babangida Jauro Mohammed^{*1}, Hussaini Abatcha Geidam²

*E-mail: jaurobabangida21@gmail.com

¹Electrical and Electronics Engineering, Mai Idriss Aloomo Polytechnic Geidam, Nigeria

²Electrical and Electronics Engineering, Federal Polytechnic Damaturu, Nigeria

Abstract

Hardware/software partitioning has been considered as one of the most crucial steps in the design of embedded systems is i.e. deciding which components of the system should be implemented in hardware and which ones in software. Majority of the hardware/software partitioning problem formulations are $N P$ -hard, this is the reason why most researchers are focusing on developing efficient heuristic methods. This paper compare the most popular heuristic methods after which the most simplest and efficient methods were considered for the design of a combinatorial structure. Two versions of the partitioning problem were considered, one $N P$ -hard, and one with polynomial time solution. This is to understand the real cause of complexity in hardware/software partitioning. The heuristic makes use of problem-specific knowledge, and can thus find high-quality solutions rapidly, and also the polynomial-time algorithm serves as the basis for a highly efficient novel heuristic for the $N P$ -hard version of the problem and it was observed after comparison that multi-level algorithm when implemented gives more efficiency and the different versions when combined supplement each other by eliminating the problems encountered when each of them act alone.

Key words: Hardware/software partitioning, heuristic, $N P$ -hard, polynomial time solution

1.0 Introduction

The Hardware/software partitioning algorithms are tools which help researchers in decision making as to which function is to be implemented in hardware and software, to achieve design goals with regards to performance, power, size and cost. This part of the embedded system acts mostly as coprocessors [1].

The operating system (OS) resource managers were mostly used by software partitioning to segments the operating system, which limits the number of CPUs by creating areas where CPU resources are allocated to applications within the same operating system. This is a flexible way of managing data processing resources since the CPU capacity can be changed fairly easily, as additional resource is needed [2]. The Hardware partitioning on the other hand segments a server, by taking a single large server and separating it into distinct small systems. Each separate system acts as a physically independent, self-contained server, with own CPUs, operating system, separate boot area, memory, input/output subsystem and network resources [3].

Many algorithms have been implemented by researchers worldwide to obtain a solution to hardware and software partitioning problems. Some implemented single algorithm while some combined few of the methods to obtain a hybrid algorithm.

After review of so many of these algorithms, this work found that one of the best combination to make and achieve a better hybrid is to combine Particle swarm optimization (PSO) algorithm, and Genetic algorithm (GA) because PSO and GA shared some similarities. Both of them begin with a randomized population and each population has their own fitness value for evaluation. They update the population and search for the optimum with random technique. Their differences been that while PSO has no evolution operators such as crossover and mutation GA do have [14]. Also in PSO, particles update themselves with the internal velocity and has memory to store the parameters and is simpler and faster than GA [12].

PSO algorithm is population-based selection, where a set of convenient solutions will be obtained through a set of potential solutions. Each potential solution in search space will adjust its movement according to its own moving experience as well as the moving experience of other solutions. The solution will move towards a promising area to get the global optimum. In short, the purpose of this algorithm is to find the global optimum of the fitness function defined in a given area.

GA algorithm is natural-based selection. This method modifies a population of individual solutions repeatedly. At each step, GA picked the individual solution randomly from the current population to be parents and used them to produce the child for the next generation. As the steps keep on repeating, the population will move towards an optimal solution. There are three main rules at each step to obtain the next generation from the parent population, namely selection rules, crossover rules and mutation rules [11].

The combination of these two algorithms to design a hybrid algorithm gives a more or less optimal solution of a partitioning problem, because it utilizes the advantages of the two algorithms and also overcome their disadvantages. A better results in hardware and software partitioning problem is thus obtained. The GA is easy to express in solving a combinatorial optimization problem and PSO has fast convergence speed [12]. If both of these algorithms were combined, it is very obvious that the execution time and partitioning result of hybrid algorithm will be improved.

Two types of algorithms were used to implement the hardware software partitioning. They are; the exact and the heuristic or evolutionary methods. The exact method partitioning algorithms tends to be quite slow for bigger dimensions of the problem. Therefore, this research work uses heuristic method to increase performance while also reducing the cost of the system.

2.0 Problem Statement

Partitioning remain a key challenge that affect embedded system efficiency and optimization. Partitioning were done manually by the designers based on their experience in the olden days [4]. As the embedded system design increased in its complexity over the years, these efforts to do partitioning manually become unrealistic due to the number of components with different characteristic involved in the design [2].

Exact algorithms, such as branch-and-bound and dynamic programming were among the initial automated partitioning design proposed by researchers [6, 7]. But they are slow, heuristic algorithms such as genetic algorithms, particle swarm optimization and simulated annealing were then developed. These heuristic algorithms also have their own limitations [8, 9]. The PSO algorithm tends to back into its local optimum as the size of the given area is high and the size of convergence rate is low during the iteration process. The Genetic algorithm on the other hand has no guarantee of finding global maxima and requires a decent size of population and a large number of generations to obtain good results. In order to improve the performance, many hybrid algorithms were proposed by researchers. This work proposed a multi-level hybrid and compare their performances.

3.0 Objectives

- a. To evaluate the performance of multi-level hybrid algorithm in term of number of iteration to obtain stable cost.
- b. To compare the algorithm performance of the hybrid algorithms based on their levels to see how the hybrid level affect performance.

4.0 Methodology

A two and three-level hybrid models were designed using PSO and GA algorithms. They were used to optimize the performance of an embedded system by deciding the implementation of specific application or function in software or hardware. The number of iterations to achieve best cost and the time taking to reach the best cost were examined. And based on these parameters a comparison between GA, PSO and hybrid of GA and PSO were made and also a three-level hybrid model of GA-GA-PSO is constructed and compared.

In this work GA and PSO were implemented separately, and then two and three level algorithms were constructed. In the two level hybrid GA was implemented followed by PSO. And in the three level were implemented using two level successive GA algorithms followed by a PSO model. Figure 1(a) and (b) shows the algorithms architecture.

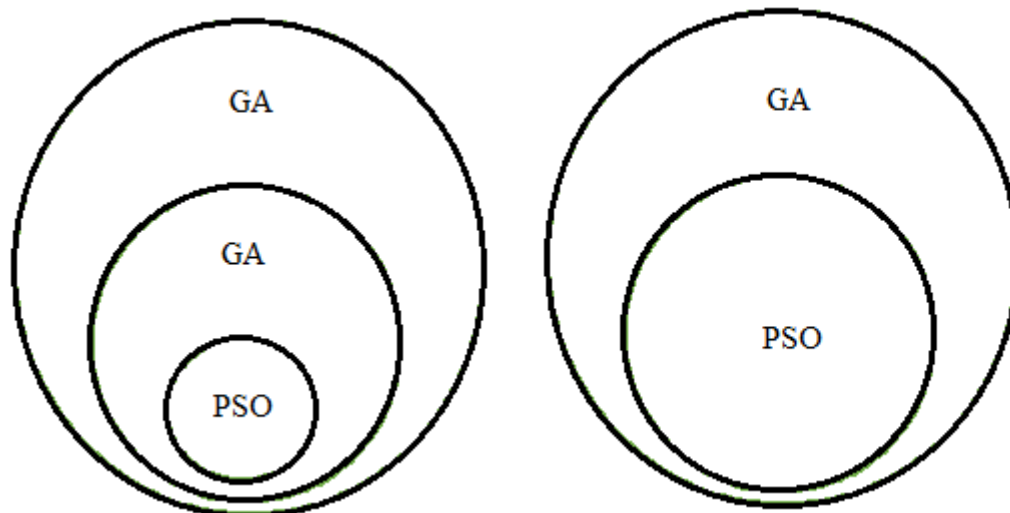


Fig.1. (a) Three level hybrid model architecture (b) two level hybrid model architecture

GA and PSO models were constructed individually in MATLAB environment before combining them into the hybrid model.

GA algorithm imitates the process of natural selection. The first step in GA algorithm is to initialize all the populations of solution and evaluate their fitness after which they will

undergo a crossover and mutation operations. The fitness for each of these solutions will then be re-evaluated after crossover and mutation. By sorting all the solutions according to fitness, the extra number of solutions with lowest fitness will be eliminated [15]. The flow chart of the implemented algorithm is shown in Fig. 2.

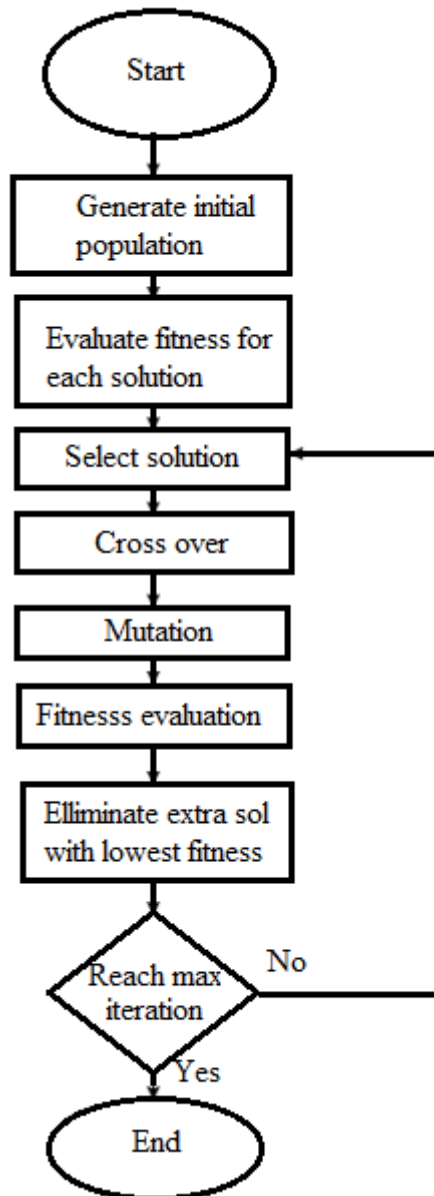


Figure 2: GA algorithm flow chart

PSO algorithm is a population based stochastic optimization technique inspired by social behaviour of bird flocking or fish schooling. The best way to illustrate it is by considering a group of birds searching for food in an area.

They don't know where the food is but they know how far the food is. The best strategy to reach the food is to follow the bird nearest to the food. PSO is an inspiration from this scenario [3].

The PSO model, was obtained by initializing the populations of solutions and fitness were evaluated for each solution. The velocity for

each solution was initially set to zero. The velocity was then updated using equations 1 and 2.

$$v[i] = (W * v[i]) + C_1 r_1 (pBest[i] - x[i]) + C_2 r_2 (gBest - x[i]) \quad (1)$$

$$x[i] = x[i] + v[i] \quad (2)$$

Where

$v[i]$ = velocity of particle

W = Damping inertia factor that takes values downward from 1 to 0 according to the iteration number. ($W = W * w_{damp}$)

C_1 = self-confidence (cognitive) factor

r_1 = random numbers between 0 and 1

C_2 = swarm confidence (social) factor

r_2 = random number between 0 and 1

$[i]$ = current position of particle

$p[i]$ = position vector of best solution that this particle achieved so far

$gBest$ = best position vector obtained so far by any particle in the population

The fitness of each of the particles were evaluated after changing their position and velocity. $pBest$ and $gBest$ were updated accordingly. These steps were repeated until maximum iterations were reached. Fig. 3 shows the PSO flow chart.

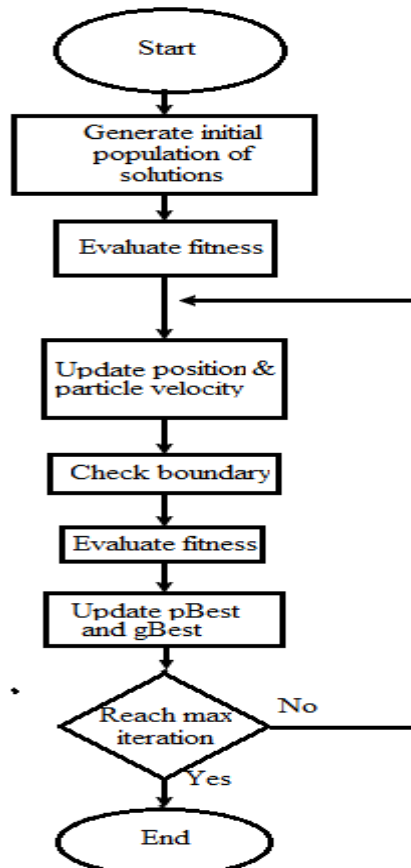


Figure 3: PSO flow chart

4.2

Multi-Level Hybrid Modelling

To implement the multi-level hybrid models, GA was implemented followed by PSO in the two level hybrid, while in the three level hybrid implementation, two successive GA algorithms model were constructed followed by a PSO model. In the two level hybrid, first GA flow chart was utilized up to extra data elimination then the set of data was passed over to PSO algorithm.

In the three level hybrid, the set of data was send over to the next GA algorithm for another round of crossover and mutation after data elimination of the first GA. the data was again passed through second data elimination of the second GA algorithm, after which it was passed over to PSO algorithm. The flow charts of the two level and three level models were shown in figure 4(a) and (b) respectively.

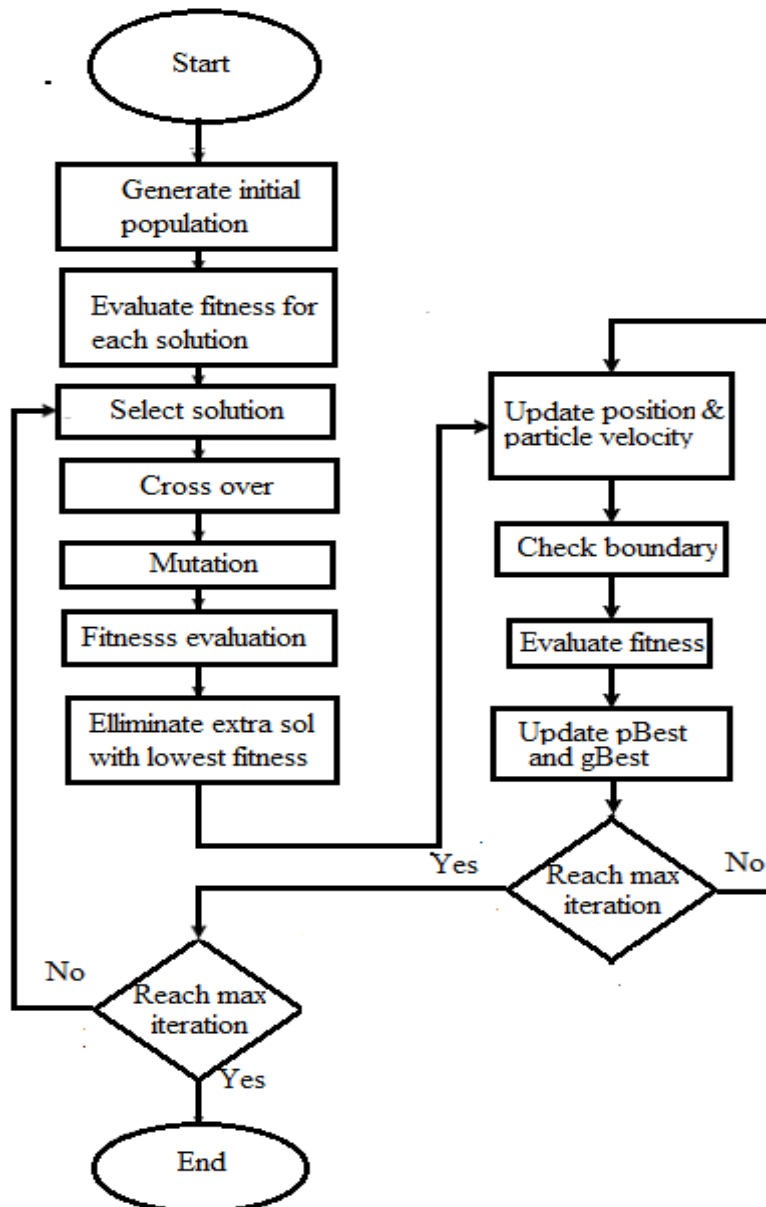


Figure 4(a): GA-PSO algorithm flow chart

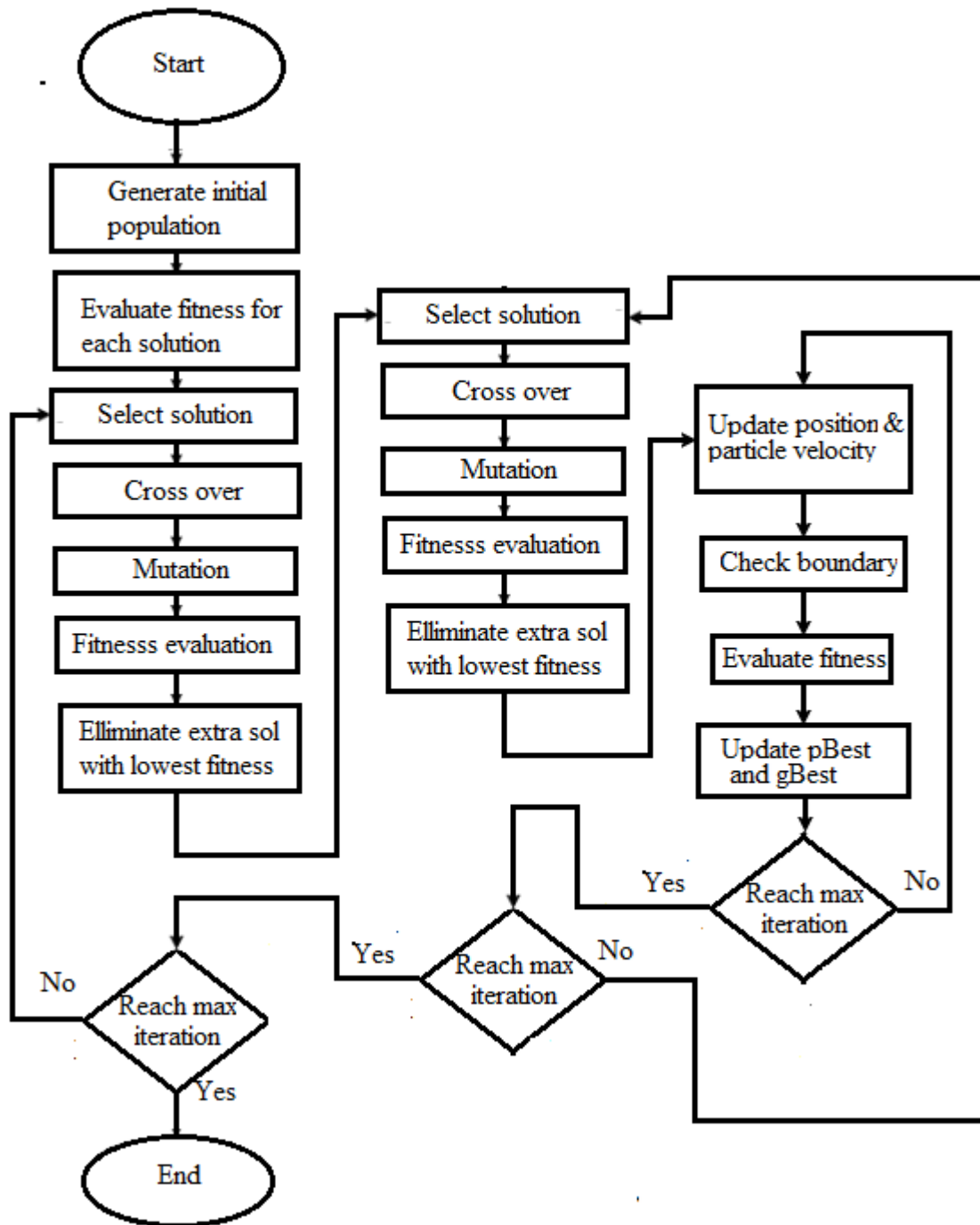


Figure 4(b): GA-GA-PSO algorithm flow chart

4.3. Setting of model and choice of Parameters

Binary solutions were used in this work with hardware node assuming a value of 0 and software node a value 1. Damping coefficient was made to decrease in each iteration by a

factor of W_{damp} which is set as 0.98. Both hardware cost and software cost are uniformly and randomly generated in the range from 1 to 99. The cost function is given in Equation 3.

Comparative Evaluation and Analysis of Hardware/Software Partitioning Algorithms for Embedded System

$$\text{Cost} = 100 * \left[\frac{\text{HWcost}}{\text{all HWcost}} + \frac{\text{SWcost}}{\text{all SWcost}} + \frac{\text{PWcost}}{\text{all PWcost}} \right] \quad (3)$$

Where

HWcost is the hardware implementation cost of particle

SWcost is the software implementation cost of particle

PW cost is the power implementation cost of particle

allHWcost is the total of hardware implementation cost of all particle allSWcost is the total of software implementation cost of all particle

allPWcost is the total of power implementation cost of all particle in both software and hardware

Since the node value must be 0 or 1 for a binary problem, the particles were rounded by using hard decision rounding (HDR). a node is mapped to hardware if the node value is lower than 0.5 and mapped to software if node value is greater than 0.5.

GA, crossover probability (Pc) is set to 0.9 and mutation probability (Pm) is set to 0.1. C₁ and C₂ for velocity equation were set to 2 and W was set to 1. Damping value is set to 0.97 for the PSO. Number of particle = 512 Population size = 60 Maximum iterations = 500

Fitness Proportionate Selection method was adopted for this research because of its simplicity and fastness for large number of particles. A random number R between 0 and 1 is chosen. Last individual whose accumulated normalized value is smaller than R was selected.

Heuristic Crossover method was also used for this work. This operator creates one child offspring from two parents. The child gene was obtained using Equation 4.

$$O_1 = P_1 + R (P_2 - P_1) \quad (4)$$

Where

O₁ is the child gene

P₁ and P₂ is parent genes

R is a random number between 0 and 1

And finally uniform mutation was applied for mutation operator. This was used to

replace the original value of the chosen gene with a uniform random value generated between lower and upper boundary for the gene.

5.0 Results and Discussion

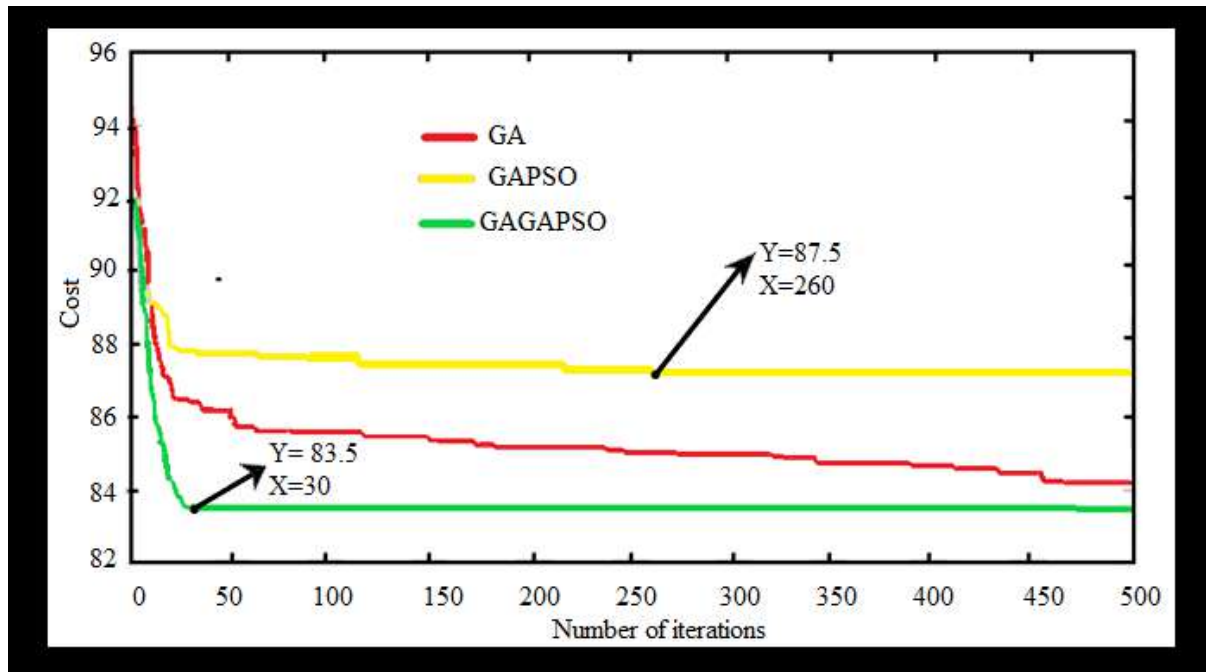


Figure 5: Cost versus Iteration graph of first simulation

The figure above shows the cost versus iteration graph of first simulation. Three algorithms, GA, GA-PSO and GA-GA-PSO were plotted on the graph to show the iterations needed to achieve the best cost. The best cost was said to be reached when the cost is not changing for 450 consecutive iterations. The GA cost keeps changing even after 450 iterations therefore the best cost cannot be determined. The algorithm was not stable to reach the best cost in fewer than 450 iterations. Therefore, the data will not take into consideration. The two level GA-PSO, on the other hand became stable after 260 iterations and the three level GA-GA-PSO was the lowest among the three algorithms and was stable after just 30 iterations, as such it has the best cost. Also, the GA-GA-PSO is able to

provide solution with exact value of 0s and 1s while GA algorithm and GA-PSO algorithm show decimal values. The time needed was then calculated from the number of iterations to know the algorithm efficiency using the following formula.

$$t = T_{total} \times \frac{\text{iteration}}{500}$$

However, since random particles were used in the simulation, the total time needed is slightly different for each simulation. Hence, 10 trials of the simulations were carried out and the average was taken. The result of 10 simulations were recorded in table 1 and 2. The averaged value was used for comparison and discussion.

Table 1: Result from GA-PSO algorithm

Trial	Number of Iteration	Total time needed (s)
1	260	5.3113
2	319	5.4610
3	172	3.8159
4	398	7.7873
5	300	5.0115
6	340	7.1647
7	313	6.5724
8	299	6.1977
9	386	8.1843
10	266	5.5137
Average		6.1020

From table 1. the average time needed to reach the best cost is 6.1020s. The GA-PSO algorithm is more efficient and stable than GA algorithm

alone and require less time to reach the best cost when compared to GA.

Table 2: Result from GA-GA-PSO algorithm

Trial	Number of Iteration	Total time needed (s)
1	30	1.1254
2	21	0.7100
3	15	0.6149
4	25	0.9702
5	15	0.5203
6	23	0.9236
7	21	0.8727
8	16	0.6687
9	12	0.4960
10	23	0.9102
Average		0.7812

From table 2. The time needed to reach the best cost for three level hybrid GA-GA-PSO model

is 0.7812s. And is the lowest among the three algorithms.

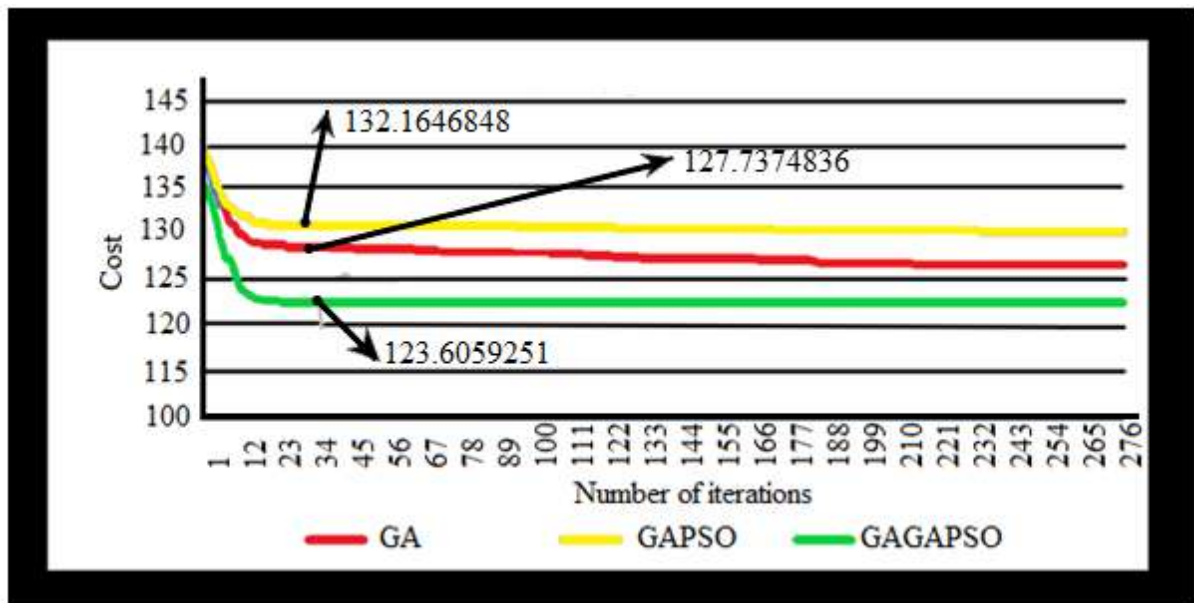


Figure 3. Cost versus iteration for 450 nodes

Figure 3 also shows the cost versus iterations graph of the three algorithms was plotted on the graph and it was seen that the GA-GAP-SO has a smooth graph with few iterations to achieve

the minimum cost. The number of iterations to reach the best cost is approximately 12-31 iterations.

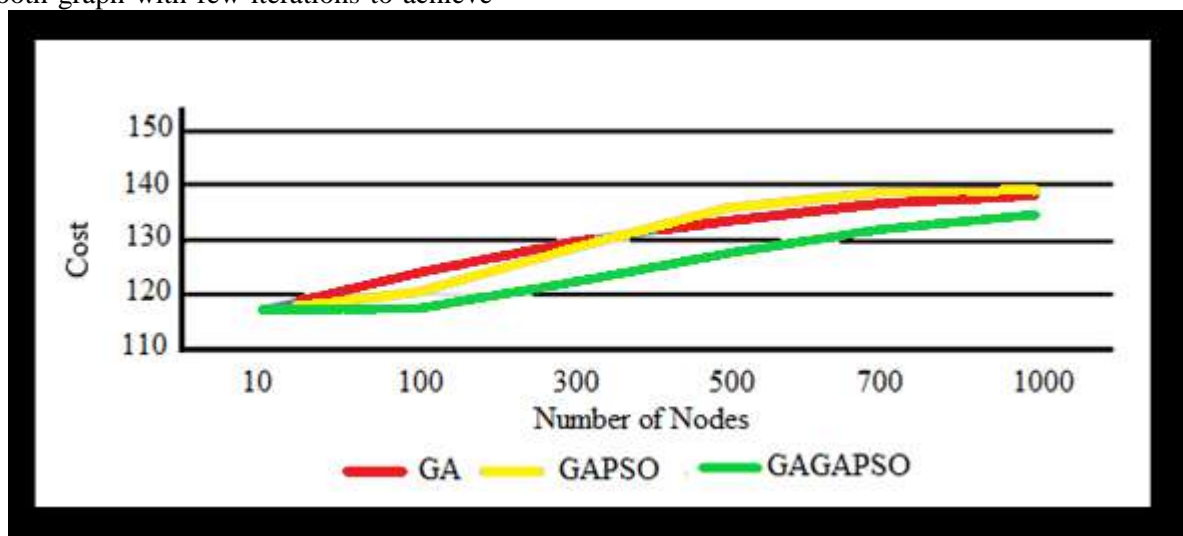


Figure 4. Cost versus number of nodes

Figure 4 shows the cost versus the number of nodes for the three algorithms. From this graph, the GAPSO performs better than GA when the number of nodes is less than 450. If the number

of nodes is more than 450, then GA performs better than GAPSO. From the graph also GAGAPSO performs better than GA and GAPSO for all nodes.

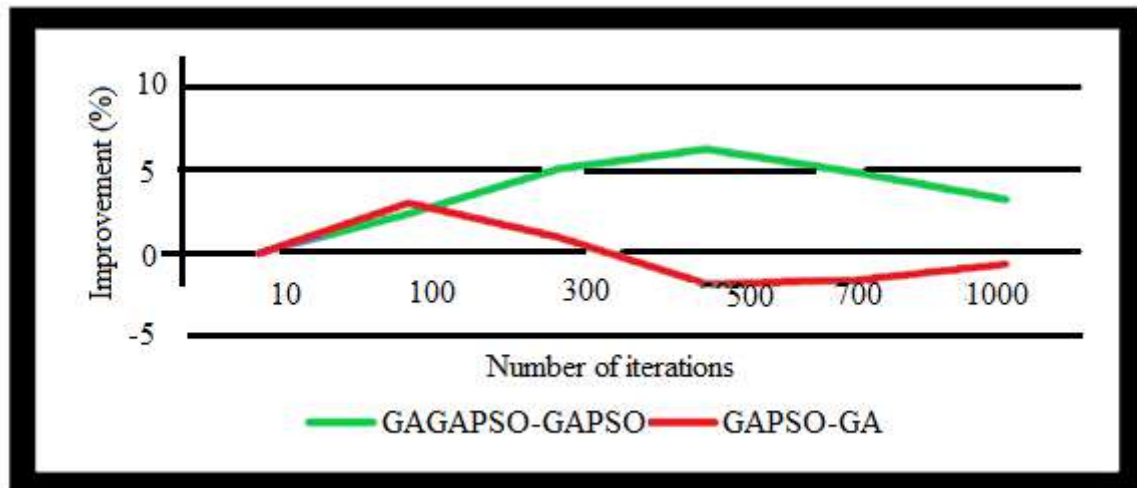


Figure 5. Improvement versus number of nodes

Figure 5 is the plot of percentages of improvement in terms of the minimum cost for GA-GA-PSO over GAPSO and GA-PSO over GA. It was observed from the graph that the maximum improvement of GA-GA-PSO over GA-PSO, is at 450 nodes, with an improvement of 6.3%. After 450 nodes, the improvement of GA-GA-PSO slightly decrease. And for GA-PSO over GA, the maximum improvement was achieved at the 100th node with improvement at approximately 3%. When the number of

nodes continuously increase, the performance of GA-PSO also decrease.

5.1 Comparison between algorithms

The GA algorithm was excluded from this comparison because it was not able to give its best cost within 450 iterations. Therefore, it can be concluded that GA algorithm is unstable and require longest time to reach best cost.

Table 3: Result comparison between 3 algorithms

Algorithm	Average time needed (s)
GA	-
GA-PSO	6.1020
GA-PSO-GA	0.7812

The average time needed for GA-PSO algorithm to reach best cost was obtained to be 6.1020s while that for GA-GA-PSO algorithm to reach best cost is 0.7812s. The average time needed for GA-GA-PSO is much lower compared to GA-PSO algorithm and have lower best cost value and computational time. Its solution also consist of exact value of 1s and 0s. Moreover the GA-GA-PSO algorithm also provides better solution for optimization, compared to GA-PSO algorithm and GA algorithm.

6.0 Conclusion

A three-level hybrid GA-GA-PSO algorithm that combines the advantages of successive algorithms into a single model has been designed for software hardware partitioning using MATLAB. This algorithm used shorter iteration to obtain stable cost compared to GA and hybrid GA-PSO algorithm. It also obtains the lowest cost compared to single and two level hybrid algorithms. It also proved to have better average execution time to reach best cost.. The slope was smoother and iterations to achieve best cost was also shorter.

7.0 References:

- Tiong Reng Xian, Zaini Abdul Halim, Ching Chia Leong, Tan Jiunn Gim
"Hardware-software partitioning using three-level hybrid algorithm for system-on-chip platform"
Bulletin of Electrical Engineering and Informatics Vol. 10, No. 1, February 2021, pp. 466~473 ISSN: 2302-9285, DOI: 10.11591/eei.v10i1.2201
- Mohamed b Abdelhalim, A.E. Salama, Serag E. D. Habib. Hardware Software Partitioning using Particle Swarm Optimization Technique. Conference paper from System-on-Chip for Real-Time Applications, the 6th International Workshop. Source: IEEE Xplore. DOI: 10.1109/IWSOC.2006.348234
- Imene Mhadhbi, Slim Ben Othman, and Slim Ben Saoud (2016). An Efficient Technique for Hardware/Software Partitioning Process in Codesign. Scientific Programming Volume 2016 (2016),
Article ID 6382765, 11 pages.
[dx.doi.org/10.1155/2016/6382765](https://doi.org/10.1155/2016/6382765)
- Marrec, P. L., Valderrama, C., Hessel, F., Jerraya, A., Attia, M., & Cayrol, O. (n.d.). Hardware, software and mechanical cosimulation for automotive applications. Proceedings. Ninth International Workshop on Rapid System Prototyping (Cat. No.98TB100237). doi:10.1109/iwrsp.1998.676692
- B., M., & Habib, S. E. (2009). Particle Swarm Optimization for HW/SW Partitioning. Particle Swarm Optimization. doi:10.5772/6740
- Binh, N. N., Imai, M., Shiomi, A., & Hikichi, N. (1996). A hardware/software partitioning algorithm for designing pipelined ASIPs with least gate counts. 33rd Design Automation Conference Proceedings, 1996. doi:10.1109/dac.1996.545632
- J. Madsen, J Gorde, P. V. Knudsen, M. E. Petersen, A. Haxthausen (1997). "LYCOS: The Lyngby cosynthesis system", Design Automation of embedded Systems, vol. 2, no. 2, pp. 195-236, April 1997.
- Z. A. Mann (2004). "Partitioning algorithms for Hardware/Software Co-design", 2004.
- J. Henkel, R. Ernst (2001) "An approach to automated hardware/software partitioning using a flexible granularity that is driven by high-level estimation techniques", IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. 9, no. 2, pp. 273-289, 2001.
- J. Kennedy and R. Eberhart. "Particle swarm optimization," Neural Networks, 1995. Proceedings., IEEE International Conference on, Perth, WA, 1995, pp. 1942-1948 vol.4. doi: 10.1109/ICNN.1995.488968
- Eberhart, R., & Kennedy, J. (1995, October). A new optimizer using particle swarm theory. In Micro Machine and Human Science, 1995. MHS'95., Proceedings of the Sixth International Symposium on (pp. 39-43). IEEE.
- Shi, Y. (2001). Particle swarm optimization: developments, applications and resources. In evolutionary computation, 2001. Proceedings of the 2001 Congress on (Vol. 1, pp. 81-86). IEEE.
- G.Li, J.Feng, C.Wang, J.Wang. Hardware/Software Partitioning Algorithm Based on the Combination of Genetic Algorithm and Tabu Search, 2015. Engineering Review, Vol 34, Issue 2, pg 151-160.
- R.Hassan, B.Cohanum, O.Weck A Comparison of Particle Swarm Optimization and The Genetic Algorithm, 2005. 46th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics & Material Conference. doi:10.2514/6.2005-1897
- Erik D. Goodman Introduction to Genetic Algorithms, 2011. GECCO '11 Proceedings of the 13th annual conference companion on Genetic and evolutionary computation on (pg.839-860).
- T.Blickle, L.Thiele A comparison of Selection Schemes used in Genetic Algorithms, 1995. TLK-Report Second Edition.
- A.J. Unbarkar, P.D. Sheth Crossover Operators in Genetic Algorithms: A Review, 2015. ICTACT Journal on Soft Computing, Vol 06, Issue 1, pg 1083-1092.
- Introduction to Genetic Algorithms, Part XI Crossover and Mutation, 1998. Retrieved from:
<http://www.obitko.com/tutorials/genetic-algorithms/crossover-mutation.php>

The invasion of Cattail (*Typha species*) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic Benefits in The Area

Mohammed Inusa Nguru* , Rabi Sabo and Mustapha A.U.

*Department of Science Laboratory Technology, School of Sciences, Mai Idris Aloomo Polytechnic,
P.M.B. 1020, Geidam, Yobe State, Nigeria*

*Email: ngurumuhammad@yahoo.co.uk

Abstract

*The Hadejia-Nguru wetland is an important wetland in the Sahelian region of Northern Nigeria. The wetland is very important to the regional economy by providing fertile alluvial soil for flood recession farming and dry season irrigation farming of vegetables and cereals (rice and wheat). It provides fish resources, fuelwood and other non-timber forest products. In recent years the area is facing a lot of problems and challenges among which are construction of dam at the upstream which distracts the normal flow of water to the downstream, population pressure causing conflicts between herders and farmers. The most serious problem is the proliferation of *Typha spp* an invasive species which blocks water ways and impedes farming and fishing activities, causing siltation and harbouring pests of grain crops (Red billed quelea), and vectors of malaria (Mosquitoes). The paper highlighted some management options for the *Typha* including, physical, mechanical, biological and chemical control as plan A. The Paper highlighted the various economic uses of the plant as option B for management including using it for biomass production, bio -coal production, harnessing the medicinal uses of the various plant parts, as a phytoremediation agent, using it as a source of food and incorporating it in the mixture of animal feeds among others.*

Key words: Wetland, Hadejia-Nguru wetlands, *Typha species*, Invasion, Management techniques

I. Introduction

Wetland ecosystem have a diverse array of direct and indirect functions. directly they supply water, provide a lot of wetland products such as fish and plant resources. indirectly they help in recharging the underlying aquifers (Acharya, 2000). Wetlands which includes fresh water swamps, marshes and peatlands covers an area of about 6-8 million km² worldwide and are ecosystems which are abundant source of natural capital (Barbier, 2011). They are among the most productive ecosystems in the World, only comparable to rain forests and coral reefs. They are regarded as the biological supermarkets, they produce great quantities of food that attract many animal species (Fagorite *et. al.*, 2019). wetlands serve a lot of functions, they provide services such as water purification and regulation of flows, fish and other related resources, provide habitat for plants, animals and microorganisms, they also serve as a site for recreation and tourism. hydrologically they serve as buffer against drought and flooding (Silvius *et al.*, 2000). The economic importance of dry Sahelian wetland like Hadejia- Nguru wetland can never be over emphasized as highlighted by Kimmage and Adams (1992). They provide agricultural surplus in most years (rice, wheat and vegetables). They are also an important source of fish and fuel wood. The Hadejia-Nguru wetlands are of international importance for breeding and wintering waterfowl. It was in this recognition that the Royal Society for the protection of birds (RSPB) and the World Conservation Union (IUCN) launched the Hadejia-Nguru wetlands conservation project in 1987 with the aim of conserving the natural resources and functions of the Hadejia-Nguru wetlands (Polet, 2000). The area is declared a Ramsar site for being an important Bird Area (IBA) and a wetland of national and international significance holding resident, inter-African and palearctic migrant birds in sub-Saharan region (Sabo *et al.*, 2021). Despite the severe ecological changes experienced by the area recently, it supports about 1.5 million people who relies directly or

indirectly from its aquatic resources such as fuel wood, potash, vegetables, fish etc. (Edegbene, 2018; Munishi, and Jackson, 2012). Furthermore, Wetlands play an important role in global climate change regulation by its ability to sequester carbon (Benalcazar, *et.al.*, 2019). They play an important role by serving as a transition zone of varying water regimes, they acted as natural filters that improves water quality through reduction in nutrients loadings, water aquifer, hence bearing the name " Kidneys of the catchment" (Apeverga, *et. al.*, 2019). Estimates puts it that more than 40% of the entire World's species and 12% of all animals are found in the wetlands (Ibrahim, 2020). Wetlands are considered as highly productive ecosystems they provide many goods and services to the people near and far away from them (Abdullahi., 2018). The Hadejia-Nguru wetlands (Fig. 1) is so important to the regional economy in terms of ecosystem provisional services. For this reason they have one of the earliest existing ecosystem valuation studies of any Nigerian (or African) wetland (Ayeni *et al.*, 2019). While Ayeni *et al* (2019) focused on monetary valuation of the provisional services of the wetland. other researchers such as Barbier *et. al.* (1993). assessed the economic importance of the wetlands highlighting the opportunity cost of their loss to the nation. Others such as Eaton and Sarch (1997) focused on the economic importance of wild resources in the Hadejia-Nguru wetlands.

Furthermore, Hollis *et al* (1995) Conducted a more general study of the natural resources climate and the hydrology of the HNWs. For Amans *et. al.* (1992) they looked at the productivity, stability and sustainability of farming systems in the wetlands. The primary drivers of degradation and biodiversity loss in the wetland include change in the climatic conditions in the area, Construction of dams and other infrastructures, land use change, water withdrawal, pollution, over-exploitation of resources and above all the introduction of invasive aquatic species -*Typha* (Tafida, and Galtima, 2015).

The invasion of Cattail (Typha species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

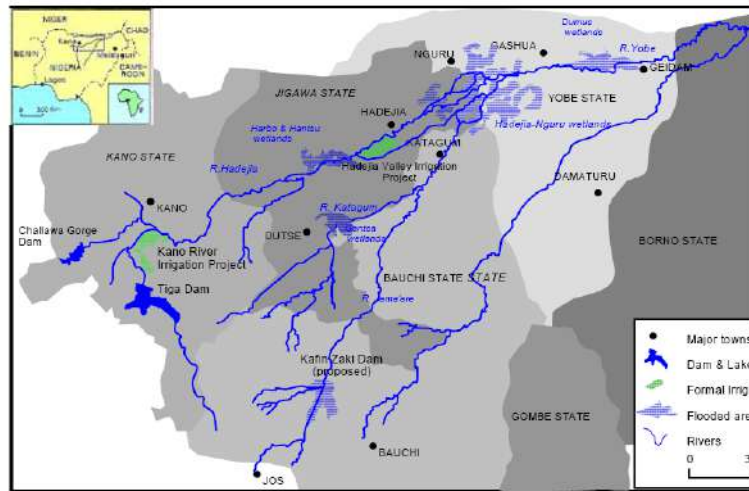


Figure 1: The Hadejia –Jama'are Komadugu-Yobe Basin

Fig 1. Map of Komadugu Yobe basin including Hadejia- Nguru and Jama 'are river.

II. Problems Associated with Hadejia - Nguru wetlands

Wetlands are under intense pressure from anthropogenic activities which include agricultural expansion, urbanization, pollution from agricultural production, industry and households. Other factors that are negatively affecting the sustainable management of the wetlands include poverty, pressure from population growth and immigration (Tafida, and Galtima, 2015). Some of the institutional problems of this basin includes the modification of the natural run off by the construction of dams and the associated large –scale irrigation schemes such as the Tiga and Challawa dams and the Kano irrigation schemes (KRIP) in the upper basin, The Hadejia valley irrigation project (HVIP) in the middle. While on the Jama'are River there is the construction of the Zaki Dam (Chiroma, 2002). The major threats facing the wetlands include population pressure, invasive *Typha* grass, overgrazing, overfishing and shrinking of the floodplains because of diversion from dams, irrigation developments and drought (Idris 2008; 2013; Mohammed 2014; Olalekan 2014; Abubakar, 2016). *Typha* is a common problem of the wetlands throughout the world, they tend to choke off any other vegetation and make a poor habitat for many waterfowl and other birds

(Mitsch & Gosselink, 2015). *Typha* is the primary producer of estuarine ecosystems, which has the ability to concentrate elements and compounds from the polluted soils and water bodies and to metabolize molecules in its tissues (Ali et al., 2020). Consequently, it can incorporate large amounts of elements from the environment (Minkina et al., 2021). Cattail stands provide nesting sites for birds and spawning areas and protection for fish (Mitich, 2000).

In addition, the invasive aquatic plants reduce the flow of water in the irrigation canals by reducing the available space and acceleration of frictional resistance to the flow, thus expediting a sedimentation process in the infrastructures. Fisheries are threatened and rice paddies, which depend on a good irrigation system is successively invaded reducing the agricultural yield (Sabo et al. 2010). Furthermore, the need to investigate the effect of this grass on the livelihood of people living in this area becomes prominent. The need to carry out this research work stems from the fact that the plant (*Typha*) presence in the wetland has interfered markedly with the utilization of water and land resources. This inhibits the development and expansion of agriculture which is the primary occupation of the inhabitants. From the foregoing, it become imperative to investigate the level which this weed affect livelihood of the people of the area, because assessing the effect of this weed will

The invasion of Cattail (Typha species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

give a clear understanding of the damages and constraints to wellbeing of people. Consequently, this study answers the following research questions. One of the serious problems affecting the wetlands is bio invasion. *Typha* have been reported to be invading rice and cassava fields, these blocks and redirects the flow of rivers and channels of the associated rivers, this alongside affects the fishing in the area. This makes the area liable to environmental degradation and ecosystem food chain imbalance, biodiversity deformation, this is mostly caused by human activities such as industrialisation, , mineral exploitation urbanisation and civilisation (Olalekan *et al.*, 2014).

To add more, *Typha* species have been the primary focus of research on wetland biomass crops in Minnesota because of their productivity, adaptability, large sugar and starch rich rhizome system, exceptional pest resistance, and aggressive growth and regeneration characteristics. Evaluation of the commercial potential of *Typha* plants as an energy resource depends on an understanding of the tradeoffs between productivity and production costs (Johnson, 1988). Upstream developments have affected incoming water either through dams which alter the timing and size of flood flows or

through diversion of surface or groundwater for irrigation activities. The main cause of unexpected reduction in extent of the flooded area is also linked to reoccurring drought which is a persistent, stochastic environmental problem facing most arid and semi-arid environments (Bukar *et al.*, 2021).The spread of invasive *Typha* spp, taking over flood rice and cassava fields, blocking river channels, and undermining fisheries, is seen as a major problem. See figure 2, 3, 4 and 5 for *Typha* invasion). *Typha* spp or 'cattail' is a species of water loving plant that can, under favourable conditions (that is. in shallow permanently inundated areas), proliferate and become difficult to control, making the plant an invasive species (Chiroma, Mohammed J., 2003). Cattail (*Typha* spp), is a plant known to local people as Kachala around Hadejia-Nguru wetland area of North-eastern Jigawa and north western parts of Yobe States (Akinsola *et al.*, 2010). 24% (8 of 33) of the World's most invasive plants are wetland species (kercher, 2004). The invasion of this plant species In the Hadejia – Nguru wetlands and in the Hadejia-Jama'are Komadugu Yobe basin in general has caused a serious problem that can be considered a threat to ecology and economy in the past seven years or so (Ayeni *et al.*, 2019; Murray-Hudson and Mmopelwa, 2011).



Fig 2. A fisher man floating on gourd at Hadejia- Nguru River. Fig.3 Fishermen paddling canoe in Hadejia- Nguru wetlands. Notice the invasion of *Typha* grass on the fore ground.

Source: Hadejia - Nguru wetland.

In the last fifteen years, river channels, lakes and fadamas in the wetlands have been taken over by *Typha*, along with many hectares of farmland and potential grazing lands. On the Marma channel and Nguru Lake for example, where *Typha*

invasion is more severe, over two thirds of potential farming and grazing lands have been taken over by the plant. Conversely it has contributed to the desiccation of Burun gana channel, where about 60% of dry season

The invasion of Cattail (*Typha* species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

irrigation farms are wasting. In addition, the grass provides a harbour for large flocks of quelea birds that seasonally destroy cereal crops. This problem of *Typha* has over the years become a serious concern to the local communities and to traditional authorities, government institutions and line agencies with a responsibility for enhancing the livelihoods of people living in the affected areas. Repeated efforts, ecological studies and manual clearing have yielded very little results in the past. (Chiroma, Mohammed J., 2003).

Typha swamp harbour more mosquito larva than the open water. This make the surrounding community of *Typha* infested rivers prone to mosquito bites and malaria disease.(Salako *et al.*, 2016, Layne, 2009) . Ramsar,(2000) reported the colonisation of wetlands by *Typha* (*Typha Australis*) as an example of the growing problem worldwide (Sulaiman, I.M., Cresswell, 2014). Invasion events have increased substantially in the last 200 years due to human migration and commerce (Mitchell, 2011). Biological invasions are considered as a key threat to biodiversity (Borokini *et al.*, 2012). *Typha* is a species of hardened aquatic macrophyte that grows wildly on water channels and river banks During the recent time it is a common feature along the HNW and is a serious nuisance to the communities. It makes passage by canoe used for fishing difficult or access to remote farmlands (Kaugama & Ahmed, 2014). Changes in water regime from season to all year round have caused the invasive *Typha* to establish itself in the basin This causes difficulty in manipulating water to be used for Agriculture. *Typha* impede the flow of water for irrigation by growing naturally in

ditches, swamp and marshy areas. They are identified as one of the commonly water loving plants (M.M., 2012). They have been considered second major threat to biodiversity following habitat destruction (Babagana *et al.*, 2018) . The specie has been identified as a serious threat to the sustainability of the whole farming house hold. It is a serious problem threatening the sustainability of the whole irrigation scheme. About 90% of the main channels were blocked by this perennial species, this eventually blocked free flow of water into irrigation fields(Bukar *et al.*, 2021; Sabo, 2016). This has inflicted object poverty to majority of communities to the extent that people are thinking of migrating to neighboring Niger republic or Chad after losing hope of any intervention from government. The specie has been identified as a threat to the livelihood of many families in the basin. *Typha* invasion increases methane production relative to native dominated marshes in the Great Lakes region. studies showed that above ground biomass doubled with *Typha* invasion and was positively correlated with methane emissions (Lawrence *et al.*, 2017). A large productive Fadama land amounting to about 60% has been taken over by *Typha* grass in Jigawa state. Around the Madachi area in Kirikasamma local government the figure is as high as 80%. Productivity in fadama (Valley –bottom or flood plain around a river that floods or becomes wet when the river is high) agriculture has, as a result, shrunk to 4% of its former value(Chiroma, *et. al.*, 2003). The plant which can grow up to two or more meters in height has a higher growth rate than any other aquatic plant (Zungum, IU; Imam, 2019).



Figure 4 and 5. Rice field inside the wetlands and mounds of cleared aquatic vegetation inside water. Source Julian Thompson (2001)

While food and fish production are reducing, the extent of *Typha* invasion is undergoing exponential increase in the past 5 to 10 years. This gradual increased the silting of channels caused by the slow all-year round flows. In the overall scenario *Typha* invasion have increased from 550 ha to over 200 square kilometers in the last 10 years (Yarima Mohammed, 2016). In North Dakota USA, another problem with cattail-choked wetlands is the assemblage of large numbers of migrating Red-winged black birds (*Agelaius phoeniceus*), Common Grackles (*Quiscalus quiscula*) and Yellow-headed black birds (*Xanthocephalus xanthocephalus*) roost there and damage nearby crop fields (Dan Svedarsky *et al.*, 2019; Linz *et al.*, 2011). In Hadejia-Nguru wetlands the dense stands of cattail provide a roost for the migratory Red-billed quelea (*Quelea quelea*) which damages nearby rice fields and other grains.

III. Management of Typha Grass (Cattail):

Cattails are aggressive species that quickly inhabit disturbed areas, ultimately reducing diversity and productivity of wetland systems. They disperse seeds over a wide area and preempt spaces rapidly following a disturbance. They are mainly self-pollinators, but can also cross-fertilize (Sharp *et al.*, 2002). Several efforts were made to control *Typha* in Hadejia-Nguru

wetlands. From available information from cited literatures several efforts were made by communal people to clear water channels and construction of local dykes by the people to prevent flooding which pose threat to their settlements. The Jigawa State Government did some mechanical excavation to clear the channels. Local government due assist people in manual clearance of the *Typha* in channels using cutlasses and sickles. During dry seasons when the waters dry up burning is prescribed as means of *Typha* clearance. Non-governmental organizations also help in clearing the *Typha* vegetation and raise awareness among the communities to participate in communal efforts and also fund some proposals by people (Sabo B.B., 2016). Some of the NGO's includes, Joint wetlands livelihood project (JEWEL) Nigeria Conservation Foundation (NCF) Hadejia-Nguru wetland Project (HNWP), Coalitions for change C4C (a DFID project), Wings over Wetlands, IUCN ROCA, LCBF/GEF project, Ramsar Swiss Grant, Komadugu Yobe basin Development initiative and Hadejia – komadugu -Yobe basin trust fund, *TYPHA* Project an action research component of TRIMING (Transforming Irrigation Management in Nigeria), funded by the World Bank, 2017-2020. Also, in participation were governmental bodies such as Federal ministry of water resources, Hadejia-Jama'are River Basin Development Authority (HJRBD), Federal and State Integrated Water Resources Management, Chad Basin Development

The invasion of Cattail (Typha species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

Authorities (CBDA). Right now, The Yobe State Government is doing a clearance at Magujin Idi in Kirikasamma Local Government Area. Some months back the Federal Government and some prominent politicians have done the same effort in the area. There are three alternative control methods for the management of cattail. These are: -

1. Physical method of controlling *Typha* grass

Physical management involves the manipulation of the plant which in turn acts on the plant. Several physical methods are available including dredging, drawdown, benthic barriers shading or light attenuation and nutrient inactivation (Madsen, 2000). Account of how the plant was controlled using shading was described by Abdullahi *et al.*, (2019) using Black Tarpaulin in different measured sampling sites with a given counted species of *Typha* and leaving another site with the *Typha* species exposed with no covering with the Tarpaulin. It was found out that there was high mortality of *Typha* covered with Black Tarpaulin. Other physical methods of cattail control include: - shading and manipulating water levels (Solberg & Sojda, 1993; Svedarsky *et al.*, 2019). This method is mostly done by the communal people. Hand or mechanical cutting of cattails followed by submergence of all cattail stems results in high control (Apfelbaum, 1983). Mechanical methods use machines such as mowing machines. The efficiency of cutting *Typha* using mowing boat was tried in Senegal river and was found to be effective in removing the aquatic weed. However, the method is slow and regrowth of the vegetation was observed in some portions of the experimental sites (Hellsten *et al.*, 1999). This is mostly carried out by government and other agencies. Various mechanical methods of control were applied including clearing using cutlass and sickles. After cutting the area is flooded 15 to 18 inches above the cut stalk. This method was successful in the Murrumbidgee irrigation area of South Wales (Project, 2017). cutting, crushing, disking prescribed burning, grazing, Mowing during winter time over ice followed by flooding for the duration of the growing season reduced a *Typha*

standby 89% depending on how the cut stems are submerged inside water after the flooding the result could be 100% reduction in the *Typha* stand (Miklovic, 2000). (Birnin Yauri, *et al.*, 2019). Cutting and reflooding with at least 8cm (3.1 in) of standing water was found to be effective as reported by Apfelbaum (1985). He also reported the use of black polyethylene tarps to control cattail (Apfelbaum, 1985). However, because of the tedious nature of using hand implements in removing weeds, particularly that the weed has to be removed from the water at the end of the day. Long stretches of rivers and lakes larger than one acre and above may therefore require some mechanised approach (Seagraves, 1988). From the above examples it can be seen that, the method can be applicable to Northern Nigeria.

It has the following advantages: -

- It is target specific.
- No danger of chemical toxicity to the environment.
- The cut weed can be used for other purposes.
- There is availability of cheap labour in comparison to places like UK and USA where manual labour is very expensive.
- Generally, people in Northern Nigeria are collectivist, they have the tendency to come and work together for the benefit of the whole community. They can engage in a voluntary communal work locally known as (aikin gayya). Communal voluntary work is something very common in Northern Nigeria. If all the stake holders in the study area, the government, NGO's, traditional rulers, politicians, all other community members will come together to make it participatory where each and every one will have a certain role to play. The government will play the role of execution of policy and planning, budgeting and financing, the NGO's will help with expertise and advice and donations. The local people will help with their local experience and manual labour when it is needed. Government will buy hand tools such as sickles, syches, and chain.

The invasion of Cattail (*Typha* species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

2. Chemical method of controlling *Typha* grass

Chemicals used to control plants are called herbicides. About 200 herbicides are registered in the US and only fewer than a dozen is labeled for use in the aquatic sites. These herbicides under various trade names contains combination of seven active ingredients copper, 2,4-D, dichlobenil, diquat, endothall, fluoridone and glyphosate (Fennessy, 2001). The use of chemical in controlling *Typha* has also been reported by Apfelbaum but with great cautious as using chemical in natural areas have some effects on non-target species (Apfelbaum, 1985). Using aquatic herbicide to reduce cattail appears successful in some wetlands. Glyphosate is the only registered herbicide with the EPA. Using Glyphosate to treat cattail appears successful but the cattail may grow back in later years (Ralston & Bleier, 2004). In Pakistan a trial of different management options for cattail was done using 8 different treatments with glyphosate under different treatments (1.0, 1.5, 2.0 kg a.i. ha⁻¹), isoproturon (0.741 kg a.i. ha⁻¹), Clodinafop-propargyl 90.3 kg a.i. ha⁻¹), and halosulfuron methyl (0.0375 kg a.i. ha⁻¹), along with a hand-weeding treatment and an untreated control. it was find out that glyphosate did well out of the 8 options and glyphosate dose of 2 kg a.i. ha⁻¹ proved the best in *Typha* control (Gul *et al.*, 2018). Kanatas (2019) reported the combined use of mowing and herbicide give an efficient result. in particular, no any herbicide succeeded to adequately control *Typha* spp without previous mowing. The combined use of mowing and latter applying herbicide gives a better result (Kanatas, 2019). In consonance to this Wilcox *et al* (2017) reported the cutting of cattail ramets during the period with reduced rhizome carbohydrates followed by hand wicking resprouted ramets with herbicide in later summer, this allows herbicide to be absorbed by the rhizomes and consequently gives a better result (Wilcox *et al.*, 2017).

Elgersma *et al* (2017) reported that under high-nutrient conditions in *Typha* stand, combinations of treatments (burning, mowing and using

herbicide) were generally more effective than treatments applied singly. and conversely combinations were not more effective than singly-applied treatments in the low nutrient wetlands. They concluded that controlling nutrients inflow into wetland is potentially more effective than using burning, herbicide and mowing, the effectiveness of these methods is context-dependent and strongly modified by nutrient availability (Elgersma *et al.*, 2017). Effectiveness of glyphosate in controlling *Typha* using different doses have also been reported by (Sesin *et al.*, 2021). A mixture of dalapon (15-30 kg/ha) and amitrole (6-12 kg/ha) applied to foliage of the weed at its full spike stage will destroy its shoots as well as the shallow rhizomes. In North Dakota US, depredation by black birds on Sunflower was identified. A benefit/ cost analysis of cattail control using chemical was conducted to identify trade-offs and to estimate the efficacy of chemical treatment. Both Sunflower farmers and the society benefited as damage on sunflower was markedly reduced and population of waterfowl increase with the fragmentation of cattail stand. A 70:30 ratio of open water body and cattails was achieved (Leitch *et al.*, 1997).

3. Biological method of controlling *Typha* grass

This involves the use of organisms such as Grass carp, Cattail borer (*Bellura oblique*). This insect belongs to the order Lepidoptera and family noctuidae. It is one of the three species of *Bellura* found in Florida and presumably the south eastern United States (Pratt, 1986). The host plant to this specie of this insect is the *Typha specie*. Not very much is known about the mode of life and extent of destruction caused by this specie. They normally bore through the stem of *Typha* plant hence the name cattail borer. A high population of this insect could lead to dramatic impact to cattail (Grodowitz *et al.*, 1998). Furthermore, another insect Cattail caterpillar (*Simyra henrici*) belongs to the class insecta, order Lepidoptera and family noctuidae. It is common widespread specie found to be feeding on cattails. Other plant hosts are *Salix* spp, *Cephalanthus* spp *polygonum specie*. The larval stages are the only

The invasion of Cattail (Typha species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

damaging stage (Grodowitz et al., 1998), etc. Insects cause considerable damage or mortality to cattail aerial shoots, spikes, and rhizomes. *T. latifolia* is more heavily damaged by herbivorous insects, especially the leaf-mining and stem-boring noctuid moths *Bellura obliqua* and *Achanara oblonga* (Smith, 2017). Damage by black bird is reduced by fragmenting dense cattail stands near sunflower areas. (Ralston & Bleier, 2004). Some aquatic mammals such as the manatee or sea cow (*Trichechus manatus*) have also been found to be herbivorous in nature and feeds actively on aquatic weeds such as *Typha*, water hyacinth and other aquatic vegetation (Richardson, 2008; T., 2000; Zimdahl, 2007). Manatee is a threatened species in Nigeria and there is need for a gradual build-up of its stocks. The animal has been identified as an excellent aquatic weed controller in areas where the weeds are considered a nuisance. In addition, the animal has also been found to be a popular specie for attracting tourist worldwide and therefore may be an important animal for game viewers and for the location of hotel. Even though there are various existing methods for the control of aquatic plants, there is no single method that is suitable for every situation (Hussner et al., 2017).

IV. Harnessing the Economic importance of *Typha* grass

Cattail served a variety of economic needs, In the US it was an important element in several aspects of Salish ritual life. In particular, cattail down was strongly associated with traditional funerary rites among the Salish. The ritual significance of the down may be in part associated with the symbolic importance of the color white in the worldview of the Coast and Interior Salish (Ostapkowicz et al., 2001). Aquatic macrophytes play a vital role in the removal of pollutants and the maintenance of the overall system. The aquatic macrophytes have multiple roles to play in constructed wetlands, which have made them an essential component in constructed wetland systems. In Portugal industrial waste water treatment from tanneries was tried in a constructed wetland by planting two species *Phragmite australis* and *Typha*

latifolia and the two species provided high removal of organics from the tannery waste water (Calheiros et al., 2009).

The macrophytes promote a series of chemical and bio-chemical reactions by providing an oxygenated environment for the microbes in the root zone resulting in the decomposition of organic matter, bacterial growth and assimilation of nutrients into their tissues. The choice of macrophytes is very important because, it not only serves the purpose of nutrient removal from the wastewater, but also be of economic interest. Among the emergent macrophytes, Phragmites and *Typha sp.* were widely used in wastewater treatment in CWs. (Arpudhalin, 2017).

Under a controlled environment in a constructed wetland, aquatic macrophytes and bacteria use the natural processes such as sedimentation, filtration, adsorption, photolysis, degradation, microbial uptake, plant uptake, volatilization, nitrification/denitrification, biotic/abiotic etc. to treat the waste water (Arpudhalin, 2017). For a very long time *Typha latifolia* and *T. angustifolia* have been used by man as a source of food (Mitich, 2000). They are potentially used in the production of active carbon. They are used as substrate for the growth of mushroom. They also have a potential use for biomonitoring Cu, Cd, Cr, Fe, Ni, Pb and Zn contamination through analyzing their concentration in plants (Fahlgren & Fahlgren, 2017). In lake Winnipeg Manitoba, harvesting cattail as biomass have attracted a lot of benefits for both public and private sector (Dohan & Grosshans, 2012). Harvesting novel plants such as cattail as a sustainable and renewable biomass feedstock for use in the biomass industry also delivers valuable ecological services through nutrient capture and reduction of nutrient loading (i.e. phosphorus) to downstream water bodies (Grosshans, 2014). Brinson et al. (1981) report values for above-ground biomass of between 0.996 and 1.68 kg dry mass m⁻² for *Typha latifolia* marshes in wetlands characterized by high water level fluctuations in North America and England. Paludiculture is the cultivation on wet peat meadow areas. (“Palus “Latin for “swamp”). The method was developed in Germany around the 1990s and it enables a sustainable use of previously degraded land by

The invasion of Cattail (Typha species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

rewetting the peat lands. One of the promising plants for paludiculture is the marsh plant cattail (*Typha spp*) (Kenniswerkplaats *et, al.*, 2017). Agriculture on peat meadow areas is based on

water drainage of the lands, which is needed for e.g. ploughing, sowing and harvesting. cattail has been proposed as wet crop for cultivation peatlands in the North East of Friesland.

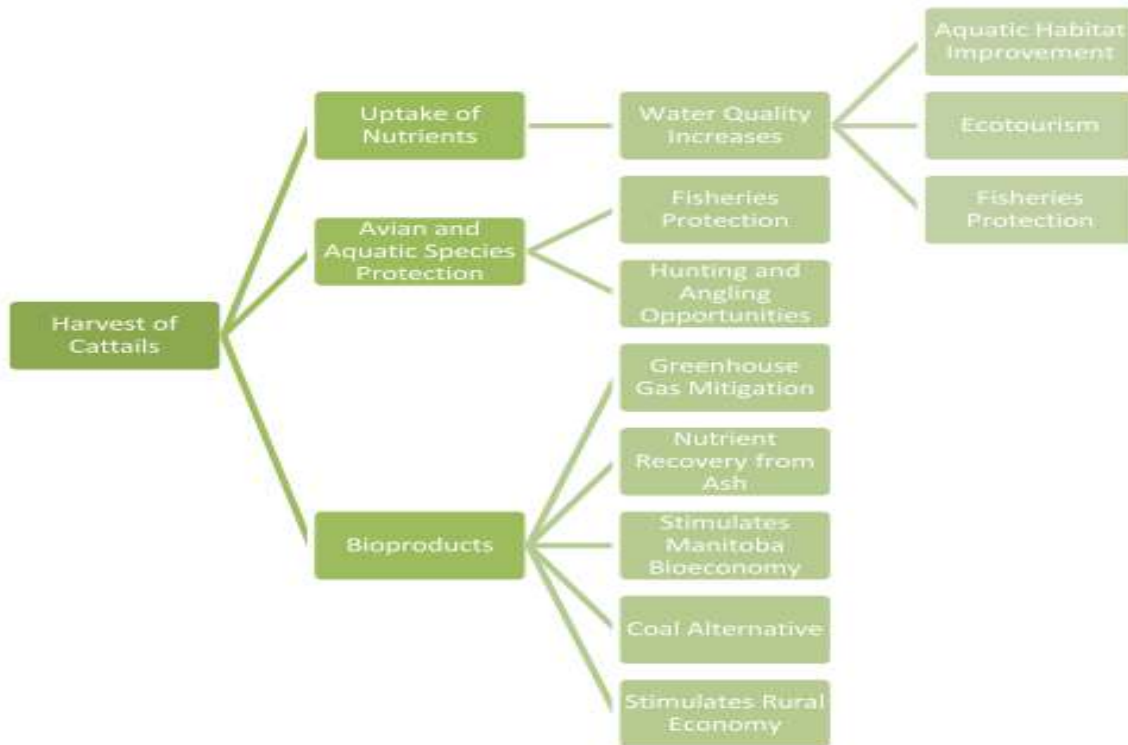


Fig. 6: Benefits of cattail harvesting in Manitoba flow diagram.

Current water management practices in the agricultural sector of the Netherlands have resulted in highly productive soils. Specifically, a region of major importance for water management is North-East Friesland with its rural and (wet) peat meadow areas. Unfortunately, these peat meadow areas are facing severe problems (Kostecke *et al.*, 2005). Cattail is a monocotyledonous, hydrophilic crop that can grow on high water levels. Cattail has long and big leaves and its flowering time is from June to July. Using cattail for bio-energy production is mostly used in the U.S., Canada, Switzerland, and Italy (Geurts, personal communication, 2017). However, currently the most potential application seems to be the usage of cattail for insulation material. This application is being used mostly in Germany, Austria, and Switzerland (Geurts, personal communication, 2017). Cattail has a high potential for insulation material because it

has a high amount of the “air space” tissue “aerenchyma” in its leaves and stem. This aerenchyma provides material with a low heat conduction and thus excellent insulation value. Cattail has a high nutrient removal ability of phosphorous and nitrogen. Therefore, it can be excellently used in the first stage of a transition of dairy farming in peatlands towards wet agriculture (Figure 4). After wetting the soil by raising the water levels, many stored nutrients from the soil will be released into the water. Both aboveground and belowground harvest of *Typha* stands increased plant diversity and richness for two years following treatment. Some economic importance of *Typha* includes:

1. *Typha* as a source of biomass

Harvesting *Typha* biomass for bioenergy production may be an appropriate alternative to herbiciding and burning methods in Great Lakes wetlands (Lishawa *et al.*, 2015). Using *Typha* for

The invasion of Cattail (Typha species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

biomass has also been tried in Imawa Kano state Nigeria (Mukhtar, A.A. and Abdullahi, 2020) . The demand for charcoal in Senegal and many other African countries is a threat to the forest and ecosystem. Much effort is given in finding alternative sources of charcoal. World bank and GTZ projects have evaluated *Typha* as a potential source of Charcoal (Elbersen, 2005). Research have been conducted to characterize the textile properties of extracted cattail fiber it was found that cattail have excellent fiber diameter, moisture regain, burning behaviour and thermal properties similar to commonly used textile fiber such as cotton, wool and polyester. *Typha latifolia* have been considered as potential crops because of their high productivity, interesting chemical composition and natural growth on a substantial portion (Chakma *et al.*, 2017).

2. *Typha* as a source of food

Common cattail is probably the most famous of all the edible plants of the northern hemisphere (M. Larry, 2000). Cattails are widely regarded as great untapped plant resources of enormous potential benefit Many parts of this plant are edible for human consumption. Rook (2004) states that the “native Americans used leaves and stems as food. Rhizomes were dried and ground into flour or eaten as cooked vegetables, young stems were eaten raw or cooked, and immature fruiting stalks were roasted” In spring, the root stock and rhizomes were important food source for native people when other food was scarce. *Typha latifolia* over time have been used for many other uses. It has been used for thatch in roofing, or woven into mats, chairs and hats. It was a source of fiber for rayon and a crude, greenish brown paper; torches and tinder. Pollen was used in making fireworks; stuffing pillows, insulation, crude floatation devices, wound dressing, and lining for diapers (Boreal Forest, 2005). According to Rook (2004) Emerging young *Typha* plants are edible and the tender developing spike is also edible. He added that they were considered by many people as delicacies. Mitich (2000) Noted that “common cattail is probably the most famous of all the edible plants of the northern hemisphere. They are widely regarded as great untapped plant

resources of enormous potential benefit. He further stated that “no one should starve or even go hungry in an area where cattails are abundant. The Native Americans pulled up the young spike or cut the rootstocks (rhizomes) for food. Harrington and Matsumura 1967 in Mitich (2000) find out that one hectare of cattails yield about 2,265 kg of flour, containing about 80% carbohydrates and around 6% to 8% protein. The plant yields flour that is as rich in protein as corn (*Zea mays*) rice (*Oryza sativa*) and wheat (*Triticum aestivum*).

3. Incorporation of *Typha* for animal feed

A study was designed to evaluate the effects of *Typha* silage as substitute for sorghum straw on feed intake, blood profile, economics of production and growth performance of beef cattle. The result showed that up to 300g/kg TS can be incorporated in the diet of beef cattle to replace sorghum straw with no negative influence on feed intake, blood profile, economics of production, and growth performance of beef cattle (Olayinka *et al.*, 2022).

4. *Typha* as phytoremediation agent

Phytoremediation is an effective technique in decreasing the unparalleled pollution in the aquatic environments (Ali *et al.*, 2020). The high biomass growth rate, and clonal expansion rates of *Typha* result in stands of *Typha* acting as N and P sinks, this makes it useful for phytoremediation efforts (Bansal *et al.*, 2019). *Typha latifolia* and other vegetations are found to possess extensive root systems that show greater pollutant removal efficiency related to rhizosphere (Parzych *et al.*, 2016). The higher efficiency in pollutant removal is due to some antibacterial properties of this plant situated in the rhizome (Shingare *et al.*, 2017). Because of their low -cost, simple operation/ maintenance and environmental friendliness aquatic plant -based systems such as constructed wetlands have being used for treatment of all kinds of waste water including pharmaceutical and personal care products (PPCPs) (Zhang *et al.*, 2014). Using cattail for the processing of insulating materials has good

The invasion of Cattail (Typha species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

strengths. Cattail-based insulation material has the excellent capability of heat insulating comparing to traditional insulation material, for example glass fibre (Berg, 2015). One example of wetland plants that act as either critical components or biological invaders in wetlands around the world are cattails (*Typha spp.*). Cattails comprise 10–15 species of perennial, semi-aquatic plants that are widespread in temperate and tropical wetlands of the northern and southern hemispheres, occurring in all major land masses except Greenland and Antarctica *Typha spp.* can be found in diverse wetland communities, ranging from early to late successional stages and from large, monospecific stands to scattered clumps or individuals distributed throughout mixed-species stands. In Nigeria, recently the Federal government and the World bank have jointly funded a project titled "TYPHA PROJECT" focused on developing economic uses of invasive *Typha* biomass. The idea is to produce Biogas by fermenting *Typha* as a source of clean energy for lighting and for cooking (Iglesias *et al.*, 2018), (Minggagud and Yang, 2013). 38% of the World's population lack access to clean cooking and typically use inefficient stoves or open fires in poorly

ventilated spaces. More than 90% of households rely on wood, charcoal, and garbage for cooking in 25 countries, mostly in sub Saharan Africa. Nearly 90 million Nigerians cook with wood on the traditional "three- stone fire". Regrettably, Nigeria experiences the highest number of smoke-related deaths in Africa (Iglesias *et al.*, 2018).

The Natural Resources Research Institute (NRRI) of the University of Minnesota - Duluth is a research institute dedicated to the fostering economic development of Minnesota's natural resources in an environmentally sound manner to promote private sector employment. They Visited Mauritania in 2013 to Explore NRRI-Developed Option for Conversion of *Typha australis* to Bio coal (Strzok, 2013). The project was titled "Conversion of *Typha australis* and other biomass to a Biocoal for local use in heating and cooking". In Senegal river valley over 30 million people are adversely affected by *Typha* invasion and over 346 000 hectares of land were covered by *Typha*. Production of Biocoal form *Typha* have been a very good option to control the menace of the specie. The diagram below summaries the production of bio coal from *Typha* raw material.

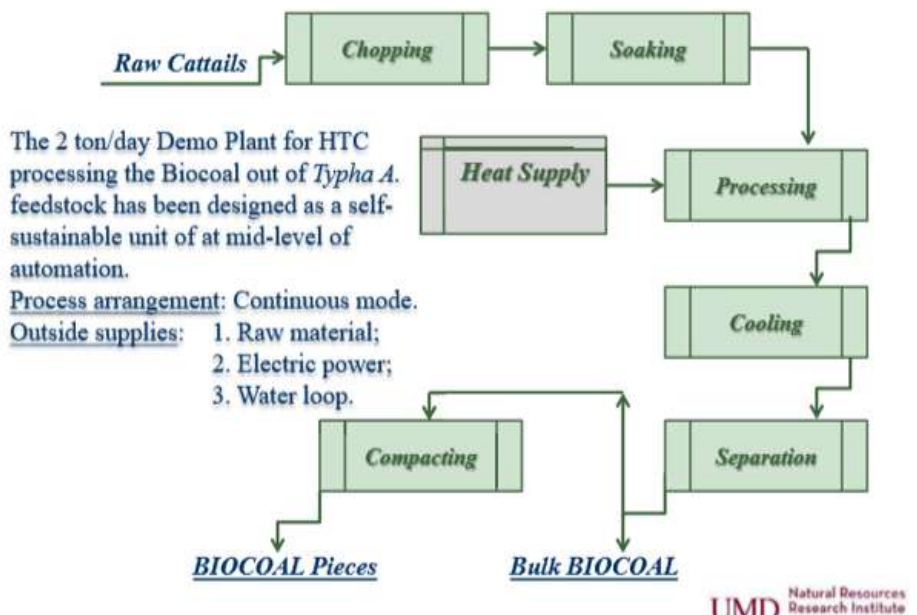


Figure 7: Flow diagram of *Typha* conversion from Raw cattail to Bio coal

The invasion of Cattail (*Typha species*) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

In Senegal and Mauritania, the project **Tyccao** was introduced in order to boost their energy need and to mitigate climate change. The aim of the project is to harness *Typha* for a source of bio coal and construction material. The project was jointly funded by five major non-governmental organizations namely DEEC, ADEME, Bio Build concept, OMVS and GRET in Senegal and Mauritanian governments.

5. *Typha* as source of fuel

The utilization of aquatic plants for bioenergy in form of bioethanol and biogas not only produce bioenergy but also produces benefits by removing fugitive nutrients from aquatic systems. The method has more advantage by recycling nutrients back into agricultural system, in the long run displacing inorganic fertilizer production (Wilkie & Evans, 2014).

The *Typha* Fuel Construction West Africa (TyCCAO) project aims to contribute to the energy transition and the fight against climate change, by developing the use of renewable fuels and energy efficiency in the building sector. The massification and dissemination of products based on *Typha*. Apart from the possibility of harnessing the plant as a food material. The plant also has the potential of being exploited for fuel. People are proposing the utilisation of *Typha* as a source of energy. Elbersen, (2005) stated that cattail has been proposed as a biomass crop for renewable energy. According to him, harvesting *Typha* for biomass and bio coal production is very economical considering the present energy global crisis. Similarly, In Hadejia – Nguru wet land there is a proposal for experimenting the plant by UNIDO in 2007 as a fuel source.

6. *Typha* cultivation for construction, insulation and other domestic uses

The realization of the use of cattail as an insulation material in buildings increase a larger demand for the product in some EU member countries. This necessitate for the cultivation of the product where suitable cultivation areas were proposed in order not to rely on importing the products from elsewhere (Krus, 2013). In Germany cultivation of *Typha* was initiated under the project titled " Rohrkolbenanbau in Niedermooren" (cultivation of *Typha* in fens). This is owing to the vast number of uses of the plant including phytoremediation, land restoration,

absorption of carbon, resistance to pest and disease, high productivity, source of raw materials for building and construction (Krus et al., 2014). *Typha* species are among the most productive plant species (Wetzel 1983; Mitsch and Gosselink 2000); however, their performance is strongly influenced by the environment. Phytoremediation with the wetland plant *Typha latifolia* is a technique that could potentially aid the restoration of polluted surface water (Papadopoulos et al., 2009). Cattails are physiologically better able to tolerate permanently flooded conditions than are many other emergent species. Cattail seeds can germinate without oxygen (Vaccaro, 2005).

7. *Typha* as source of medicine

Cattail is used by native Americans for multiple purposes including medicine, clothing and bedding. The remnants of the crop were then taken back into the soil where they decomposed over time, providing structure and nutrient to the soil (Deziel & Magner, 2022). *Typha domingensis* is an important medicinal plant it is traditionally used in the treatment of neurological disorders and skin malignancies. *T. domingensis* is nontoxic and can be a potential source of phytoconstituents with promising pharmacological potential (Dilshad et al., 2022). The leaves of *Typha domingensis* is effective in the treatment of nose bleeds, hematemesis, hematuria, urine bleedings, dysmenorrhea postpartum abdominal pain were treated using the pollen of *T. domingensis*. The leaves of *T. domingensis* have also been used as a diuretic in Chinese medicine. Furthermore, seeds and rootstocks of *T. domingensis* have also been used in treating homeostatic conditions in human (Albert Banunle, Bernard Fei-Baffoe, 2021). Furthermore, Musara and Aladejana (2020) reported the medicinal uses, chemical and pharmacological properties of *T. capensis* pointing its anti-microbial, fertility promoting effect, anti-inflammatory, anti-oxidant and cytotoxicity effects of the plant (Musara & Aladejana, 2020).

V. Conclusion.

In conclusion Wetland is an area of land that is a transition between a terrestrial and aquatic habitat that is inundated for most of the times. It is

an ecosystem that is very rich and provide a lot of direct and indirect services to man. Directly they provide water, fish, fuelwood and other natural resources. Indirectly they serve as a source of filter and provides aquifer for recharging water sources. The Hadejia-Nguru wetland is a very important wetland in Sahelian region of northern Nigeria. The wetland is so important to the economy of the region by providing natural resources to the inhabitants. They are environmentally important as area of conserving wildlife population particularly afro paeleatic and other wintering bird species. It was so important in terms of conservation that it was declared a Ramsar site. In 1987 the RSPB in conjunction with NCF open the Hadejia-Nguru wetland conservation project. In recent years the area is facing a lot of problems including construction of dams at the upstream which distract the smooth flow of drainage particularly to the downstream region. Population pressure resulting into conflicts between farmers and herders. In addition, the proliferation of invasive *Typha* has been the major issue of concern blocking water ways and impeding farming and fishing and providing roost for birds to damage cereal crops. Several management options were adapted to control *Typha* including mechanical, Physical, chemical and Biological method as plan A for the management. The plan B option of the management is harnessing the various economic uses of the specie including using it for food, medicine, construction, insulation material, using it for carbon sink, phytoremediation agent, a source of biomass, a source of bio coal and a mixture in preparing animal feed.

Reference

- Abdullahi. *et al.* (2018). Estimating the non-use value: The contingent valuation approach on rural households in Hadejia-Nguru wetlands, Northern Nigeria. *International Journal of Ecology and Development*, 33(4).
- Acharya, G. (2000). The Values of Wetlands: landscape and Institutional perspectives Approaches to valuing the hidden hydrological services of wetland ecosystems. *Ecological Economics*, 35(1), 63–74. [https://doi.org/10.1016/S0921-8009\(00\)00168-3](https://doi.org/10.1016/S0921-8009(00)00168-3)
- Akinsola, *et. al.*. (2010). Conservation of waterbirds in the Hadejia-Nguru Wetlands , Nigeria : current efforts and problems efforts and problems. *Ostrich Journal of African Ornithology*, 71(1 & 2), 118–121. <https://doi.org/10.1080/00306525.2000.9639885>
- Albert Banunl *et al.* (2021). Utilization potentials of invasive plants in Owabi Dam in the Ashanti Region of Ghana. *Bio Resources*, 16(2), 3075–3095.
- Ali, A., Naeem, M., Singh, S., & Alzuaibr, F. M. (2020). Phytoremediation of contaminated waters : An eco-friendly technology based on aquatic macrophytes application. *The Egyptian Journal of Aquatic Research*, xxx. <https://doi.org/10.1016/j.ejar.2020.03.002>
- Apeverga, P. T., Aliyu, Z. H. & Francis, M. J. (2019). A Survey of the Ecosystem Services Rendered to the Surrounding Communities of Hadejia-Nguru Wetlands. *Dutse Journal of Pure and Applied Sciences (DUJOPAS)*, 5(1), 193–200.
- Apfelbaum, S. I. (1983). Cattail (*Typha* spp) management.pdf. *Natural Areas Journal*, 5(3), 1–9.
- Apfelbaum, S. I. (1985). Cattail (*Typha* spp .) Management. *Natural Areas Journal*, 5(3), 1–9.
- ARPUDHALIN, E. G. (2017). *Phytoremediation Potential of Arundo donax and Typha latifolia for the treatment and reuse of domestic greywater*. pondicherry university.
- Ayeni, A. O., Ogunesan, A. A., & Adekola, O. A. (2019). Provisioning ecosystem services provided by the Hadejia Nguru Wetlands , Nigeria – Current status and future priorities. *Scientific African*, 5, e00124. <https://doi.org/10.1016/j.sciaf.2019.e00124>
- Babagana, M., Adamu, Abubakar Magama, Y. A., & Suleiman, G. (2018). *Typha* spp (*Typha Domingensis*) and its control strategies along Nguru wetlands , Yobe state Nigeria. *International Journal of Agriculture, Environment and Bioresearch*, 3(02), 1–15.

The invasion of Cattail (Typha species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

- Bansal, S., Lishawa, S. C., Newman, S., & Wilcox, D. (2019). *Typha* (Cattail) Invasion in North American Wetlands: Biology, Regional Problems, Impacts, Ecosystem Services, and Management. *Wetlands*, 39, 645–684.
- Barbier, E. B. (2011). Wetlands as natural assets. *Hydrological Sciences Journal*, 56(February 2012), 1360–1373.
<https://doi.org/10.1080/02626667.2011.629787>
- Bdliya, H. H. (2000). *A Report on Designation of Hadejia-Nguru Wetlands as Ramsar site* (Issue March).
- Berg, R. V. van B. D. van den;Wenyan Z. (2015). *Cattail Production Chain Development in Northeast Friesland*.
- Borokini, T. I., Babalola, F. D., & Dana, E. (2012). Management of invasive plant species in Nigeria through economic exploitation: lessons from other countries. *Management of Biological Invasions*, 3(1), 45–55.
<https://doi.org/10.3391/mbi.2012.3.1.05>
- Bukar, Y., Monguno, A. K., & Abdulrahman, A. T. (2021). Environmental Change and Livelihood Activities in Hadejia - Nguru Wetlands of Yobe State, North East Nigeria. *Journal of Geography and Geology*, 12(3), 1–12. <https://doi.org/10.5539/jgg.v13n1p1>
- Calheiros, C. S. C., Rangel, A. O. S. S., & Castro, P. M. L. (2009). Treatment of industrial wastewater with two-stage constructed wetlands planted with *Typha latifolia* and *Phragmites australis*. *Bioresource Technology*, 100(13), 3205–3213.
<https://doi.org/10.1016/j.biortech.2009.02.017>
- Chakma, K., Cicek, N., & Rahman, M. (2017). Fiber extraction efficiency, quality and characterization of cattail fibres for textile applications. *The Canadian Society for Bioengineering*, 1–10.
- Chiroma, Mohammed J., Y. D. K. et. al. (2003). *Water Management Issues in the Hadejia-Jama'are-Komadugu-Yobe Basin: DFID-JWL and Stakeholders Experience in Information Sharing, Reaching Consensus and Physical Interventions*.
- Dan Svedarsky, Richard Grosshans, Henry David Venema, Susan N. Ellis-Felege, J. Bruggman, A. O. (2019). Integrated management of invasive cattails (*Typha* spp.) for wetland habitat and biofuel in the Northern Great Plains of the United States and Canada: A review. *UND Scholarly Commons*, 1–16.
- Deziel, B., & Magner, J. (2022). Cattail harvest and diseased wood turned into biochar for improved soil health and water quality: an analysis of phosphorus mitigation for the Red River of the North. *International Journal of Hydrology*, 6(3), 105–108.
<https://doi.org/10.15406/ijh.2022.06.00309>
- Dilshad, R., Khan, K., Saeed, L., Sherif, A. E., Ahmad, S., Ovatlarnporn, C., Nasim, J., Hussain, M., Ghalloo, B. A., Basit, A., & Mukhtar, I. (2022). Chemical Composition and Biological Evaluation of *Typha domingensis* Pers. to Ameliorate Health Pathologies: In Vitro and In Silico Approaches. *Hindawi Biomed Research International*, 2022, 1–16.
- Dohan, R., & Grosshans, R. (2012). *Cattail (Typha spp.) Harvesting in Manitoba: A legislative and market analysis for operationalization and carbon emission offsets* (Issue October 2012).
- E. Amans, C.Cecilia, G. Lacruz, et. al. (1992). Analysis of the farming system in the Hadejia-Jama'are floodplain, Northern Nigeria. *Scientific African*, 5, 1–13.
- E.B. Barbier, W.M. Adams, K. K. (1993). Economic valuation of wetland benefits: the Hadejia-Jama'are floodplain, Nigeria. In *The Hadejia-Nguru wetlands: environment, economy and sustainable development of a Shaelian floodplain wetland*. IUCN.
- Eaton, D., & Sarch, M. (1997). *The Economic Importance of Wild Resources in the Wetlands, Nigeria* (Issue 13).
- Edegbene, A. O. (2018). *Invasive grass (Typha domingensis): a Potential menace on the assemblage and abundance of Migratory/water related birds in Hadejia-Nguru Wetlands, Yobe State, Nigeria*.

The invasion of Cattail (Typha species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

- Tropical Freshwater Biology*, 27(2), 13–30.
- Elbersen, W. (2005). *Typha for Bioenergy*.
- Elgersma, K. J., Martina, J. P., Goldberg, D. E., & Currie, W. S. (2017). Effectiveness of cattail (*Typha spp.*) management techniques depends on exogenous nitrogen inputs. *Elementa Science of the Anthropocene*, 5(19), 1–13.
- Fahlgren, D., & Fahlgren, D. (2017). *Genetic variation in common cattail (Typha latifolia) in southern Sweden*. Swedish University of Agricultural Science.
- Fennessy, J. K. C. M. S. (2001). *Wetland Plants Biology and Ecology*. Lewis Publishers.
- Grodowitz, M. J., Madsen, J. D., Whitaker, S. G., Jeffers, L., & Stewart, R. M. (1998). *APIS — The Aquatic Plant Information System*.
- Grosshans, R. E. (2014). *Cattail (Typha spp.) Biomass Harvesting for Nutrient Capture and Sustainable Bioenergy for Integrated Watershed Management*. University of Manitoba Winnipeg.
- Gul, B., Khan, A., & Khan, H. (2018). Management of cattail in standing water of Swabi district, Khyber Pakhtunkhwa (KPK) province, Pakistan. *Journal of Aquatic Plant Management*, 56, 31–34.
- Hussner, A., Stiers, I., Verhofstad, M. J. J. M., Bakker, E. S., Grutters, B. M. C., Haury, J., Valkenburg, J. L. C. H. Van, Brundu, G., Newman, J., Clayton, J. S., Anderson, L. W. J., & Hofstra, D. (2017). Management and control methods of invasive alien freshwater aquatic plants: A review. *Aquatic Botany*, 136, 112–137. <https://doi.org/10.1016/j.aquabot.2016.08.002>
- I, S. H., Dieme, C., Mbengue, M., Georg, A. J., Hollander, N. Den, & Pieterse, A. H. (1999). *Typha* control efficiency of a weed-cutting boat in the Lac de Guiers in Senegal: a preliminary study on mowing speed and re-growth capacity. *Hydrobiologia*, 415, 249–255.
- Ibrahim, O. U. and A. A. (2020). Assessing challenges of Baturiya Wetlands and Game Reserves Biodiversity as Ecotourism Resource in Hadejia of Jigawa State, Nigeria: A viewpoint Dr. U. O. Ujih* and Agye Adoka Ibrahim**. *Journal of African Sustainable Development*, 20(2), 1–13.
- Iglesias, E., Loureiro, M. L., & Escribano, F. (2018). *Conference Workshop AERNA 2018: Household perceptions on biogas as a sustainable energy source. A focus group study in Hadejia Valley, Nigeria*.
- Johnson, D. C. P. D. R. D. E. G. G. W. D. (1988). *Cattail (Typha Spp.) Biomass Production - Stand Management and Sustainable Yields-*.
- Kanatas, P. (2019). Combined use of mowing and chemical control for the efficient control of the noxious invasive species *Typha* spp. *Agriculture, Environment and Food Sciences*, 3(3), 144–149. <https://doi.org/10.31015/jaefs.2019.3.5>
- Kaugama, H. H., & Ahmed, B. A. (2014). Prospect and Challenges of Farming along the Hadejia-Nguru Wetland in Jigawa State Nigeria. *International Journal of Academic Research in Economics and Management Sciences*, 3(6), 43–52.
- Kenniswerkplaats Noordoost Fryslân, Laura Webb, Elena Moreno-Giménez, N. G.-V. (2017). *A feasibility study on the usage of cattail (Typha spp.) for the production of insulation materials and bio-adhesives*.
- Kostecke, R. M., Smith, L. M., & Hands, H. M. (2005). Macroinvertebrate response to cattail management at Cheyenne Bottoms, Kansas, USA. *Wetlands*, 25(3), 758–763. [https://doi.org/10.1672/0277-5212\(2005\)025\[0758:MRTCMA\]2.0.CO;2](https://doi.org/10.1672/0277-5212(2005)025[0758:MRTCMA]2.0.CO;2)
- Krus, M. (2013, June 3). Using cattails for insulation. *European Union*, 1–3. <https://cordis.europa.eu/article/id/130870-using-cattails-for-insulation>
- Krus, M., Theuerkorn, W., & Grosskinsky, T. (2014). *Typha* cultivation in Agriculture. In ; P. G. ; W. M. (Ed.), *2nd International Conference - Water resources and wetlands. 11-13 September, 2014 Tulcea (Romania)*; (pp. 301–306).

The invasion of Cattail (Typha species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

- Lawrence, B. A., Lishawa, S. C., Hurst, N., Castillo, B. T., & Tuchman, N. C. (2017). Wetland invasion by *Typha × glauca* increases soil methane emissions. *Aquatic Botany*, 137, 80–87. <https://doi.org/10.1016/j.aquabot.2016.11.012>
- Layne, C. R. (2009). *Biology and Control of Aquatic plants*. Aquatic ecosystem restoration foundation.
- Leitch, J. A., Linz, G. M., & Baltezare, J. F. (1997). Economics of cattail (*Typha spp.*) control to reduce blackbird damage to sunflower. *Agriculture, Ecosystems and Environment*, 65, 141–149.
- Linz, G. M., Homan, H. J., Linz, G. M., & Homan, H. J. (2011). Use of glyphosate for managing invasive cattail (*Typha spp.*) to disperse blackbird (*Icteridae*) roosts. *Crop Protection*, 30, 98–104. <https://doi.org/10.1016/j.cropro.2010.10.003>
- Lishawa, S. C., Lawrence, B. A., Albert, D. A., & Tuchman, N. C. (2015). Biomass harvest of invasive *Typha* promotes plant diversity in a Great Lakes coastal wetland. *Restoration Ecology*, 23(3), 228–237. <https://doi.org/10.1111/rec.12167>
- M.M., A. (2012). Impact of Emergent Macrophytes on Fish Catch in Nguru Lake. *Bayero Journal of Pure and Applied Sciences*, 5(2), 47–50.
- Madsen, J. D. (2000). *Advantages and Disadvantages of Aquatic Plant Management Techniques* (Issue September).
- Miklovic, S. (2000). *Typha angustifolia* Management : Implications for Glacial Marsh Restoration. *Restoration and Reclamation Review*, 6(2), 1–11.
- Minggagud, H., & Yang, J. (2013). Wetland plant species diversity in sandy land of a semi-arid inland region of China. *Plant Biosystems - An International Journal Dealing with All Aspects of Plant Biology*, 147(1), 25–32. <https://doi.org/10.1080/11263504.2012.737865>
- Minkina, T., Fedorenko, G., Nevidomskaya, D., Konstantinova, E., Pol, T., Fedorenko, A., Chaplygin, V., Mandzhieva, S., Dudnikova, T., & Hassan, T. (2021). The Morphological and Functional Organization of Cattails *Typha laxmannii* Lepech. and *Typha australis* Schum. and Thonn. under Soil Pollution by Potentially Toxic Elements. *Water*, 13, 227–247.
- Mitchell, M. E. (2011). *Cattail (Typha X Glauca) Invasion in Wetlands of the Great Lakes* *Cattail (Typha X Glauca) Invasion in Wetlands of the Great Lakes Region: Are Impacts Time-Dependent?* Loyola University Chicago.
- Mitich, L. M. (2000). Common Cattail, *Typha latifolia* L. Intriguing World of Weeds. *Weed Technology*, 14(2), 446–450. [https://doi.org/10.1614/0890-037X\(2000\)014](https://doi.org/10.1614/0890-037X(2000)014)
- Mitsch, W. J. & Gosselink, J. G. (2015). *Wetlands* (Fifth Edit). John Wiley & Sons, Inc.
- Mukhtar, A.A. and Abdullahi, I. L. (2020). *Typha* Biomass Energy for Sustainable Management of *Typha domingensis* L. in Affected Communities of Northern Nigeria. *Dutse Journal of Pure and Applied Sciences*, 6(4), 246–252.
- Munishi, P.K.T., Kilungu, H. Jackson, H. et al. (2012). Wetland Related livelihoods, Institutions and incentives for conservation in the great Ruaha river Wetland System. *Tanzania Journal of Forestry and Nature Conservation*, 81(2), 34–44.
- Murray-Hudson, M., & Mmopelwa, G. (2011). Biomass Production and Economic Value of *Phragmites australis* Reedbeds in the Southern Okavango Delta, Botswana. *The African Journal of Plant Science and Biotechnology*, 5(special issue 1), 1–5.
- Musara, C., & Aladejana, E. B. (2020). *Typha Capensis* (Rohrb.)N.E.Br. (Typhaceae) : Morphology, medicinal uses, biological and chemical properties. *Plant Science Today*, 7(4), 578–583.
- Olalekan, E. I., Abimbola, L.-H. M., Saheed, M., & Damilola, O. A. (2014). Wetland Resources of Nigeria: Case Study of the Hadejia-Nguru

The invasion of Cattail (Typha species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area

- Wetlands. *Poultry, Fisheries & Wildlife Sciences*, 2(2). <https://doi.org/10.4172/2375-446X.1000123>
- Olayinka, M., Musa, J., Rufai, A., Johnson, A., Escribano, S., Richard, K., Eva, I., Maidala, A., Amos, M., Chana, M., Hannatu, C., & Sunday, O. (2022). Cattail (*Typha domingensis*) silage improves feed intake, blood profile, economics of production, and growth performance of beef cattle. *Tropical Animal Health Science and Production*, 54(48), 1–8. <https://doi.org/10.1007/s11250-022-03066-1>
- Ostapkowicz, J., Lepofsky, D., Schulting, R., & McHalsie, A. (Sonny). (2001). The use of Cattail (*Typha latifolia* L.) down as a sacred substance by the interior AND COAST SALISH OF BRITISH COLUMBIA. *Journal of Ethnobiology*, 21(2), 77–90.
- Papadopoulos, N., Gikas, E., Zalidis, G., & Tsarbopoulos, A. (2009). Simultaneous Determination of Herbicide Terbutylazine and Its Major Hydroxy and Dealkylated Metabolites in *Typha latifolia* L. Wetland Plant Using SPE and HPLC-DAD. *Journal of Liquid Chromatography & Related Technologies*, 32(20), 2975–2992. <https://doi.org/10.1080/10826070903320566>
- Parzych, A., Cymer, M., & Macheta, K. (2016). Leaves and roots of *Typha latifolia* L. and *Iris pseudacorus* L. as bioindicators of contamination of bottom sediments by heavy metals. *Limnology Review*, 16(2), 77–83. <https://doi.org/10.1515/limre-2016-0008>
- Paul Benalcazar, Vivekananthan Kokulan, Alexandre Lillo, J.-P. M. (2019). *The Contribution of Wetlands Towards a Sustainable Agriculture in Canada*.
- Polet, G. (2000). Waterfowl and flood extent in the Hadejia-Nguru wetlands of north-east Nigeria. *Bird Conservation International*, 10, 203–209.
- Pratt, J. M. P. and D. C. (1986). Effect of *Belura Obliqua* on *Typha latifolia* productivity. *Journal of Aquatic Plant Management*, 24, 24–28.
- Project, T. I. M. in N. (TRIMING). (2017). ***The invasion of Cattail (Typha species) in Hadejia-Nguru Wetlands area, an Appraisal towards Exploring Various Management Techniques and Utilizing its Economic benefits in the area***
- Environmental and Social Impact Assessment (ESIA) For the Hadejia Jama'are Sub-Basin with Kano River Irrigation Scheme (KRIS) and Hadejia Valley Irrigation Scheme (HVIS) and the Associated Cumulative Impacts*.
- Ralston, S. T., & Bleier, W. J. (2004). Quantification of cattail (*Typha spp.*) in the Prairie Pothole region of North Dakota in relation to Blackbird damage to Sunflower. *USDA National Wildlife Research Center Staff Publications*, 351(October), 1–8.
- Richardson, R. J. (2008). Aquatic Plant Management and The Impact of Emerging Herbicide Resistance Issues Aquatic Plant Management and the Impact of Emerging Herbicide Resistance Issues. *BioOne*, 22(1), 8–15. <https://doi.org/10.1614/WT-07-034.1>
- Sabo, B., Mohammed, S., & Mafara, A. (2021). Species diversity of birds of prey in Hadejia-Nguru Wetlands, Nigeria. *FUDMA Journal of Sciences*, 5(4), 260–267.
- Sabo B.B., K. A. K. et. al. (2016). *Typha* Grass Militating Against Agricultural Productivity along Hadejia River, Jigawa State, Nigeria. *Journal of Agricultural Science*, 6(2), 52–56.
- Salako, G., Sawyerr, H., Olalubi, O., & Salako, G. (2016). Does *Typha spp.* Contribute to Wetland Waterloss and Health Risk: A Case Study of Hadejia Nguru Wetlands (HNW) System NE Nigeria. *Open Journal of Ecology*, 6(6), 151–158. <https://doi.org/10.4236/oje.2016.64015>
- Sesin, V., Davy, C. M., Dorken, M. E., Gilbert, J. M., & Freeland, J. R. (2021). Variation in glyphosate effects and accumulation in emergent macrophytes. *Management of Biological Invasions*, 12(1), 66–84.
- Sharp, J. L., Waller, T., & Dick, G. O. (2002). ***MANAGING CATTAIL (Typha latifolia) GROWTH IN WETLAND SYSTEMS***.
- Shingare, R. P., Nanekar, S. V., Thawale, P. R., & Karthik, R. (2017). Comparative Study on Removal of Enteric Pathogens from Domestic Wastewater using *Typha latifolia* and *Cyperus rotundus* along with Different Substrate. *International Journal of Phytoremediation*,

- March, 1–35.
<https://doi.org/10.1080/15226514.2017.1303809>
- Silvius, M. J., Oneka, M., & Verhagen, A. (2000). Wetlands: Lifeline for people at the edge. *Physics and Chemistry of the Earth, Part B: Hydrology, Oceans and Atmosphere*, 25(7), 645–652. [https://doi.org/10.1016/S1464-1909\(00\)00079-4](https://doi.org/10.1016/S1464-1909(00)00079-4)
- Smith, S. G. (2017). THE Cattails (*Typha*): Interspecific Ecological differences and problems of identification. *Lake and Reservoir Management ISSN:*, 2(1), 356–362.
<https://doi.org/10.1080/07438148609354657>
- Solberg, K. L., & Sojda, R. S. (1993). DigitalCommons @ University of Nebraska - Lincoln and Control of Cattails. *Waterfowl Management Handbook, January*, 1–9.
- Strzok, D. R. F. (NRRI) P. P. (2013). *Visit to Mauritania to Explore NRRI-Developed Option for Conversion of Typha australis to Biocoal*.
- Sulaiman, I.M., Cresswell, W. and D. F. D. (2014). Bird diversity and abundance in relation to *Typha* occurrence at the hadejia – nguru wetlands. *Biotropic Research International Journal*, 6(NO1).
- Svedarsky, D., Grosshans, R., Venema, H., Bruggman, J., Ostlund, A., & Lewis, J. (2019). Integrated management of invasive cattails (*Typha spp.*) for wetland habitat and biofuel in the Northern Great Plains of the United States and Canada : A review. *Mires and Peat*, 25(09), 1–14.
<https://doi.org/10.19189/MaP.2018.APG.367>
- T., P. T. (2000). *Interaction between fish and macropyhtes in inland waters*.
<http://www.fao.org/docrep/006/X7580E13.htm>
- Tafida, A.A. and Galtima, M. (2015). Capital assets as building blocks for livelihood activities and sustainability among rural dwellers in Hadejia-Nguru wetlands, Nigeria. *Nigerian Journal of Rural Sociology*, 16(1), 1–6.
- Thompson, J. R., & Hollis, G. E. (1995). Hydrological modelling and the sustainable development of the Hadejia-Nguru Wetlands , Nigeria Hydrological modelling and the sustainable. *Hydrological Sciences Journal*, 40(1), 97–116.
<https://doi.org/10.1080/02626669509491393>
- V. I. Fagorite, O. A. Odundun , L.E. Iwueke, E. al. (2019). Wetlands ; a review of their Classification , Significance and Management for sustainable development. *International Journal of Advanced Academic Research*, 5(3).
- Vaccaro, L. E. (2005). *patterns, Mechanisms, and Ecological implications of Cattail (Typha spp.) dominance in great lakes wetlands*. Cornell UniversityP
- Wilcox, D. A., Buckler, K., & Czayka, A. (2017). Controlling Cattail Invasion in Sedge / Grass Meadows. *Wetlands*.
- Wilkie, A. C., & Evans, J. M. (2014). Aquatic plants : an opportunity feedstock in the age of bioenergy. *Biofuels*, 1(2), 311–321.
<https://doi.org/10.4155/bfs.10.2>
- Y. Birnin Yauri, Abdullahi, M.L. Balarabe, A. K. A. (2019). Ecology and control of *Typha* species in Hadejia-Nguru Wetlands , Nigeria. *Bonorowo Wetlands*, 9(2), 71–91.
<https://doi.org/10.13057/bonorowo/w090203>
- Yarima Mohammed. (2016). Analysis of the effects of typha grass infestation on the livelihood of the farmers living within Hadejia-Nguru Conservation Project. In *Thesis*. Ahmadu Bello University Zaria.
- Zhang, D., Gersberg, R. M., Jern, W., & Keat, S. (2014). Removal of pharmaceuticals and personal care products in aquatic plant-based systems : A review. *Environmental Pollution*, 184, 620–639.
<https://doi.org/10.1016/j.envpol.2013.09.009>
- Zimdahl, R. L. (2007). *Fundamentals of Weed Science* (Third Edit). Academic Press-Elsevier Imprint.
- Zungum, IU; Imam, T. et. a. (2019). Impact of *Typha* Grass on Biodiversity Loss of Hadejia-Nguru Wetland Located between Jigawa and Yobe States of Nigeria : A Review. *Journal of*

Information a Tool for Social Advocacy Protection Services for Children in Damaturu Metropolis, Yobe State

Mohammed Karfa Bizi¹, Dikkuma Mohammed Ibrahim², Ali Usman³, Gambomi Goni Musa⁴ & Musa Adamu Mahdi⁵

^{1,2&3}Fane-fane Central Library, Mai Idris Aloomo Polytechnic, Geidam, Yobe State

⁴Department of General Studies, Mai Idris Aloomo Polytechnic, Geidam, Yobe State

⁵Department of Public Administration, Mai Idris Aloomo Polytechnic, Geidam, Yobe State

Abstract

This study attempted to examine the role play by Information as a tool for social advocacy protection services for children in Damaturu, Yobe State. The study set to determine available types of social protection services in Damaturu Metropolis and how these services reach the children who no interest in education or acquiring any vocational skill that will shape their lives and the involvement of information managers in the dissemination of the knowledge for child protection. The study adopted the descriptive survey design and the population consisted of all the one hundred and ten (110) respondents on child protection and forty (40) members of the community was used. Structured questionnaire (4-Point likert scale rating) and interview method was employed for data collection. The data were analyzed using frequency counts and mean scores. The finding reveal low level involvement of information managers in packaging, disseminating and communicating knowledge on child protection against social vices by the agencies responsible for designing and coordinating programs. The study also showed dissatisfaction of few teachers and some members of the community over the unavailable access to the knowledge on how to counsel and manage cases of social vices among children when the need arises. The study suggest that adequate integration of the services of information managers into the services of child protection agencies is necessary since their major task is to create and disseminate information to various kinds of information seekers everywhere.

Key words: Social Advocacy, Information, Protection, Children, Damaturu.

Introduction

Information is a powerful phenomenon that any living being can't do without it if he want to leave efficiently and effectively. In other aspect every person is dwelling within the pool of his information. Information is a resource that influences the determination of any person or group of persons to arrive at the attainment of set goals. In other word, every rational being needs some vital information for their day-to-day existence and wellbeing. The fact still remains that no individual or society can grow beyond the quality of information at their disposal (Emmanuel, 2022). Information is seen as the strategic tool for virtually every person or group of person in organization or establishment be it public or private for growth and sustainability (Emmanuel, 2012). Information when used as tool in social advocacy for the protection of children would importantly help in their social life, in comprehension and learning of what they are being taught.

Advocacy is a set of coordinated activities (ideally contributing to a broader strategy) that seek to protect of persons of concern by promoting changes that bring policy, practice or law into line with international standards. Advocacy (media campaigns, public speaking, and commissioning and publishing research and lobbying) aims to influence decision makers and stakeholders to adopt policies and practices that will protect refugees, internally displaced people, stateless people and other affected populations. It is a central element of comprehensive protection and solution strategies. Combined with other protection activities (such as information sharing, monitoring, negotiation), advocacy can help to transform attitudes, systems and structures that put Persons of Concern at risk. Advocacy messages must have clear objectives and audiences (UNHCR, 2021).

Social Media Advocacy can be used to enhance the following protection outcomes: To prevent and end human rights violations, and encourage States to respect, protect and fulfill their human rights obligations; To ensure humanitarian actors deliver protection and assistance to Persons of

Concern in a safe and dignified way, on the basis of need and without discrimination; To ensure relevant actors and stakeholders make funds and resources available to meet the needs of Persons of concerns (PoCs); To bring the policies, practice and law of a State into line with international standards (notably refugee law, humanitarian law, human rights law, guiding principles on internally Displaced Persons (IDPs), international standards on the prevention of statelessness and the protection of stateless people); To promote greater acceptance of Persons of Concern (PoCs); by host communities and combat discrimination and xenophobia (UNHCR, 2021).

Child Protection is the prevention of, and response to, exploitation, abuse, neglect, harmful practices and violence against children. It is embedded in the Convention on the Rights of the Child and the Sustainable Development Goals. Child Protection is universal: it is for all children everywhere, from low- to high-income countries (UNICEF, 2021).

Over 1 billion children experience violence every year. The consequences of Child Protection violations are catastrophic – profound, enduring and often deadly for children – and with economic costs of violence against children estimated at \$7 trillion per year. The COVID-19 pandemic has intensified risks for children and reduced services to manage those risks. But there have also been significant and positive changes in child protection in recent years. Government- and community- led actions have resulted in increases in birth registration and reductions in child labour, child marriage and female genital mutilation. Above all, we have learnt that child protection violations are preventable: progress can be made through political will, societal change and an emerging science of prevention and treatment strategies (UNICEF, 2021).

Knowledge is power and one must understand that power that cannot be tap into is useless. This means that only applied knowledge brings results. For this reason, information dissemination is a core responsibility of any organization tasked with generating and sharing

***Information a Tool for Social Advocacy Protection Services for Children in Damaturu
Metropolis, Yobe State***

knowledge products. In other word, achieving optima utilization/applicability of the services provided by the advocacy protection agencies, the information managers and libraries should be carried along due to their expatriates (the Librarians and Information Managers) in attending to the various needs of users in addressing their information needs. Managers of information are saddled with the tasks of selecting, managing, providing access, and sharing of information in a manner that attracts its users (Kwakpovwe, 2019). Roger et al. (2019) describe information manager as someone who collects, records, organizes, stores, preserves, retrieves and disseminates printed or digital information.

Dissemination is the interactive process of communicating knowledge to target audiences so that it may be used to lead to change (Muriel and Oliver, 2017).

Many studies have discussed extensively on the role of information in social advocacy with reference to vulnerable youths and children in Nigeria and elsewhere. This particular study is aimed at finding out the available types of social protection services. How often the services reach the children, and the involvement of information managers in the dissemination of knowledge on child protection to children with a special reference to Damaturu Metropolis of Yobe state, Nigeria.

The paper is segmented into five sections with introduction as section one. Literature review in Section two. While methodology adopted for this study is presented in section three. The Results, discussions and recommendations are done in section four and five respectively.

Literature Review

Emmanuel (2022) analysed in her study the Information a tool for social advocacy protection services for children in Gwagwalada area council, Abuja. Where she critically dwelled on the challenge of social vices effects among children in Gwagwalada town as worrisome as

their life destiny is been truncated. These children or teenagers no longer have interest in education or acquiring any vocational skill that will shape their lives for a better future. So the study was set out to determine available types of social protection services in Gwagwalada, how the services reach the children and the involvement of information managers in the dissemination of the knowledge for child protection. The study also adopted the descriptive survey design and the population consisted of all the 120 agencies staff on child protection. Structured questionnaire and interview was used for data collection. The data were analyzed using frequency counts and mean scores of four-scale rating. The finding reveal low level involvement of information managers in packaging, disseminating and communicating knowledge on child protection against social vices by the agencies responsible for designing and coordinating programs. The results also showed dissatisfaction of few teachers and some members of the community over the unavailable access to the knowledge on how to counsel and manage cases of social vices among children when the need arises.

Hestres (2017) examine the Social Media and the Work of Advocacy Organizations; were find out that Advocacy organizations rely on social media services, such as Facebook and Twitter, to engage their supporters. These services increasingly influence how citizens and advocacy organizations engage politically online through the technical features and policies they choose to implement a phenomenon that can sometimes disrupt the work of advocates. Interviews with digital strategists at several US advocacy organizations revealed low levels of awareness of this phenomenon, despite its potential impact on their work; substantial dependence on these services for advocacy work; and a shared sense of necessity to embrace these tools, despite their potential downsides. Implications for the scholarship and practice of Internet governance and digitally mediated advocacy are discussed.

According to Bowen, Nickesia and Margaret (2017) in their study Advocacy through Social Media: Exploring Student Engagement in Addressing Social Issues; were they revealed

Information a Tool for Social Advocacy Protection Services for Children in Damaturu Metropolis, Yobe State

Social media have become ubiquitous and are seen as beneficial to society. Although the use of social media for educational purposes has been the subject of recent research, not much is known about their role in higher education civic engagement. Employing critical discourse analysis, this study explored the function of social media as a tool to promote the civic engagement of students through advocacy focused on identified social issues. Findings of this qualitative research are discussed as themes pertaining to the challenges of advocacy, the relative importance of advocacy processes, and the function of social media infrastructure. They further discuss the implications for pedagogy and for research in the area of technology-mediated, issue-focused advocacy by university students.

Scott and Maryman (2016) in their study *Using Social Media as a Tool to Complement Advocacy Efforts*, were in which they said Community practitioners must leverage a variety of tools in order to promote and advocate for social change. Social media are relatively innovative tools for informing and mobilizing communities in an advocacy effort. As part of a coordinated effort, social media align well with the principles of community psychology by enabling individuals to contribute to participatory dialogue about social issues, collaborate on change efforts, and establish a sense of community. These tools can enhance supporters' advocacy engagement and can help sustain efforts in the midst of inevitable challenges. However, social media alone are not sufficient for promoting social change, but should be used to enhance traditional organizing strategies. In addition to synthesizing literature across empirical and practitioner (e.g., communication consultants) sources, real-world examples are provided to illustrate how social media can enhance advocacy efforts.

Methodology

The Study Area

Damaturu is the headquarters of Yobe state and equally the headquarters of Damaturu

(metropolis) Local government area which was creation on 27th August 1991. Situated on the coordinates of 11^o 44'40'' N 110 57'40''E 11.74444 ^oN 11.961110 E at north eastern corner of Nigeria, with a total land mass area of 2,366 KM² (914sq mi) and a total Population of 88,014 (NBS, 2006).

Damaturu is the headquarters of Damaturu emirate, at one time part of and headquarters the Ngazargamo emirate now based in Geidam town (Wikipedia, 2021). Damaturu local government area consist of twelve (12) wards in which four (4) wards of (Bundigari/Pawari, Gwange/Njiwaji, Nayinawa, and Damaturu central) are in metropolitan area or core metropolis while the remaining eight (8) wards are term as sub-core metropolis. Damaturu houses all Nigerian ethnic groups and other foreign nationals. But the major ethnic groups in the study area are: Kanuri, Fulani, and Hausa among others. The people are predominantly Farmers, Business men and Civil servants.

Sampling Techniques and Sample Size

The study employed descriptive survey research design to analysed the study information as a tool for social advocacy protection services of children in Damaturu metropolis, Yobe state. Descriptive survey research design according to Nworgu (2015), descriptive survey is concerned with systemic description of events as they are, because it is aimed at collecting data on something and describing the characteristics and facts about the population of a given study. The research population consisted of the one hundred and ten (110) children social protection advocacy staff and Fourty (40) randomly interviewed teachers and members of the community in the study Area Council, Damaturu metropolis. The purposive sampling technique method was employed for the study. A well-structured questionnaire and interviews was conducted to primary school teachers and some members of the community in study area. The structured questionnaire was governed by psychometric scale of 4-point Likert rating *scale (SA: Strongly Agreed; A: Agreed; D: Disagreed; and SD: Strongly Disagreed)*. The data collected were

Information a Tool for Social Advocacy Protection Services for Children in Damaturu Metropolis, Yobe State

subjected to analysis using frequency counts and mean scores statistic, percentages and tabular representations.

Results Analysis and Discussions

Table 1: Gender distribution and Years of working experience of the respondents

Characteristic	Respondent:	Percentage (%)
Gender:		
Male	75	68.18
Female	35	31.82
Working Experience:		
1 – 5 Years	10	9.09
6 – 10 Years	22	20
11 – 15 Years	60	54.54
16 – 20 Years	8	7.42
21 Years above	10	9.09

Source: Authors' computation, 2022.

Table 1 shows that 75(68.18%) respondents were males and 35(37.5%) of respondents were females. This shows that majority of the respondents were males. On working experiences the result shows that 10(9.09%) of respondents have working experiences between 1 and 5 years, 22(20.0%) respondents have working experiences in service between 6 and 10 years, 60(54.54%) respondents have working experience in services ranges from 11 to 15 years,

8(7.42%) respondents have working experiences between 16 and 20 years and 10(9.09%) respondents have working experiences between 21 years and above. The analysis therefore, reveals that majority of the respondents are males 75(68.18%) and those within the working experiences of 11 – 15 years 60(54.54%) have the highest majority. These entails the study have masculine and active sample size.

Table 2: Types of social protection services available for children

S/N	Kind of services	SA	A	D	SD	Mean	Decision
1	Social Welfare Child	20	90	0	0	2.9	Accepted
2	Protective Human	35	75	0	0	3.2	Accepted
3	Right Children	5	105	0	0	3.0	Accepted
4	NGOs	0	0	48	62	1.0	Rejected

Source: Authors' computation, 2022.

Information a Tool for Social Advocacy Protection Services for Children in Damaturu Metropolis, Yobe State

Table 2 above shows that social welfare, child protective and human right with the mean scores of 2.9, 3.2 and 3.0 respectively were accepted as some of the types of social protection services in Damaturu Metropolis. While children NGOs was

rejected by the respondents with mean score of 1.0 as is not considered as type of social protection services for children protection in the study area.

Table 3: The Services channels

S/N	Ways in which the services get to the children	SA	A	D	SD	Mean	Decision
1	Organized seminar	40	70	0	0	2.8	Accepted
2	Camp meetings	3	7	82	18	1.3	Rejected
3	Special outreach to event Centres	0	7	85	17	1.1	Rejected
4	Social Media platforms	33	77	0	0	3.2	Accepted
5	Radio	54	56	0	0	2.7	Accepted
6	Internet	50	60	0	0	2.6	Accepted
7	Visits to Schools	27	49	16	18	2.5	Accepted
8	Television	41	55	8	6	2.6	Accepted

Source: Authors' computation, 2022.

Table 3 above shows that respondents with the mean scores of 3.2, 2.8, 2.7, 2.6, 2.5 and 2.6 respectively indicates that seminars, social welfare platform, radio, internet, visits to schools and television are the means through which information on child protection get to the children in need. Whereas, majority representing (90.91% and 92.73%) of the respondents disagreed with

camp meetings and special outreach to event centres as means to channel information to children with mean scores of 1.3 and 1.1. The respondents affirmed that camp meetings and special outreach has never been used as means of disseminating information on children's protection in the study area.

Table 4: How often are the services offered to children?

S/N	Times these services are provided	SA	A	D	SD	Mean	Decision
1	Seminar/camp meetings:						
	Monthly	24	23	30	35	2.4	Rejected
	Quarterly	0	27	54	29	2.0	Rejected
	Yearly	36	72	1	0	2.8	Accepted
2	Outreach to event centres/ visits schools:						
	Beginning of every term	4	8	80	18	1.1	Rejected
	Twice in a term	4	0	50	56	2.0	Rejected
	Middle of the term	51	55	4	0	2.9	Accepted
3	Social media platforms/internet:						
	Every day	36	65	0	9	2.9	Accepted
	Weekly	27	68	19	6	2.6	Accepted
	Monthly	57	28	19	6	2.7	Accepted
	Quarterly	35	55	10	10	2.6	Accepted
	Yearly	40	45	19	6	2.8	Accepted

Information a Tool for Social Advocacy Protection Services for Children in Damaturu Metropolis, Yobe State

4	Radio/television:						
	Weekly	45	56	3	6	2.7	Accepted
	Monthly	25	45	20	10	2.5	Accepted
	Quarterly	40	45	20	5	2.5	Accepted
	Yearly	20	65	19	6	3.0	Accepted

Source: Authors' computation, 2022.

Table 4 shows that respondents with mean scores of 2.5 and above agreed that organized seminars only holds yearly whereas respondents with less than 2.50 disagreed with camp meetings been means of social service for children in Damaturu. Hence the mean scores of 2.9 and 2.5 agreed that visits to schools holds at the middle of the term before the commencement of serious class work. However, almost all the respondents attested that outreach to event centres were assumptions but never a reality. Interview with few respondents

assert that visits to schools by the agencies were never for the children's benefits at all. Respondents with the mean scores of 2.9, 2.6, 2.7, 2.8 and 2.7 respectively, that is children often get information on social protection through social media platforms and the internet. Radio/Television are major means through which information on children protection against social vices gets to children as opined by majority of the respondents with the mean scores of 2.9, 2.6, 2.7, 2.6, 2.8 and 2.7.

Table 5: The involvement of information managers in disseminating/packaging of knowledge on child protection in Damaturu

S/N	Items	No. of information managers	Percentage (%)
1	Information managers are involved in disseminating and packaging knowledge on child protection	80	72.73
2	Information managers are not involved in disseminating and packaging knowledge on child	30	27.27
	Total:	120	100

Source: Authors' computation, 2022.

Table 5 shows the percentage distribution of information managers' involvement in the dissemination and packaging of child protection knowledge to children in the area of study. The result shows that 80(72.73%) of information managers are involved in the service of

disseminating and packaging information/knowledge on child protection to the children in the study areas. Whereas, 30(27.27%) of the respondents admitted that they are not involved in the protection advocacy service to children in the study area.

Table 6: Primary schools teachers and community leaders' responses on the availability of information on children protection to schools and the community

S/N	Items	No. of primary school staff and community leaders	Percentage (%)
1	Readily Available Information /knowledge on protection children to schools and the community alright	16	40
2	Information provided on child protection are satisfactory	24	60
	Total:	40	100

Source: Authors' computation, 2022.

Table 6 shows that 24(60%) of knowledge/information provided to both the schools and the community are not satisfactory. Whereas 16(40%) of the respondents confirmed that the available information/ knowledge on child protection are alright in Damaturu metropolis. But the further study reveals 24(60%) of the interviewed teachers and the community members attested that the information/knowledge are not alright. While the remaining 16(40%) are of the view that information provided on children protection are satisfactory in Damaturu metropolis.

Conclusions

The study has assessed the role of information as a tool for social advocacy protection services for children in Damaturu Metropolis, Yobe State. Were the researchers concludes that applied information is a tool for positive progress in any person, group of persons, society or nations that embrace it, and then it has become imperative for agencies on child's protection to redesign and strategized their services to capture the interest of targeted audience for effective applicability of the services. Also, the agencies should incorporate the services of information managers into their

services, since their major tasks is to create, generate, acquire, disseminate information and ensure availability and accessibility of the information to the targeted audience. Finally, the knowledge on child protection by the agencies on protection should be readily available to the targeted audience on their preferred platform.

Recommendations

Based on the results of this study, the research proffers the following recommendations: That NGOs should be incorporated as their roles in disseminating of vital information to rural areas into social welfare services of Damaturu council and all local government councils in Nigeria by extension; Information managers should incorporate vocational advocacy services for effective delivery of relevant and timely information in the community.

References

- Bowen, G. A., Nickesia, S. G. & Margaret, K. C. (2017). Advocacy Through Social Media: Exploring Student Engagement in Addressing Social Issues; *Journal of Higher Education Outreach and*

- Engagement*, Volume 21, Number 3, p. 5, ISSN 1534-6104, ISSN 2164-8212.
- Emmanuel, H. (2012). Information Needs and Information Seeking Behaviour of Rural Farmers in Okpokwu Local Government Area of Benue State, Nigeria. Unpublished Master Dissertation
- Emmanuel, H. (2022). Information a tool for social advocacy protection services for children in Gwagwalada area council, Abuja, *International Journal of Library and Information Science*, Vol. 14(1), pp. 1-7, June 2022.
- Hestres, L. E. (2017). Tools beyond Control: Social Media and the Work of Advocacy Organizations; *Social Media + Society*; April-June 2017.
- Kwakpovwe C (2019). Catch these 3 Prayers: Daily Devotional. Lagos: Our Daily Manna Publication.
- Muriel O, Oliver S (2017). Disseminating Knowledge Products, Knowledge Solutions. Singapore: Springer pp. 871-878.
- National Bureau of Statistics (NBS) (2006): 2006 Population Census Data, Federal Republic of Nigeria, *National Bureau of Statistics*; Archived from the original on 25 March 2009.
- Roger CG, Robert J, Susan GF (2019). Introduction to the Library and Information Professions pp.12-15.
- Nworgu, B. G. (2015). *Educational Research: Basic Issues and Methods*; University of Nigeria Nsukka, University Trust Publishers.
- Scott, J.T. & Maryman, J. (2016). Using Social Media as a Tool to Complement Advocacy Efforts. *Global Journal of Community Psychology Practice*, 7 (1S), pages 1-22. Retrieved Day/Month/Year, from (<http://www.gjcpp.org/>).
- UNHCR (2021). Using Social Media in Community-Based Protection: A Guide: *a publications of United Nations Higher Commissioner for Refugees (UNHCR)*; January, 2021.
- UNICEF (2021). UNICEF Child Protection Strategy 2021- 2030; *A publication United Nations Children's Fund (UNICEF)*, 2021.
- <https://en.m.wikipedia.org/.../Damaturu>, 2022.

Endangered Trees, Herbs and Shrubs in Nigeria, Why They Are Endangered and Conservation Approaches

Mohammed Inusa Nguru and Rabi Sabo

School of Sciences, Department of Science Laboratory Technology,
Mai Idris Aloomo Polytechnic P.M.B. 1020 Geidam, Yobe State, Nigeria.
Email: ngurumuhammad@yahoo.co.uk

Abstract

Plants are crucial to the life of man as agents of primary production. Man relies on them for food, shelter and medication. As human population is increasing more pressure is put on the forest and forest products. There is massive felling of trees for farmland expansion, urbanization and domestic use of firewood as source of energy for heating and cooking. This enormous pressure makes some species to become endangered with some disappearing from the globe totally (extinction). The level of exploitation of plant resources is becoming bigger than production. This article highlights some ways that could be followed to conserve the endangered species from total extinction. Some of the conservational approaches include knowledge creation and awareness, provision of alternative sources of energy, value adding to local forest products, massive afforestation, plant tissue culture to increase production and improve upon the existing species by adding some desirable qualities, Government policies and laws to restrict bush burning and indiscriminate cutting down of trees, agroforestry practices to save trees at the same time produce food.

Key words: Endangered species, Conservation, approaches, trees

Introduction

Endangered trees, herbs and shrubs in Nigeria, why they are endangered and conservation approaches

A well-managed tropical forest is constantly self-renewing resource. It produces several benefits among which are high quality timber, rattan and rubber, fuel wood, fruits, nuts, spices and other foods, and numerous “minor” products of high economic value such as dyes and medicines. These multiple products can sustain the basic needs of local communities as well as providing goods and services for outside markets (Okunlola & Akinyele, 2015). Nigeria has a total land area of about 99.3 million hectares and only 10 percent of that is estimated to be a forest land. This is very small when compared with countries like Ghana with 41%, Liberia with 48% and Sierra Leone with 26% (Okunlola & Akinyele, 2015). According to 1997 IUCN Red list of threatened plants over 12.5% of the World's plant species has been identified as globally threatened. These threatened species cover around 34,000 species which are facing the danger of extinction if no any effort is made to conserve them (Walter, K.S. and Gillett, 1997). In Canada wild medicinal plants are already threatened by harvesting of medicinal plants, land clearing and development, logging, and invasive weedy species (Westfall & Glickman, 2004). An estimated US \$60 million have been realized from the global sales of medicinal herbs in the year 2000 (Idu et al., 2010). A total of commonly used plants from 56 genera, belonging to 31 families were used among the traditional healthcare practitioners in Abeokuta (Idu et al., 2010). As reported by World conservation and monitoring centre (WCMC) about 8000 tree species are endangered worldwide (Choudhury & Khan, 2010).

Estimates shows that two thirds of the World population use plants and their related products for medical care (Agyemang et al., 2021). In Ethiopia the Boosat people collected medicinal plants from the wild, with only few under cultivation. they are obtained from woodlands, roadsides, farmlands and spiritually protected areas. Depending on the part of the plant collected some of these plants are unsustainably collected posing a threat to their habitat (Debela et al., 2006). medically important plants are some of the victims of indiscriminate and wanton destruction

of tropical forests by man. These plant species are disappearing at a very alarming rate. half of the World's plants lies within the tropical forests are in danger as they are declining by about 16.8 million hectares per annum as reported by FAO (2012) (Adeniran & Daramola, 2018). The world health organization (WHO) estimates that about 80% of the population of the developing world countries use traditional medicine, particularly herbal medicine for their health care needs (WAHO, 2013; Duguma & Mesele, 2019; Ekor, 2014). This is because an assessment by FAO and UNEP in the forest resources showed that in 1980 about 11.4 million hectares of closed and open forests were being cleared annually, 3.7 million hectares in tropical Africa, 5.7 million hectares in tropical America and 2.0 million hectares in tropical Asia (UN reports, 1991). This report shows that the causes of deforestation in the late 1970's varied according to region with the expansion in agriculture accounting for the highest rate of deforestation. Apart from agricultural expansion, the rate of deforestation through road construction, timber logging, cutting of fire wood and charcoal, carving of mortar and pestle and other domestic utensils, is far more greater than the rate at which the trees are planted or replaced hence making them to become endangered species (Naziru, Z. M. and Habu, 2017; U.C., 2019). Senegal and Mauritania, like most countries in sub-Saharan Africa, face two crucial challenges: the need for energy for development, and climate change, to which these countries are particularly vulnerable. In this region, the lack of access to energy directly affects 70% of the population, and 85% in rural areas. In addition, about 730 million people use solid fuels for cooking (firewood and charcoal), harmful fumes and whose exploitation puts strong pressure on the forest resource. In places such as Africa and Asia, herbs are even used as the first line of treatment for diseases such as malaria, diabetes, hypertension, sickle cell anaemia, dermatological disorders, and most recently, HIV/AIDS opportunistic infections. In fact, over 120 pharmaceutical products currently in use are plant-derived, and most of these originate from the tropical regions of the world including Africa.

Endangered trees, herbs and shrubs in Nigeria, why they are endangered and conservation approaches

Endangered species of trees, shrubs and herbs in Nigeria.

Endangered species: is a population of an organism which is at risk of becoming extinct because it is either few in numbers, or threatened by changing environmental or predation parameters(Nadeen Sadeq Abdullah Hinnawi, 2010). Fasola et al define a threatened plant as plant in which the worldwide population is below 1000 or is found in less than 100 locations(Ogunshe & Onyeachuchim, 2004). The world conservation union (IUCN) has developed a criteria for evaluating the extinction probability of species(IUCN 1994), it contains five criteria of vulnerability : Extinct, critical endangered, Endangered, vulnerable and Near threatened(Sapir et al., 2003). Nigeria is rated highest in terms of deforestation in the World considering its large population and on economy

based largely on extensive, land based agriculture and extraction of natural resources(Isichei, 2010). In 2016, Asian countries imported about 1.4 million m³ of rosewood from West Africa, of which 58 per cent came from Nigeria(Jaya, 2019). The rate of deforestation in Nigeria was 1.8%per annum which was higher than any other country of the world. In Osun state a study was conducted using GIS and remote sensing and the result showed that the average rate of deforestation of 3.1%was shown(Asifat et al., 2019). Global forestry is battling with the problem of forest depletion, culminating into desertification and famine and extinction of species. Research indicated that there are over 4,600 plant species in Nigeria ranking the country the eleventh in Africa in terms of diversity of species(Haastrup et al., 2019). The developmental challenges of the country can only be tackled if the environment is protected and restored(Jaya, 2019).

Fig. 1 Causes of deforestation in a forest. Source Isichei, A. O. (2015).

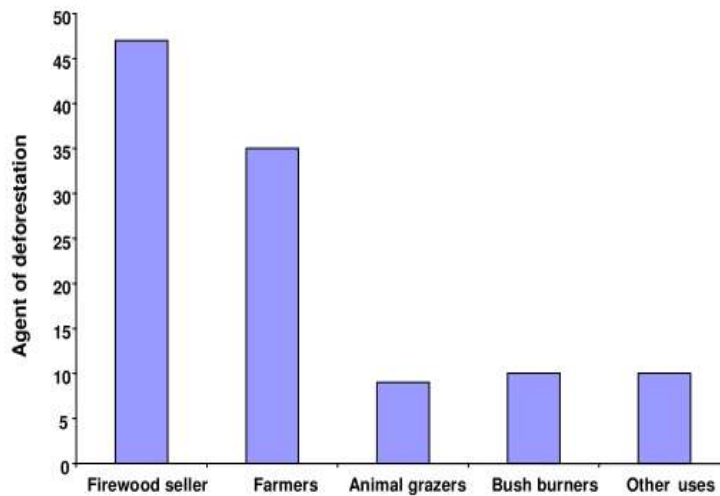


Figure 2. Agents of deforestation in the study area.

Source Isichei, A. O. (2015).

The value of wood and non-wood forest products is enormous even though there is no clear

statistics to that. Studies have shown that forest reserves occupy about 10 million ha in Nigeria

Endangered trees, herbs and shrubs in Nigeria, why they are endangered and conservation approaches

which accounts for about 10% of a land area of approximately 96.2 million ha (Alamu, L.O. and Agbeja, 2011). Native species of trees such as *Milia excelsa*, *Entandrophragma spp*, *Khaya senegalensis* were highly exploited for their quality timber and they are severely threatened and almost extinct in Nigeria (Onefeli & Adesoye, 2014).

In South Eastern Nigeria about 30 plant species belonging to 19 different families were identified as endangered species. Four are climbing dicotyledons, two are monocots and the nineteen are tree species (Meregini, 2005). In the Sahelian region habitat loss has been attributed to human clearance for fuel wood, grazing and conversion to intense agriculture (Cresswell et al., 2007).

In Nigeria a gradual loss of the traditional knowledge about plants due to oral transmission has been reported. Similarly medicinal plants are at the risk of extinction through unsustainable exploitation (Mukaila et al., 2021). Traditional medicine is simply accessible, effective in treatment and has an affordable cost compared to modern medicine (Duguma & Mesele, 2019). A species is said to be endangered if there is a reduction in the number of that species at a given time (estimated to be less than 2,500 mature individuals). An endangered species is facing the danger of extinction if the threatening factors persist. By projection extinction of 20% within 20 years (Abubakar et al., 2018; Isichei, 2010). In Igonigoni and Abo Mkpang villages in Cross River state a comparison study was conducted to identify the relationship of the villagers' life with tree and tree products. Tree and tree products make a significant contribution to the food security of many rural households. They are used

as a source of wood for construction, firewood, medicine, as a source of food (fruits, edible seeds and edible leaves) and miscellaneous tree use (Justine, D. and Damian, 1992). North eastern and north western Nigeria is threatened by the confrontational effect of desertification. The phenomenon is distressingly intensifying as a result of exploitation without replacement. The Sahelian region bordering Niger Republic is facing a huge cutting down of trees subsequently exposing the ground cover coupled with overgrazing by cattle (Go, 2020). Trees and other valuable plants have undergone different levels of depletion due to rapid increase in human population, this led to cutting of trees for firewood, charcoal production, and infrastructural developments (Ogwu, M.C., Osawaru, M.E. and Obayuwana, 2016). In the Sahelian region the plants destroyed were mostly aromatic and medicinal plants gathered, traded and used by communities as a source of livelihood (Go, 2020). Overharvesting has placed many medicinal species at risk of extinction (Roberson, Emily, 2008).

Exploitation of plant for medicine.

A medicinal plant is any plant which, in one or more of its organs, contains substances that can be used for therapeutic purposes or which are precursors for the synthesis of useful drugs. This description makes it possible to distinguish between medicinal plants whose therapeutic properties and constituents have been established scientifically, and plants that are regarded as medicinal but which have not yet been subjected to a thorough scientific study (Sofowora et al., 2013).

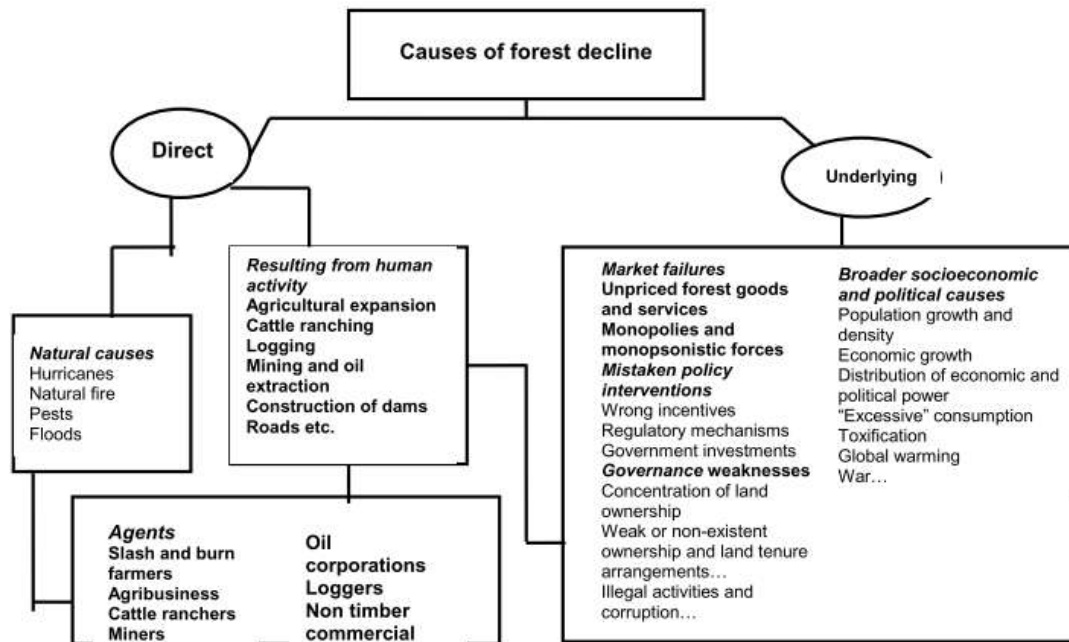


Fig. 3 Causes of Forest decline. Source Isichei, A. O. (2015).

According to IUCN and WWF there are between 50,000 and 80,000 flowering plant species used for medicinal purposes worldwide (Chen et al., 2016). Many economic and effective medicinal plants have disappeared resulting from unsustainable harvest and destruction of tropical forest for farmland expansion and urbanization (Oni, 1993). Osemeobo studied on the capability of the rain forest of Nigeria over sustaining the commercial harvest of medicinal plants. The study shows that under common resources management with no plan and sustainable harvest of the medicinal plant over harvesting or over exploitation is due to occur as the level of harvest is greater than regeneration, hence conservation action must be included to sustain the trade in forest resource (Osemeobo,

2010). In Katsina state prominent medicinal plants are endangered seriously subjecting them to threat of total extinction. Plant species such as *Neocarea macrophylla* (Gawasa), *Sclerocarya birrea* (Daniya), *Detarium microcarpum* (Taura) and *Prosopis africana* (Kirya) (Bello, A., Jamaladdeen, S., Elder, M.T., Yaradua, S.S., Kankara, S.S., Wagini, 2019). Medicinal plants therefore constitute a vital resource that can be harnessed for both health and socio-economic benefits. Nevertheless, but for the high cost of modern medicines, limited national health budgets and inadequate health facilities, which have compelled many governments to reconsider the advantages of traditional health care systems, the sector has remained largely ignored.

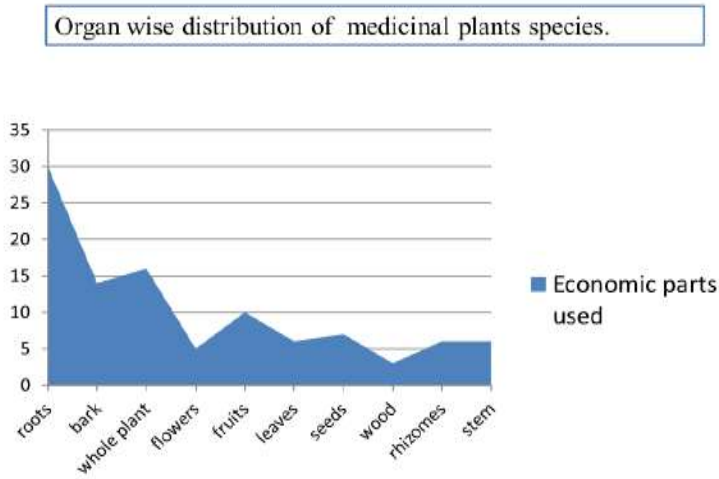


Fig 4. Parts of plants used. Source Isichei, A. O. (2015).

Exploitation of plant for timber

In developing countries Nigeria inclusive fuelwood is the major source of energy as poor masses cannot afford conventional cooking gas or kerosene. The over reliance on fuel wood brings about environmental degradation particularly desertification as result of indiscriminate cutting down of trees for firewood(Mukhtar, A.A. and Abdullahi, 2020). *Milicia excelsa* is a fast - growing forest trees species native to tropical

Africa, especially west and East Africa. The tree is classified as “lower risk but near threatened” in the international union for conservation of nature (IUCN) red list of threatened species. This is as a result of threat from habitat loss and degradation due to expanding agriculture, overexploitation of the wood. It produces one of the World's most valuable commercial timbers(Babalola et al., 2013; U.C., 2019).

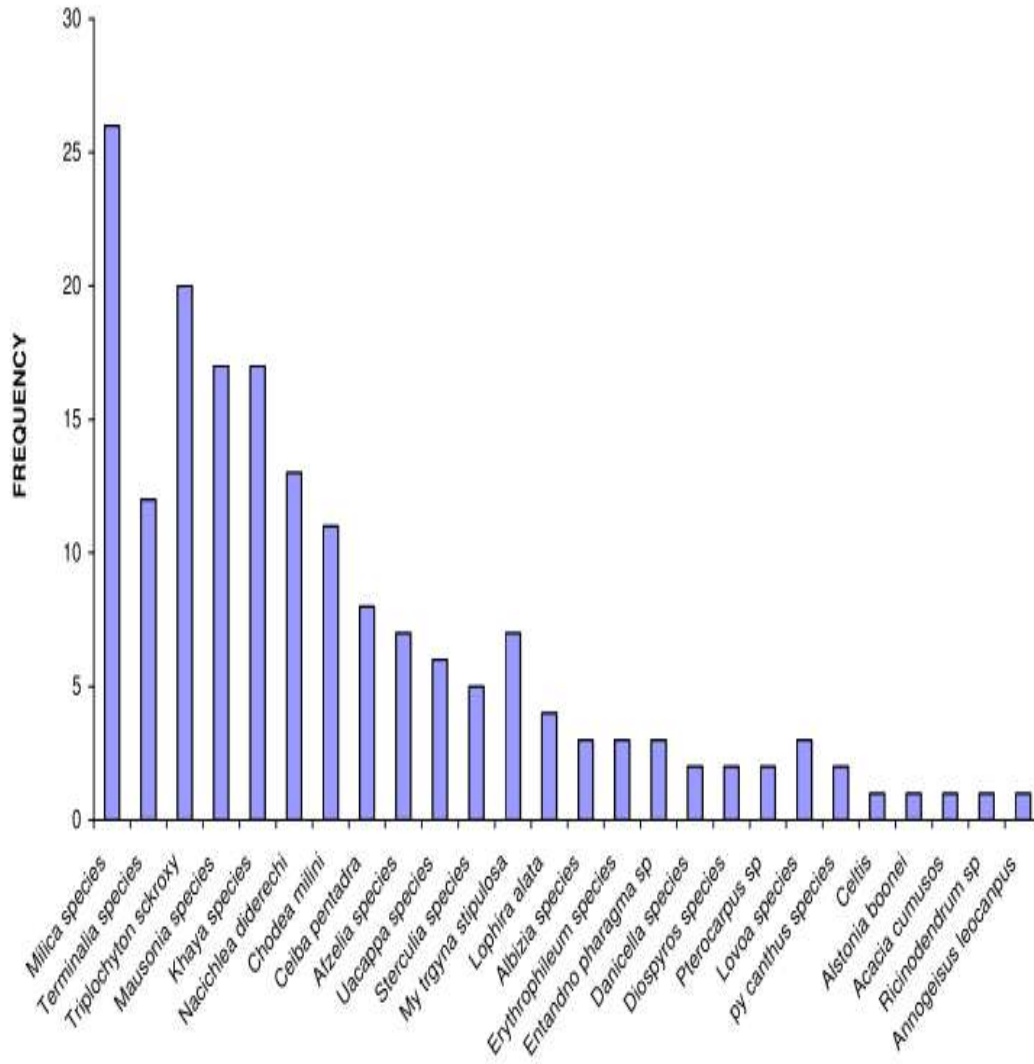


Fig 5. Indigenous endangered tree species experiencing deforestation Source Isichei, A. O. (2015).

Exploitation of plant for firewood and other uses.

In sub-Saharan Africa more than 90% of the households rely on firewood, charcoal and waste for cooking in about 25 countries(Iglesias et al., 2018). In Nigeria 94% of the population rely on firewood and charcoal for cooking. Traditional cooking using firewood is related to health risks arising from smoke , causes deforestation and climate change in addition to being very expensive(Iglesias et al., 2018). Using firewood in cooking is the major causes of deforestation in Nigeria burning p to 90% more wood than is necessary making families to spend more money that could be put in health, education and

nutrition(Iglesias et al., 2018). In South eastern Nigeria the demand for and consumption of the fruits and seeds of indigenous and wild species has no age limit boundary, standards of living or literacy level. mention of the feeding habit of the people will be incomplete without mentioning them(Meregini, 2005). In South western Nigeria, disappearance of indigenous trees from urban areas is taking place in alarming rate and the contributions of the existing trees are not adequately formalized(Babalola et al., 2013). Other species of trees that are threatened by agricultural expansion and urbanization includes:

Endangered trees, herbs and shrubs in Nigeria, why they are endangered and conservation approaches

- The Baobab tree (*Adansonia digitata*), Dum or Ginger bread palm (*Hyphaene theibaca*), Silk cotton tree (*Ceiba pentandra*), Tropical tulip tree (*Spathodea campanulata*), *Prosopis africana* (Kirya), Indian tamarind tree (*Tamarindus indica*), Desert date (*Balanites aegyptiaca*), *Anogeissus schimperi* (marke), Dry zone ebony tree (*Diospyros mesfiliformis*). These tree species are regarded as endangered species. Odoligie and Wisdom (2019) noted that poverty, population growth, invasive alien species, habitat fragmentation are some of the prominent factors for depletion of biodiversity in Nigeria (Imarhiagbe & Egboduku, 2019). In Kano state, a total of thirty one (31) species of medical importance were said to be threatened including *Securidaca longipedunculata*, *Prosopis africana*, *Mitragyna inermis*, *Terminaliaacicenoides*, *Lamnea Microcarpa*, *Kigelia africana*, *Ficus sycomorus*, *Cissusquandrangularis*, *Ceiba pentandra*, *Burkea africana*, *Balsamodendron africanum*, *Aristolochia albida*, *Albizia chevalieri*, *Anogeissus leiocarpus*, *Acacia seyel*, *Acacia nilotica*. Loss in plant species is attributed to Urbanization, deforestation, expansion of agricultural activities and unsustainable collection of plants with a very few effort of conserving or cultivating the species (Abubakar et al., 2018). Biodiversity loss is increasing in exponential rate in northern Nigeria especially across the northwest and north eastern states threatened by desertification. Plants are primary producers all other consumers depend on plants for food, fibre and energy. Environmental crises such as global warming and biodiversity loss involves plants directly (Isichei, 2010). Moreover, in these societies, herbal remedies have become more popular in the treatment of minor ailments, and also on account of the increasing costs of personal health maintenance. Indeed, the market and public demand has been so great that there is a great risk that many medicinal plants today face either extinction or loss of genetic diversity. In developing countries all over the world, large numbers of people die daily of preventable or curable diseases because of the lack of even simple health care. Diseases in these countries are often associated with malnutrition. As a result, those that do survive often never recover

completely from the effects. The developing world is not a homogenous entity, but is made up of a variety of widely differing countries and areas which are at different stages of development. Nevertheless, these developing countries have certain features in common, including extremely limited resources, poor communications, vast distances, low levels of education, and individual and community poverty. These factors act together to keep these countries in a perpetual state of poverty. Yet, their populations continue to rise, especially in the rural regions which usually account for about 80 per cent of the total population.

Discussion, conclusion and recommendation.

In Nigeria the total forest estate which covers around 10% of the country's land area in 1996 is now less than 6%. This seriously calls for forest conservation practices. The synergy between human population and forest utilization is endangered as deforestation, soil erosion, flooding and pollution increases (Onwubuya, E.A., Ogbonna, O.I. and Ezeobiora, 2014). Saving the African Region's medicinal plant resources vis-à-vis promoting the use of plant medicines for the treatment of diseases needs an effective, sustainable and coordinated strategy. Concerns have also been raised about the unregulated exploitation of Africa's bio-resources, environmental degradation, deforestation, uncontrolled burning and poor agricultural practices leading to depletion of rare and threatened medicinal plant species. Going by the population of the country and economy based on agriculture and extraction of natural resources. The country will bound to have the highest deforestation rate in the world (Imarhiagbe & Egboduku, 2019; Isichei, 2010). out of the 4,600 plant species, 707 are said to be endangered and a hundreds of plants and animals species have since gone to into extinction (GUNDU, E.G. and ADIA, 2014). According to reports by NGO rain forest action network Nigeria originally had 72,000 km² of forest which is now reduced to 10,000 km². deforestation is at the rate of 14.3 percent. Agricultural expansion is one of the major causes of deforestation. As population increases demand for fuel wood also increases

Endangered trees, herbs and shrubs in Nigeria, why they are endangered and conservation approaches

demand for other forest products will increase as well including medicinal products (Isichei, 2010).

measures taken to combat deforestation include:

1. promoting the use of alternative source of energy (solar or wind)

2. Reviewing endangered species acts to include endangered plant species and special habitats. Tanyan Rosen reported that despite continued conservation efforts, the status of many endangered species remains unchanged. This is attributed to limited funding allocated to benefit species research and conservation (Rosen, 2022). Threatened and endangered species are protected in forest reserves by establishing in situ preservation of a natural reserve which is least and effective means of conservation apparatus (Ali et al., 2016). Reintroduction of rare and endangered species into their natural habitat is one of the effective ways of supplementary regeneration. A plant restoration mechanism by introducing nursery grown seedlings is very good initiative to replace the lack of natural regeneration (Choudhury & Khan, 2010).

3. Massive reforestation to give more emphasis to indigenous species. This can be achieved by establishing seed banks. A seed bank is an ex-situ conservation storehouse typically for preserving seed species by storing them in controlled environment. The purpose is to safeguard the genetic purity and viability of seeds of endangered plant species for regeneration of seedlings in the nursery (Dau, J.H.; Donald-Amaeshi, U.A. and Chu.kwu, 2018). In China the priority for conservation is on the plants with extremely small population. Conservation can be achieved through environmental education campaign aimed at local communities, information sharing on species occurrence to coordinate conservation. combination of Ex situ and Insitu approaches must be a norm in every conservation project (Volis, 2016).

The conservation of a specie in its natural habitat or in the area where it grows naturally is known as in-situ conservation. these include s gene bank/ Gene sanction, biosphere reserves, national parks, sacred sites, sacred grooves etc. (Kr et al., 2014). Some plants are difficult to propagate using conventional horticultural techniques. in view of this many botanical gardens have tissue

culture laboratories for their micropropagation. This makes it easier for distribution of material of these species to other institutions around the world without the need for quarantine (Fay, 1992).

Ex-situ conservation of plants is the conservation of plants outside their natural habitat by cultivating and maintaining plants in botanic gardens parks and other suitable sites. it can also be through long term preservation of plant propagules in gene banks (seed bank, pollen bank, DNA libraries etc.) and in plant tissue culture form (Kr et al., 2014).

4 Boosting economy to reduce pressure on land as result of unemployment or retrenchment. Forest and its products will be given the needed attention for conservation by empowering the communities around forest reserves in the tropical forest regions so that they can have alternative sources of livelihood that are biodiversity friendly, this will definitely reduce their dependence on forest and forest products (Japheth, 2019). The impact of Global Environmental facility intervention (GEF) project on biodiversity conservation was studied by Tajudeen et al at the Kainji Lake National Park in North Central Nigeria. It was found out that poverty and illiteracy are the major drivers of the problems affecting conservation notably poaching, illegal hunting, boarder encroachment, over harvesting of firewood and medicinal herbs. The study therefore recommended training and giving proper education and training to the local people as well as awarding scholarships to deserving people and indigent youths (Azeez, 2012). Human activities resulted in the loss of habitats such as over harvesting of resources particularly timber, and more than 21 million hectare of forest have been lost since 1970 (Bc, 2020). Botanical gardens are areas set aside for propagation and preservation of plant species to ensure their continuous existence. 354,000 species of plant are found in the 1,500 botanical gardens around the world (GUNDU, E.G. and ADIA, 2014).

5. land and soil restoration as a means of increasing production rather than clearing new

Endangered trees, herbs and shrubs in Nigeria, why they are endangered and conservation approaches

land for agricultural expansion. poverty reduction through application of modern agricultural methods such as taungya farming alley cropping, improve fisheries and domestication of some wildlife species(Bc, 2020).

6. Adding value to local natural products i.e. setting up industries based on ethnobotany(Isichei, 2015). The implementation of millennium development goals putting emphasis on poverty reduction which will in return help in reversing the environmental degradation(Bc, 2020).

The extinction of plants is taking place at a very alarming rate following massive industrialization, deforestation, global warming, climate change arising from anthropogenic activities. Plants and their derivatives are harvested more than they are replaced back. Conventionally plants take a longer time to germinate and multiply and have a low rate of fruit /seed set and poor seed viability/germination

Plant Tissue culture or micropropagation is the collection of the vegetative parts of plant to grow them under In vitro laboratory condition. The root/rhizome of plants of few years old plants contains the potential of multiplying and growing to produce new plants. Using the method of plant tissue culture, a large number of plants will be produced within a short time with the desirable qualities needed since the method applied genetic principles (genetic engineering) to improve on a particular genome of plant. the generation of transgenics has helped in the manipulation of plant genomes at will(Naseem Ahmad And, 2016). Micro propagation of tree species offers a means of producing clonal planting stock for afforestation, woody biomass and conservation of elite germplasm(Mansor Ndoye, 2003).

Molecular biology and biotechnology are the major areas of science used in tissue culture research. The method is applied to preserve germplasm especially for hybrids which must be propagated vegetatively where seeds are not produced. The application of micropropagation techniques is witnessing a rapid change over the last few decades. The technique has pave way for mass-scale propagation commercially. Recent

advancement in biotechnological methodology of culturing plant cell and tissues has provided new means of rapidly propagating and conserving the endangered and other vulnerable plant species(Naseem Ahmad And, 2016)

References.

(WAHO), W. A. H. O. (2013). *WEST AFRICAN HERBAL PHARMACOPOEIA*. WEST AFRICAN HEALTH ORGANISATION (WAHO).

Abubakar, U. S., Khalifa, B. I., Sanusi, M., & Gawuna, T. A. (2018). Threatened medicinal plants of Kano Flora and the need for urgent conservation. *International Journal of Conservation Science*, 9(1), 173–178.

Adeniran, M. A., & Daramola, M. A. (2018). Trends in Preventing Medicinal Plants from Extinction in Ado Local Government Area of Ekiti State , Nigeria. *Journal of Environmental Issues and Agriculture in Developing Countries*, 10(1), 53–62.

Agyemang, A. O., Turkson, B. K., Baidoo, M. F., Amponsah, I. K., Lincoln, M., Mensah, K., Orman, E., & Bayor, M. T. (2021). Utilization of Plants for Medicinal Purposes and Concerns with Endangered Plant Species from Ghana. *Traditional and Integrative Medicine*, 6(1), 24–40.

Alamu, L.O. and Agbeja, B. O. (2011). Deforestation and endangered indigenous tree species in South-West Nigeria. *International Journal of Biodiversity and Conservation* V, 3(7), 291–297.

Ali, A. D., Elisha, E. B., Abiem, I., Habila, S., & Okeke, O. M. (2016). Hygrophytes and Wetland Angiospermic Macrophyte in Gallery Forest of Amurum Forest Reserve , Jos , Plateau State, Nigeria. *Research in Plant Sciences*, 4(1), 10–15. <https://doi.org/10.12691/plant-4-1-2>

Asifat, J. T., Oyelowo, O., Oluwapamilerin, O., & Orimoogunje, I. (2019). Assessment of

Endangered trees, herbs and shrubs in Nigeria, why they are endangered and conservation approaches

- Tree Diversity and Abundance in Selected Forest Reserves in Osun State , Southwestern Nigeria. *Open Access Library Journal*, 6, 1–16. <https://doi.org/10.4236/oalib.1105806>
- Azeez, T. O. A. and A. W. A. (2012). IMPACT ASSESSMENT OF GLOBAL ENVIRONMENT FACILITY (GEF) INTERVENTION ON BIODIVERSITY CONSERVATION IN KAINJI LAKE NATIONAL PARK, NIGERIA. *Journal of Sustainable Development in Africa*, 14(2), 77–91.
- Babalola, F. D., Borokini, T. I., Onefeli, A. O., & Muchie, M. (2013). Socio-Economic Contributions of an Indigenous Tree in Urban Areas of Southwest Nigeria. *African Journal of Science, Technology, Innovation and Development*, 5(6), 479–489. <https://doi.org/10.1080/20421338.2013.820449>
- Bc, A. (2020). Biodiversity Conservation in Nigeria : Perception , Challenges and Possible Remedies. *Current Investigations in Agriculture and Current Research*, 8(4), 1109–1115. <https://doi.org/10.32474/CIACR.2020.08.000293>
- Bello, A., Jamaladdeen, S., Elder, M.T., Yaradua, S.S., Kankara, S.S., Wagini, N. H. et al. (2019). Threatened medicinal and economic plants of the Sudan Savanna in Katsina State , northwestern Nigeria. *Bothalia- African Biodiversity & Conservation*, 49(1), 1–17.
- Chen, S. L., Yu, H., Luo, H. M., Wu, Q., Li, C. F., & Steinmetz, A. (2016). Conservation and sustainable use of medicinal plants : problems , progress , and prospects. *Chinese Medicine*, 1–10. <https://doi.org/10.1186/s13020-016-0108-7>
- Choudhury, B., & Khan, M. L. (2010). Conservation and Management of Endangered Plant Species : A Case Study from Northeast India. *Bioremediation, Biodiversity and Bioavailability*, 4(1), 47–53.
- Cresswell, W. R., Wilson, J. M., Vickery, J., Jones, P., & Holt, S. (2007). Changes in densities of Sahelian bird species in response to recent habitat degradation. *Ostrich*, 78(2), 247–253. <https://doi.org/10.2989/OSTRICH.2007.78.2.20.100>
- Dau, J.H.; Donald-Amaeshi, U.A. and Chu.kwu, O. (2018). SEED BANKS AS CONSERVATION TOOL FOR ENDANGERED WILD PLANT SPECIES IN ECOZONES OF NIGERIA. *Journal of Research in Forestry, Wildlife & Environment*, 10(3).
- Debela, H., Hunde, D., Asfaw, Z., Ph, D., Kelbessa, E., & Ph, D. (2006). USE OF TRADITIONAL MEDICINAL PLANTS BY PEOPLE OF ‘ BOOSAT ’ SUB DISTRICT , CENTRAL EASTERN ETHIOPIA. *Ethiopia Journal of Health Science*, 16(2), 1–15.
- Duguma, I. O., & Mesele, M. A. (2019). USE AND MANAGEMENT OF MEDICINAL PLANTS BY INDIGENOUS PEOPLE IN BOJI DIRMEJI DISTRICT , WESTERN ETHIOPIA. *Ghana Journal of Science*, 60(1), 37–49.
- Ekor, M. (2014). The growing use of herbal medicines : issues relating to adverse reactions and challenges in monitoring safety. *Frontiers in Pharmacology*, 4(January), 1–10. <https://doi.org/10.3389/fphar.2013.00177>
- Fay, M. F. (1992). CONSERVATION OF RARE AND ENDANGERED PLANTS USING IN VITRO METHODS 1. *In Vitro Cell Development Biology*, January, 1–4.
- Go, A. M. S. and R. (2020). Noteworthy threatened plant species in the Sahel Region, Nigeria. In *Intech Open* (Vol. 32, pp. 137–144). <https://doi.org/DOI:http://dx.doi.org/10.5772/intechopen.93975>

Endangered trees, herbs and shrubs in Nigeria, why they are endangered and conservation approaches

- GUNDU, E.G. and ADIA, J. E. (2014). Conservation methods of Endangered Species. *Journal of Research in Forestry, Wildlife and Environmental*, 6(2), 76–83.
- Haastруп, N. O., Dahunsi, O. M., & Baba, G. O. (2019). Diversity and Abundance of Tree Species at Owo. *Internaional Journal of Research and Innovationin Applied Sciences, IV(Vii)*, 27–32.
- Idu, M., Erhabor, J. O., & Efijuemue, H. M. (2010). Documentation on Medicinal Plants Sold in Markets in Abeokuta, Nigeria. *Tropical Journal of Pharmaceuatical Research*, 9(2), 110–118.
- Iglesias, E., Loureiro, M. L., & Escribano, F. (2018). Household perceptions on biogas as a sustainable energy source . A focus group study in Hadejia Valley , Nigeria. *Conference Workshop September 2-5 Madrid 2018, Spain*, 1–12.
- Imarhiagbe, O., & Egboduku, W. O. (2019). Conservation and Utilization of Biodiversity- Implications to the Nigerian Environment. *JOJ Wildlife and Biodiversity*, 1(4).
- Isichei, A. O. (2010). Endangered plants in nigeria: time for a new paradigm for vegetation CONSERVATION. *The Nigerian Field*, 84, 64–84.
- Isichei, A. O. (2015). *ENDANGERED PLANTS IN NIGERIA: TIME FOR A NEW PARADIGM FOR VEGETATION CONSERVATION. January*.
- Japheth, E. M. A. and H. D. (2019). Conservation and Restoration of Endangered Plant Species in the Tropical Forests. *Asian Journl of Resarch in Agriculture and Forestry*, 1–17.
- Jaya, M. and G. P. (2019). *National Strategy to combat Wildlife and Forest Crime in Nigeria*.
- Justine, D. and Damian, A. (1992). Tree Use in Igonigoni and Abo Mkpang , Cross River State , Nigeria ; a Comparison of Two Villages Located in Areas with Different Vegetation Types Author (s): Justine Dunn and Damian Agom Source : Global Ecology and Biogeography Letters , Vol . 2 , No . *Global Ecology and Biogeography Letters*, 2(6), 196–206.
- Kr, A., Sudharani, N., Anjali, K. B., & Tm, D. (2014). Biodiversity and strategies for conservation of rare , endangered and threatened medicinal plants. *JOURNAL OF PHARMACOGNOSY AND PHYTOCHEMISTRY*, 2(3), 12–20.
- Mansor Ndoye, I. D. and Y. K. G. (2003). In vitro multiplication of the semi-arid forest tree , Balanite aegyptiaca (L) Del. *African Journal of Biotechnology*, 2(11), 421–424.
- Meregini, A. O. A. (2005). Some endangered plants producing edible fruits and seeds in Southeastern Nigeria. *Fruits*, 60(3), 211–220. <https://doi.org/10.1051/fruits>
- Mukaila, Y. O., Oladipo, O. T., Ogunlowo, I., Ajao, A. A., & Sabiu, S. (2021). Which Plants for What Ailments : A Quantitative Analysis of Medicinal Ethnobotany of Ile-Ife , Osun State , Southwestern Nigeria. *Hindawi : Evidence-Based Complementary and Alternative Medicine*, 2021, 1–21.
- Mukhtar, A.A. and Abdullahi, I. L. (2020). Typha Biomass Energy for Sustainable Management of Typha domingensis L . in Affected Communities of Northern Nigeria. *Dutse Journal of Pure and Applied Sciences*, 6(4), 246–252.
- Nadeen Sadeq Abdullah Hinnawi. (2010). *An ethnobotanical study of wild edible plants in the Northern West Bank “Palestine.”* An-Najah National University.
- Naseem Ahmad And, M. A. (2016). *Plant Tissue Culture: Propagation, Conservation and Crop Improvement*. Springer. <https://doi.org/DOI 10.1007/978-981-10-1917-3>
- Naziru, Z. M. and Habu, A. (2017). Threats To Biodiversity Conservation In Yankari
- Endangered trees, herbs and shrubs in Nigeria, why they are endangered and conservation approaches***

- Game Reserve ., *International Journal of Innovative Research and Advanced Studies*, 4(11), 395–400.
- Ogunshe, T. R. F. A. A. O., & Onyeachuchim, H. D. (2004). ETHNOBOTANICAL IMPORTANCE OF ENDANGERED SPECIES IN THE ARID ZONES OF NIGERIA. *Zonas Aridas*, 8(April 1998), 57–61.
- Ogwu, M.C. , Osawaru, M.E. and Obayuwana, O. K. (2016). Diversity and Abundance of Tree Species in the University of Benin , Benin city, Nigeria. *Applied Tropical Agriculture*, 21(3), 46–54.
- Okunlola, O., & Akinyele, A. (2015). Sustainable management of the Nigerian forests for poverty alleviation. *Journal of Agriculture, Forestry and the Social Sciences*, 12(1), 176. <https://doi.org/10.4314/joafss.v12i1.19>
- Onefeli, A. O., & Adesoye, P. O. (2014). Early Growth Assessment of Selected Exotic and Indigenous Tree Species in Nigeria. *South-East European Forestry*, 5(1), 45–51.
- Oni, O. (1993). Conservation and vegetative propagation the genetic resources of some endangered medicinal woody plants of Nigeria. In *Acta Horticulture* (Vol. 331).
- Onwubuya, E.A. , Ogbonna, O.I. and Ezeobiora, O. C. (2014). Conservation of forest resources by rural farmers in Anambra state, Nigeria. *Journal of Agricultural Extension*, 18(2), 177–184.
- Osemeobo, G. J. (2010). CAN THE RAIN FORESTS OF NIGERIA SUSTAIN TRADE IN MEDICINAL PLANTS ? *International Journal of Social Forestry*, 3(1), 66–80.
- Roberson, Emily, A. M. & J. M. (2008). *Medicinal Plants at Risk*.
- Rosen, T. (2022). Protecting Endangered Species. *Earth Negotiations Bulletin*, 1–10.
- Sapir, Y., Shmida, A., & Fragman, O. (2003). Constructing Red Numbers for setting conservation priorities of endangered plant species : Israeli flora as a test case. *Journal of Nature Conservation*, 11.
- Sofowora, A., Ogunbodede, E., Onayade, A., & Dentistry, C. (2013). THE ROLE AND PLACE OF MEDICINAL PLANTS IN THE STRATEGIES FOR DISEASE. *African Journal of Traditional Complement Alternative Medicine*, 10(5), 210–229.
- U.C., I. (2019). A review of opportunities in conservation and use of medicinal and Aromatic plants in Nigeria. *International Journal of Advanced Research*, 7(4), 770–778. <https://doi.org/10.21474/IJAR01/8885>
- Volis, S. (2016). Plant Diversity How to conserve threatened Chinese plant species with extremely small populations ? *Plant Diversity*, xxx, 1–8. <https://doi.org/10.1016/j.pld.2016.05.003>
- Walter, K.S. and Gillett, H. J. (1997). *1997 IUCN Red list of threatened plants*. IUCN, Gland,Switzerland and Cambridge UK.
- Westfall, R. E., & Glickman, B. W. (2004). Conservation of Indigenous Medicinal Plants in Canada. *Species at Risk 2004 Pathways to Recovery Conference.*, 1–8.

Endangered trees, herbs and shrubs in Nigeria, why they are endangered and conservation approaches

Impact of Poor Selection Interview On Future Performance of Potential Employee and Organizational Productivity in Tertiary Institutions in Yobe State, Nigeria

Musa Mohammed¹, Gambomi Goni Musa², Abdullahi Mustapha Geidam³, Musa Adamu Mahdi⁴ & Dikkuma Mohammed Ibrahim⁵

¹Department of Business Administration and Management, Mai Idris Aloomo Polytechnic Geidam, Yobe state

²Department of General Studies, Mai Idris Aloomo Polytechnic Geidam, Yobe state

³Department of Marketing, Mai Idris Aloomo Polytechnic Geidam, Yobe state

⁴Department of Public Administration, Mai Idris Aloomo Polytechnic Geidam, Yobe state

⁵Fane-fane Central Library, Mai Idris Aloomo Polytechnic, Geidam, Yobe State

*(Author E-mail: musaalidala1979@gmail.com)

Abstract

This study critically assessed the impact of poor selection interview on future performance of potential employees and organizational productivity in tertiary institutions of Yobe state, Nigeria. A multistage random sampling was being employed to select one hundred and forty (150) respondents from three (3) tertiary institutions of Yobe state. The study effectively formulated and tested two hypotheses. Data were collected through primary (questionnaires and personal interviews) and secondary sources (journals, text books and other relevant literatures). The data collected from the respondents were presented using tables and analyzed with the aid of simple percentages (%) and the hypotheses were tested using Chi-square (X^2). From the analysis of the study, the findings revealed that all the organizations were highly affected by poor selection interviews. Low productivity, high cost of training and difficulties in learning are some of the problems as a result of poor selection interviews. The study also revealed the problem of poor selection interview is common to all institutions in the State. At the end of the study, following recommendations were made. Since all the organizations were affected by poor selection interviews, there is a need to restructure and improve on their selection methods to choose appropriate candidates for job. Also Organizations can take measures to improve the situation by giving proper training to the interviewers, restructuring the interview accurately and critical investigation on the applicants through their referees and fast record that can spelt out the details of the applicant and the reasons why they are looking for the new jobs.

Key words: Poor selection, Interview, Performance, Employee, Tertiary.

Impact of Poor Selection Interview On Future Performance of Potential Employee and Organizational Productivity in Tertiary Institutions in Yobe State, Nigeria

Introduction

One of the most significant developments in the field of organizations in recent times is the increasing importance given to human resource. People are vital to organizations as they offer perspectives, values and attributes to organizational life; and when managed effectively, these human traits can be of considerable benefits to the organization. As revealed in Djabatey (2012) this scenario lends credence to the increasing attention being paid to the people aspect of organizational wealth. This is so because the development of people, their competencies, and the process development of the total organization are the fulcrum of human resource management (Mullins, 1999; Djabatey, 2012). Akin to this development is the contention in National University of Ireland (2006) that the continued growth of the enterprise depends on its ability to recruit and select high quality personnel at all levels. While recruitment is the process of identifying and attracting potential candidates from within and outside an organization to begin evaluating them for future employment, selection begins when the right caliber of candidates are identified (Walker, 2009).

Human resources is one of the most important resources that an organizations need to pay more attention, because both capital and material resources are control and manage by the employees. The personnel Department of the organization is responsible to determine who will or will not allow to enter into the organization. Personnel managers must ensure that once manpower standards are set and specification identified, the process of selection placement including promotion, demotion and transfer can operate on a sound footing. As vacancies continue to increase, a standard procedure must be design to appoint the most suitable applicant to occupy the position. Despite these features, we continue to advocate a more reciprocal approach to employment decision making which is increasingly being accepted in the belief that managers will be more effective in the staffing their organization if they can bring about some

changes. The need for recruitment emanate from Departmental managers who would notify the personnel manager or personnel Department in writing. (Aminu, 1996). The personnel manager will write back to the departmental manager requesting them to forward to his office the job description and job specification for the vacant post so as to enable personnel department place an advertisement. The purpose is to ensure that the right person selected for the job.

Selection is among the major functions of human resource department and as well an important first step towards creating the competitive strength and the strategic advantage for the organization. Searching for, and obtaining potential job candidates in sufficient numbers and quality and at the right cost is the best way for organization to get the most appropriate people to fill its job positions.

The steps involved in selection process vary from organization to organization and from individual to Individual. The number of steps in selection process and their sequence do not only vary with companies but also with the type and the level of the job, the cost of administering the selection procedures of the job, effectiveness of individual steps in the procedure of eliminating unqualified candidate and feasibility of the whole selection programmed within the context of organizational environment .Also information concerning the probable success or failure of the job applicant is important and comes first because the applicant who fail to meet the basic requirement may rejected as early as possible. (Cumming, 1968).

It has been observed that many factors contribute to the poor performance of employees in an organization and one of such problem is poor selection-interview. It is a problem because where there is poor selection interview, the applicant reality cannot be identify which will eventually lead to employment of inappropriate applicant that cannot performs their responsibilities and that

Impact of Poor Selection Interview On Future Performance of Potential Employee and Organizational Productivity in Tertiary Institutions in Yobe State, Nigeria

affect the organization's performance and productivity. It is regrettably, many organizations in Nigeria ignore standard selection programmes, this makes selection of personnel inundated with myriad of unethical practices; bias, discrimination and favouritism. It is obvious that hiring someone who does not fit into a particular job or who does not suit the culture of the organization may bring about disciplinary problems, disputes, absenteeism, high labour turnover, fraud, poor service delivery to customers, suppressed creativity, innovations and learning, inability to cope with new challenges or changes, non-competitiveness, poor quality production, waste of organization's money, time and other valuable resources. All these may culminate to low level of organizational productivity. It is against the backdrop of the above vexing problems, that this study was designed.

The main objective of this study is to critically assess the impact of poor selection interview on future performance of potential employee and organizational productivity in tertiary institutions in Yobe state, Nigeria; while the specific objectives are: To determine the extent to which poor selection-interview affects the future performance of potential employees and organizational productivity in tertiary institutions in Yobe state, Nigeria and to examine the relevant problems due to poor selection-interviews in tertiary institutions in Yobe state, Nigeria.

While the research hypothesis to be tested are:

H_{o1}: Poor selection interview is not the causes of poor performance of employees' and organizational Productivity in tertiary institutions in Yobe state, Nigeria.

H_{o2}: There are no relevant problems due to poor selection-interviews in tertiary institutions in Yobe state, Nigeria.

Review of Related Literatures

This part of the research is concern with the review of relevant literature of the impact of poor selection interview on future performance of potential employee and organizational productivity. Recruitment and selection are vital functions of human resource management for any type of business organization. These are terms that refer to the process of attracting and choosing candidates for employment. The quality of the human resource the firm has heavily depends on the effectiveness of these two functions (Gamage, 2014). Recruiting and selecting the wrong candidates who are not capable come with a huge negative cost which businesses cannot afford. Thus, the overall aim of recruitment and selection within the organization is to obtain the number and quality of employees that are required to satisfy the strategic objectives of the organization, at minimal cost (Ofori & Aryeetey, 2011).

According to Aphu (2018) in his study were he investigates the impact of recruitment and selection criteria on performance using GN Bank, Accra Ghana as point of convergence. The analyses of 130 valid responses obtained through a questionnaire that was administered to randomly selected respondents uncovered that recruitment and selection criteria have significant effect on organization's performance ($X^2 = 35.723$; $df = 3$; $p < 0.05$). The more objective the recruitment and selection criteria, the better the organization's performance ($X^2 = 20.007$; $df = 4$; $p < 0.05$). In study he put candidates under meticulous check cum scrutiny so as to conceive an organizational palatability as the after-effect.

In the study the impact of recruitment and selection criteria on performance using Fidelity Bank Plc, Lagos Nigeria as focal point. Were the analyses of 130 valid responses obtained through a questionnaire that was administered to randomly selected respondents revealed that recruitment and selection criteria have significant effect on organization's performance ($X^2 = 35.723$; $df =$

3; $p < 0.05$). The more objective the recruitment and selection criteria, the better the organization's performance ($X^2 = 20.007$; $df = 4$; $p < 0.05$) (Ekwoaba, Ikeije & Ufoma, 2015).

As explained by Opatha (2010) recruitment is the process of finding and attracting suitably qualified people to apply for job vacancies in the organization. It is a set of activities an organization uses to attract job candidates who have the needed abilities and attitudes. Recruitment is the process of generating a pool of qualified applicants for organizational job vacancies. For Ofori and Aryeetey (2011) recruitment is the process of generating a pool of competent individuals to apply for employment within an organization. Evidence has shown that larger corporations are more likely than smaller organizations in implementing sophisticated recruitment processes (Bacon & Hoque, 2005) with majority of smaller organizations relying on referrals and advertising as their recruitment practices of choice (Barber, Wesson, Roberso & Taylor, 1999).

The general purpose of recruitment according to Gamage (2014) is to provide the organization with a pool of potentially qualified job candidates. The quality of human resource in an organization highly depends on the quality of applicants attracted because organization is going to select employees from those who were attracted. In the same vein, Henry and Teixeira (2002) construed recruitment as the entry point of manpower into an organization and the path an organization must follow from there on in order to make sure that they have attracted the right individuals for their culture and vibes so that the overall strategic goals are achieved .

Selection is one of the most difficult procedures of recruitment due to interest and conflict of interest. The conflict of interest may not be unconnected with the socio-cultural factors in the developing countries. While search for perfect method of continues, in its absence personnel managers continue to

use a variety of imperfect method to aid the task of predicting which applicant will be most successful in meeting the demands of the job (Torrington and Hall 1991).

Adil & Javed (2021) in their study the Impact of Recruitment and Selection Practices on Employee Performance were the human resources of an organization are one of the most pivotal assets of the organization, which defines the success and the failure of the organization. This study provides evidence for the impact of human resource practices related to recruitment and selection on staff performance and prove that underachievement or non-satisfaction can be a result of wrong recruitment and selection criteria. This study is based on Jeddah, Saudi Arabia, where 20 respondents were inquired for regarding how recruitment and selection process of the organization impacts their performance. The findings of the study elucidate a correlation between the recruitment and selection practices and its impact on the employee performance. The obtained result highlighted that small or medium scale organizations needs to focus on defining the recruitment and selection process in details for right candidate, for the right work at the right place can be hired. This lead employee satisfies their job, increasing the motivation to perform better and benefiting the organization in gaining competitive edge in the industry.

In countries like Nigeria, in most cases qualified candidate may be rejected and the least qualified candidate be selected due to a number of some reasons. Among the reasons are quota system and equal opportunity especially in public services. Aminu (1996).

Personnel managers normally exhibit their talent during recruitment and selection through the construction of selection procedures, short listing and interviewing candidate and the instrument of administrative control over the decision of who to employ. Plumbley. (1985)

Impact of Poor Selection Interview On Future Performance of Potential Employee and Organizational Productivity in Tertiary Institutions in Yobe State, Nigeria

Selection Process

According to Lawal (1993) Selection is a process of gathering information about applicants for a position and using that information to choose the most appropriate applicant. Process of selection emanates from departmental managers who would notify the personnel Department in writing. The personnel manager will write back to the Departmental manager requesting them to forward to his office the job description and job specification for the vacant post so as to enable personnel Department to place an advertisement. The purpose is to ensure that the right person is selected for the job. Morgan (1973).

Selection Instrument

The number and types of selection methods used to separate applicants into various categories according to their acceptability vary from organization to organization, and from vacancy to vacancy. The longer the organizational chart, the longer the selection process and the longer it takes to dismiss an employee.

The general purpose of recruitment according to Gamage (2014) is to provide the organization with a pool of potentially qualified job candidates. The quality of human resource in an organization highly depends on the quality of applicants attracted because organization is going to select employees from those who were attracted. In the same vein, Henry and Teixeira (2002) construed recruitment as the entry point of manpower into an organization and the path an organization must follow from there on in order to make sure that they have attracted the right individuals for their culture and vibes so that the overall strategic goals are achieved. In other words a good selection programme is important due to the following reasons are; Applicant who has been selected carefully through a good selection method tends to learn the job easier; The applicant tends to be more productive and happier in their job and a good

selection programme reduces the cost of training and development. (Ayodele and Sunday 2009).

Selection Methods

A number of selection methods do exist in order to have fair employment through selection methods a combination of two or more methods are used and the choice of these is depend upon a number of factors which include; selection criteria, acceptability and appropriateness of the selection methods, abilities of the potential employee, administrative convenience, time factor, accuracy and cost.

Selection methods are sometime called selection tools. The selection method or instruments used in recruitment of applicant in most organizations are: (Walker 1980).

Application Letter

Every applicant is expected to send to the organization he/she desires to work, a written application to give some factual information such as the applicant's Education, working experience and personal history are stated. Such application are usually sent along with the resumes of the applicant's .A resume is a few page summary of the applicant's back ground and qualification, previous job experience, life objectives and other information that may be useful in assessing an individual's ability to on a job.

Employment Test

Tests administered on a job candidates usually focus on aptitudes, skills, abilities or knowledge relevant to the job that are performs. Most of the tests are conducted for fresh graduates who have no previous working experience, but not for management level. Employment test is an instrument that involves an individual taking a written test or examination in order to get a job. The issue of using test as a selection instrument is

Impact of Poor Selection Interview On Future Performance of Potential Employee and Organizational Productivity in Tertiary Institutions in Yobe State, Nigeria

controversial in the sense that those favor test are of the view that there is unreliability in interview as a predictor of performance. Rather test has the potentiality of being accurate and objective. Therefore in order to be employ, applicant are expected to pass up to certain grade depending on the standard set out the organization.

Interview

This is perhaps the most widely used selection technique. Applicants are usually interviewed by a member of personnel Department and representative (s) of the Department he/she will be working. For higher level jobs, the applicant may have a discussion with the Managing Director. The interview session provide opportunity for the applicant and the firms to know more of each other this stage of selection process is the most biased stage where, discrimination, favoritism, and other negative virtues can be most experienced and exercised. However, some of the problems associated with this stage can be better addressed through having highly trained and experienced interviewers and using of structured interviews.

Types of Interview:

1. Biographic Interview: This type of interview requires complete and a whole history of the applicant such as name in full, address, sex, qualification, religion, marital status and referees etc. Biographic interview is mostly done to verify the content of what a candidate filled in his applicant blank.
2. Stress Interview: This type of interview showing how an applicant can sustain a lot of pressure. At times interviewer will deliberately subject the applicant to questions that are irrelevant to the interview or will put an embarrassing or unexpected questions to the applicant which may not even relevant to the job to

be performed so as to determine his/her ability to resist pressure. Stress interview is a useful method for the selection of potential employees who will be placed on jobs where resistance to pressure and stress is important.

3. Problem Solving Interview: In problem solving interview, the interviewer always make hypothetical assumptions and ask the applicant to comment. It is some time called situational interview. The applicant is expected to imagine if he were in the position, what will be his suggestions or comment. This type of interview is meant for applicant aspiring for managerial position.
4. Depth Interview: In a depth interview, the interviewer frame his questions in all aspect of the applicant life that is very much related to the employment. The applicant is expected to answer all questions in depth so as to enable the interviewer to evaluate the candidate.
5. Group Interview: Group interview as the name implied is a group of four to six applicants are allowed to enter an interview room in order to be interviewed by the interviewers. This type of interview allow the candidates to express their feeling toward a particular question or the interviewers would allow the candidates to either agree or disagree with the first candidate as he answer the question. In most cases the interviewees in group interview are company executives and interviewees are interviewed for the position of management trainees.
6. Panel Interview: in panel interview, only one candidate is to appear in the interview room to

Impact of Poor Selection Interview On Future Performance of Potential Employee and Organizational Productivity in Tertiary Institutions in Yobe State, Nigeria

answer questions that will be asked by a number of interviewers. This method of is called panel or board because the interviewers are many in numbers depend on the choice of the organization and only one candidate is called into the interview room one after another. Panel interview is the most popular method of interview in most developing countries.

7. Telephone Interview: It is an interview that is done by telephone. The interviewer arranged with the interviewee a specific time within which to reserve a phone call from the interviewer for the purpose of the interview. In telephone interview, the interviewer normally set a standard questions which he will like to ask the interviewee. This is normally said to a predetermined question. Telephone interview in most case are conducted to candidates applying for managerial post and the candidates are sometime already known to the interviewers due to the position they are holding or might have hold. The interview is conducted via telephone due to in ability to the interviewee to get chance to attend face to face dialogue.

References

Usually, a job is ask to supply the names of references, that is, the people who can verify back ground information and provide personal evaluation of the candidates. Naturally, applicants tend to list only those people who are likely to say good things about them. This personal evaluation obtained from references may not be of much value. Therefore, most organization now investigate candidate's work record, school record and the reason why an applicant choose to leave his former job.

Impact of Poor Selection Interview On Future Performance of Potential Employee and Organizational Productivity in Tertiary Institutions in Yobe State, Nigeria

Medical Check List

Medical examination is important to substantiate that an applicant is in good health, and to examine candidate physically.

Methodology

Research Design

The survey focused on the Academics and Non academics staffs of the three institutions of higher learning in Yobe state Nigeria namely Mai Idris Aloomo Polytechnic Geidam, Umar Suleiman College of education Gashu'a and Federal College of Education (Technical) Potiskum which forms the population of this study. Necessary data were collected to ascertain the extent of the effects of poor selection interview on future performance of potential employee and organizational productivity. To achieve the objectives of the study, primary source of data was employed. The primary source of data was based on the use of Questionnaire distributed and collected from the Academics and Non academics staffs of the above mentioned institutions. The target population of study was all Academics and Non academics of the above mentioned institutions. Since it is not possible to study the entire Population, a sample of 50 respondents was randomly selected and Administered questionnaire from the institutions studied. The sampling technique used for this study was stratified random sampling technique in selecting the Sample for empirical examination. The questionnaire was designed in such a way that alternatives were provided for the respondents to choose from and opinions were expected to be expressed. In the questionnaire, the Likert scale measurement of variables was used; this requires the respondents to indicate a degree of agreement or disagreement. A non-parametric statistics (Chi-square) was employed in testing the hypothesis.

Study Population and Sampling Procedures

A population of the study includes all academic and non-academic staffs of the three (3) tertiary institutions selected in Yobe state, Nigeria namely; Mai Idris Aloomo Polytechnic Geidam, Umar Suleiman College of education Gashu'a and Federal College of Education (Technical) Potiskum. The researchers used simple random sampling method for both school and staffs. The sample will draw from three (3) tertiary institutions in Yobe state, Nigeria as mentioned above. A sample of one hundred and twenty (120) staffs (both academic and non-academic) were drawn from the institutions randomly.

Data Analysis and Presentation

To make the work simple and easily understandable for both public and private users, the researcher used descriptive statistics in a tabular form to present and analyze the data collected through the questionnaire. A non-parametric statistics (Chi-square) was employed in testing the hypothesis.

The first table will use to analyze personal data of the respondent while the remaining tables are used to analyze the real research work

Table 1 Personal Data

Gender:	Frequency	Percentages (%)
Male	84	77.09
Female	25	22.91
Total	109	100
Age:		
30-40	11	10.09
40-50	46	42.20
50 and above	43	39.45
Total	109	100
Marital status:		
Married	95	87.11
Single	9	8.21
Widow	3	2.71
Divorced	2	1.83
Total	109	100
Cadre:		
Academic	43	39.45
Non academic	66	60.55
Total	109	100
Qualifications:		
PhD	22	20.18
MSC/ MA/MED	67	61.46
BA/BSC/BTECH/BED/HND	21	19.26
Total	109	100

Source: Field survey, (2022).

Above table shows that 77.09% Of the Respondents are male while 29.91% are female. It also revealed that 10.09% of the respondents are between the ages of 30-40, 42.20% are between the age of 40-50 while the

remaining 39.45% are of 50 years and above. About 87.11% of the respondents are married, 8.21% are single, 2.71% are widows while the remaining percentage (1.83%) is divorced. 4039.45% of the respondents are academic

Impact of Poor Selection Interview On Future Performance of Potential Employee and Organizational Productivity in Tertiary Institutions in Yobe State, Nigeria

staffs and the remaining 60.55% are non-academic staffs. 20.18% of the respondents are PhD holders, and 61.46% are master's degree

holders while 19.26% of the respondents are holders of bachelor degrees.

Table 2 Impact of Poor selection interviews the main causes of poor performance of potential employees and organizational:

Responses	Frequency	Percentages (%)
Agree	85	60.72
Strongly agree	44	31.4
Neutral	7	5
Disagree	4	2.86
Strongly disagree	0	0
Total	140	100

Source: Field survey, (2022).

Above table shows that 60.72% of the respondents agreed that poor selection interview is highly affected both employees and institutional performance of their organizations, 31.4% are strongly agreed that it affects the organizational productivity as well as employees performance in their institutions. 5% remain

undecided While 2.8% of the respondents disagreed to the statement. While looking at whole, majority of the respondents believed that poor selection interview have affected their institutional productivity and employees performance.

Table 3 Low productivity, High cost of training and Difficulties in learning problems:

Responses	Frequency	Percentages (%)
Agree	87	62.1
Strongly agree	40	28.51
Neutral	11	7.81
Disagree	2	1.4
Strongly disagree	0	0
Total	140	100

Source: Field survey, (2022).

From the table above, it is clearly indicated that 62.1% of the respondents agree that the above mention are relevant problem of poor selection-interviews, 28.5% are strongly agreed to the statement, 7.81 remained undecided. While 1.4% disagreed to it. Therefore, it is concluded that low productivity, high cost of training, difficulties of learning are some the problems that lead to poor performance of employees and organizations in Yobe State, Nigeria.

Chi-square (χ^2) statistical tool was used for testing the hypotheses of this research work for the primary data collected. The formula for calculating chi-square (χ^2) is stated as follows:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

E

Where O is the observed frequency, E is the expected frequency.

Hypothesis 1

Tests of Hypotheses

Impact of Poor Selection Interview On Future Performance of Potential Employee and Organizational Productivity in Tertiary Institutions in Yobe State, Nigeria

H_{o1} : Poor selection interview is not the causes of poor performance of employees' and organizational Productivity in tertiary institutions in Yobe state, Nigeria.

Table 4 Test of Hypothesis 1

Respondent view	Observed O	Expected E	Residual (O – E)	(O – E) ²	(O – E) ² E
Strongly Agree	85	28.00	57.00	3,249.00	116.036
Agree	44	28.00	16.00	256.00	5.818
Neutral	7	28.00	- 21.00	441.00	15.750
Disagree	4	28.00	- 24.00	576.00	20.571
Strongly Disagree	-	28.00	- 28.00	784.00	28.00
Total	140	140.00			186.175

Source: Computed from data, 2022.

Calculated Chi-square (X²) = 186.175

Degree of freedom (d.o.f) = n - 1 Therefore, d.o.f = 5 - 1 = 4

Tabulated (X²) at 0.05% level of significance for 4 degrees of freedom is 9.488

Decision: Since the calculated Chi-square is greater than the tabulated, the null hypothesis (H₀) is rejected and the alternative (H₁) is accepted. Consequently, this indicated that the impact Poor selection interviews is the main causes of poor of performance of potential employees and organizational productivity of

institution of higher learning in Yobe state Nigeria.

Hypothesis 2

H_{o2} : There are no relevant problems due to poor selection-interviews in tertiary institutions in Yobe state, Nigeria.

Table 5 Test of Hypothesis 2

Respondent View	Observed O	Expected E	Residual(O – E)	(O – E) ²	(O – E) ² E
Strongly Agree	87	28.00	59.00	34.81.00	124.321
Agree	40	28.00	12.00	144.00	5.143
Neutral	11	28.00	- 17.00	289.00	10.321
Disagree	2	28.00	- 26.00	676.00	24.143
Strongly Disagree	-	28.00	- 28.00	784.00	28.000
Total	140	140.0			191.728

Impact of Poor Selection Interview On Future Performance of Potential Employee and Organizational Productivity in Tertiary Institutions in Yobe State, Nigeria

Source: Computed from data, 2022.

Calculated Chi-square (X^2) = 191.928 Degree of freedom (d.o.f) = $n - 1$

Where n is number of rows Therefore, d.o.f = $5 - 1 = 4$

Tabulated X at 0.05% level of significance for 4 degrees of freedom is 9.488

Decision: Since the calculated Chi-square is greater than the tabulated, the null hypothesis (H_0) is rejected and the alternative (H_1) is accepted. Thus, this indicates that Low productivity, High cost of training and Difficulties in learning are some of the most relevant problems that affect selection-interviews in tertiary institutions that lead to poor performance of employees and organizations in Yobe State, Nigeria.

Discussion of the Findings

The findings of this study is in tandem with existing information in the literature that recruitment and selection criteria have significant effect on organization's performance. Huselid (1995) observed that recruitment and selection criteria have significant organizational performance effect due to the provision of large pool of qualified applicants: paired with a reliable and valid selection it has a substantial influence over the quality and type of skills new employees possess. Similarly, Gamage (2014) noted that the recruitment and selection practices will determine who is hired, shapes employee behaviour and attitude. If properly designed, it will identify competent candidates and accurately match them to the job. The use of the proper selection device will increase the probability that the right person is chosen to fill a slot. When the best people are selected for the job, productivity increases. According to Rauf (2007) Terpstra and Rozell (1993) there is a positive association between the extensiveness of recruiting, selection test validation and the use of formal selection procedures, organisations performance and firm profits. Rauf (2007) further concurred that sophisticated recruitment and selection procedures are positively related to performance in organizations. Accordingly,

Okoh (2005), not just that organizational selection practices determine who is hired, the use of the proper selection criteria will increase the probability that the right person will be chosen. When the best people are selected for the job, productivity increases (Osemeke, 2012).

Conclusion

Selection is the process of choosing an appropriate candidate to fill the vacancies existing in an organization. The need for an employee emanate from departmental manager would notify the personnel department in written. The personnel department will communicate back to the departmental manager requesting them to describe the job in details so as to place an advertisement for the post. Properly scheduled and conducted inter views is important to the fact that carefully selected employee tends to learn the job more easier, he/she may enhance the overall productivity of organization and reduces the cost of training and development. The appropriate tools or methods to be adopted by an organization while recruiting new employees include the following, employment application, interview, reference and medical and physical check list.

Recommendations

The study suggest these recommendations base on the findings of the study; That all organization should incorporate selection methods appropriately so as to avoid choosing in appropriate candidate for a job; Since the problem is common to all organizations, this research work will serves as a way forward for their problem; Organizations can take measures to improve the situation by giving proper training to the interviewers,

Impact of Poor Selection Interview On Future Performance of Potential Employee and Organizational Productivity in Tertiary Institutions in Yobe State, Nigeria

restructuring the interview accurately and critical investigation on the applicants through their referees and fast record that can spelt out the details of the applicant and the reasons why he is looking at the new job and furthermore Organizations should try as much as possible to avoid the effect of quota system by inviting as much as many applicant from available quotas within the environment.

References

- Adil, S. B. & Javed, U. (2021). The Impact of Recruitment and Selection Practices on Employee Performance; *Palarch's Journal of Archaeology of Egypt/Egyptology*, 18(14), 251-260. ISSN 1567-214x.
- Aphu, E. S. (2018). The Impact of Recruitment and Selection Criteria on Organizational Performance. GN Bank, Greater Accra Region of Ghana as the Mirror; *Journal of Public Administration and Governance*; ISSN 2161-7104 2018, Vol. 8, No. 3. <http://jpag.macrothink.org> 283.
- Aminu, A. A. (1996). "Personnel Management: Salone Psycho-Educational services Maiduguri.
- Ayodele I. O. & Sunday A. E. (2009). *Essential of Management*, Enykon consult, Yaba Lagos, Nigeria.
- Bacon, N., & Hoque, K. (2005). HRM in the SME sector: Valuable employees and coercive networks. *The International Journal of Human Resource Management*, 16 (11): 1976-1999.
- Barber, A., Wesson, M., Roberson, Q. & Taylor, S. (1999). A tale of two job markets: Organisational size and its effects on hiring practices and job search behaviour. *Personnel Psychology*, 52(4):841-867.
- Cumming, M. (1968). *Principle and Practice of Personnel Management*. McGraw Hill.
- Djabatey, E. N. (2012). Recruitment and selection practices of organizations: A case study of HFC Bank (GH) Ltd. Unpublished thesis submitted to the Institute of Distance Learning, Kwame Nkrumah University of Science and Technology, Ghana.
- Ekwoaba, J. O., Ikeije, U. U. & Ufoma, N. (2015). The Impact of Recruitment and Selection Criteria on Organizational Performance; *Global Journal of Human Resource Management*, Vol.3, No.2, pp.22-33, March 2015, European Centre for Research Training and Development UK (www.eajournals.org), ISSN 2053-5686(Print), ISSN 2053-5694(Online).
- Gamage, A. S. (2014). Recruitment and selection practices in manufacturing SMEs in Japan: An analysis of the link with business performance. *Ruhuna Journal of Management and Finance*, 1(1), 37-52.
- Lawal A. A. (1993). *Management in process*. Abdul Industrial enterprise, Lagos, Nigeria.
- Lewis, C. (1985). *Employee Selection*. London: Hutchinson.
- Morgan, S. (1990). *Personnel Management*. McGraw Hill, Kogakusha.
- Mullins, J. L. (1999). *Management and organizational behavior*. London: Prentice Hall.
- Ofori, D. & Aryeetey, M. (2011). Recruitment and selection practices in small and medium enterprises. *International Journal of Business Administration*, 2(3):45-60.

- Osemeke, M. (2012). The impact of human resource management practices on organizational performance: A study of Guinness Nigeria Plc. *International Journal of Arts and Humanities*, 1 (1), 79-94.
- Opatha, H.H.D.N.P. (2010). Human resource management. Colombo: Author published.
- Plumbley, R. (1985). *Recruitment and Selection*; 4th edition, Institute of Personnel Management, London, UK.
- Rauf, M. A. (2007). *HRM sophistication and SME performance: A case of readymade garment manufacturers and exporters in Lahore*. Pakistan Report, London: HMS
- Teixeira, A. (2002). On the link between human capital and firm performance; A theoretical and empirical survey.
- FEP Working Paper no. 121, November, p.1-38.
- Terpstra, E. D. & Rozell, J. E. (1993). The relationship of staffing practices to organizational level measures of performance. *Personnel Psychology*, 46(1). 27– 48.
- Torrington, D. & Hall, L. (1991). *Personnel Management. A New Approach*; 2nd edition, Prentice Hall International, (UK) Ltd.
- Walker, J. W. (1980). *Human resource planning*. McGraw Hill; New York, USA.
- Yolakwu, P. O. (2002). *Fundamentals of Management*. Peak Publishers; Lagos, Nigeria

Origin, Classification and Distribution of *Typha* Species a Paradigm for Understanding the Biology and Ecology of the Wetland Emergent Plant Species

Mohammed Inusa Nguru and Rabiou Sabo

School of Sciences, Department of Science Laboratory Technology,
Mai Idris Aloomaa Polytechnic P.M.B. 1020 Geidam, Yobe State, Nigeria.

Email: ngurumuhammad@yahoo.co.uk.

Abstract.

The paper highlighted the origin, distribution and classification of Typha. The plant is cosmopolitan found in almost all continents except Antarctica. It's a wetland species and is highly invasive spreading through wind dispersed seeds and vegetatively through their rhizome. They are erect tall wetland species that is emergent and form a thick and dense monoculture dominating other species. Three major species were identified Typha latifolia, Typha angustifolia and the hybrid form from the two species Typha glauca. Most parts of the plant are edible. Their invasive nature has implication for biodiversity. They form habitat for some wildlife species. Their thick dense vegetation block water ways and caused siltiton and blockage of waterways.

Introduction

From information available in the Flora of west tropical Africa (Hutchinson and Dalziel, 1952-1972). *Typha* is probably not an exotic species to Nigeria. It is found from the extreme south to the extreme northern end of Nigeria. The species have been found to be invasive in Hadejia Valley irrigation scheme threatening many economic activities in northern Nigeria (Olayinka et al., 2022). The plant which can grow up to two or more meters in height has a higher growth rate than any other aquatic plant in its family (Zungum, IU; Imam, 2019). One species of *Typha* is probably found in and all other tropical parts of the world. The *Typha* genus is found on every continent with the exception of Antarctica. It can be found throughout US and southern Canada, in Temperate North America, Europe and Asia (Aliero et al., 2022). According to (M. Larry, 2000) Common cattail can also be found in Russia, Morocco, India, Iran, Mexico, the Philippines Portugal and Greece where they act as weed of rice. The species was first discovered in the lake Chad Basin. *Typha* is a water-loving plant that can multiply and become difficult to control in favourable conditions making it invasive (Y. Birnin Yauri, Abdullahi, M.L. Balarabe, 2019).

Geographical range and distribution.

Typha is a cosmopolitan plant (El-amier, 2013; Shih & Finkelstein, 2008). This is attributed to its ability to tolerate a wide range of climatic conditions and can thrive in both humid coastal and dry continental climates. Cattails are essential components of wetland around the world. they can also be problematic invaders (Ciotir et al., 2017). *Typha* is an emergent monocotyledon which produces erect, approximately linear leaves from extensive anchoring systems of rhizomes and roots (Salako et al., 2016). Details of how *T. latifolia* spread beyond its native range are difficult to ascertain, partly because there are so few regions in the world where it is not native. *T. latifolia* is a perennial plant that belongs to the genus *Typha*. It is a native plant species of North America (ranging from Alaska to Guatemala (Xu et al.,

2013). Furthermore, similarities between *T. latifolia* and native *Typha* species may have helped obscure invasions of new areas. Even in North America, where *T. x glauca* (hybrid of *T. angustifolia* and *T. latifolia*) has recently been seen to occupy a much larger distribution, the history of the spread of *T. x glauca* and the mechanisms involved have yet to be worked out (Shih and Finkelstein, 2008; Zhang et al., 2008). It ranges from Arctic Circle to latitude 30° S and it prevails in water depths of 15 to 50cm. It can occupy a space of 58m² within 2 years after seed establishment (Mitich, 2000). Furthermore, In the US the native range of *Typha* includes the Alaska, continental US and Hawaii. In Africa It is common in (Algeria, Morocco, Ethiopia, Kenya, Tanzania, Uganda and Nigeria). In Asia – temperate it is found in Afghanistan, Iran, Israel, Jordan, Lebanon, Syria, Turkey, Armenia, Azerbaijan, Georgia, Russian federation-Ciscaucasia, Dagestan, Russian federation, Kazakhstan, Kyrgyzstan, Turkmenistan, Uzbekistan, Mongolia, China and Japan. In Asia-tropical it's found in Pakistan. In Europe it is found in Denmark, Finland, Ireland, Norway, Sweden, United kingdom, Austria, Belgium, Czechoslovakia, (the present Czech republic and Slovakia) Germany, Hungary, Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Moldova, Russian federation European part, Ukraine, Albania, Bulgaria Greece, Italy Romania, Ex-Yugoslavia, France, Portugal Spain. Northern America (Canada, USA) Southern America (Guatemala, Mexico, Brazil Argentina, Paraguay) (Bansal, Lishawa, Newman, Tange, et al., 2019). *Typha latifolia* is the only species of cattail usually found in relatively undisturbed habitats throughout North America.

2.2.4 Habitat Description.

Typha can be found in wetlands, sedge meadows, along slow-moving streams, river banks, and lake shores. The plant is found in areas of widely fluctuating water levels such as roadside ditches, reservoirs and other disturbed wet soil area (K. Motivans, 1987). *T. latifolia* and *C. rotundus* are the most common wetland species found in

tropical, subtropical and temperate regions of the world(Shingare et al., 2017).

In addition, *Typha* can be found growing in all our wetlands from open bogs to deep marshes, they can be found growing on any wet substrate and often in standing water that are not more than 1 to 2 feet deep. *Typha latifolia* is found in the most favorable sites where it competes against other species. *T. angustifolia* and *T. domingensis* are restricted to less favorable and more saline habitats when they occur with *T. latifolia*(K. Motivans, 1987). Cattails' tolerance to different climatic conditions and environmental changes helps them withstand a different climatic conditions under different habitats(Baldwin & Cannon, 2007). It grows where the soil is always wet and saturated with moisture. They also occur in shallow and brackish water they also occur in slightly brackish marshes. *Typha* prefers soil with high amounts of organic matter it can also grow on soil with fine texture minerals. In short, they are mostly found around coastland, estuaries, lakes, riparian zones, water courses and wetlands. Their high rapid growth makes them form a dense monoculture and eliminate other native plant species when hydrology, salinity, or fertility changes(Vetayasuporn, 2007).

Description of *Typha* grass

The name *Typhus* is from the Greek *Typha*, meaning a cat's tail, smoke or a cloud, referring to the plant's appearance when seeds are released. The species name *latifolia* refers to the leaf width of the plant: *lati* for broad or wide, and *folia* for leaf. The common name cattail is frequently used to refer to the entire genus *Typha* in the literature. Common cattail is recognised by its iris like leaves and its terminal, fat, cigar-shaped, brown surfaced spike of densely packed, wholly fibres (Mitich, 2000). *Typha* is an aquatic plant that is rooted in the soil(Elbersen, 2005).

Furthermore, *Typha* spp are tall and erect rhizomatous and perennial aquatic plants growing to 3 m tall with creeping rhizomes up to 70 cm long and from 0.5 to 3 cm in diameter(Mitich, 2000). The leaves are basal, erect, linear, flat and tall with 12-16 leaves arising from each vegetative shoot(Bansal, Lishawa,

Newman, & Wilcox, 2019). The leaves are borne on either side of a stout, cane-like stem. They are thick and pale greyish-green in colour and the plant produces flower in May and June. They are among the most common of all aquatic plants. They usually grow along the shore line but may grow in water 3 to 4 feet deep(Albert Banunle, Bernard Fei-Baffoe, 2021). *Typha* (derived from Greek word Typhos for marsh is a glabrous aquatic or semi aquatic, rhizomatous, herbaceous perennials rooted in mud. It has alternate leaves that are simple, linear, entire, sessile with sheathing base and exstipulate. cattail flowers very numerous in dense, cylindrical, complex spike unisexual. the seed is a small nut surrounded by hairs and may be best considered as a one-seeded -achene-like structure but dehiscent(El-amier, 2013).

Nevertheless, *Typha* is a highly flood tolerant species with capacity for internal pressurized gas flow to rhizomes through a well-developed aerenchyma system that provides oxygen for root growth in anaerobic substrates(Li et al., 2010). All of its morphological parts are edible, but the rhizome is the most valuable. Its starch content can be up to 70% of the dry mass(Agata Kurzawska, Danuta Gorecka, 2014). Shoots arise from a stout rhizome. The stem terminates in a spike with unisexual flowers, the males being more terminal. The male flowers fall off after maturity and the fruits develop from the bottom of the spike upwards. Several flat cauline leaves up to 22mm wide, can reach four meters in length (Mohlenbrock 1970). The rhizome at the base of a plant tends to be somewhat enlarged(Grahame, 1970).The plants can be densely packed with stems that can be more than one foot. It has tiny flowers with male cluster at the top and the female flowers cluster at the bottom. Leaves are strap like and stiff, rounded on back flat and D shaped. Leaves are straight in the bottom half but twisted and spiral in the top(Bansal, Lishawa, Newman, & Wilcox, 2019). The fruit is tiny and tufted nut let, they are ribbon like, flat, and about one inch wide. The seeds are minute and numerous(Baldwin & Cannon, 2007). Boreal Forest (2005) states that the distinguishing characteristics of cattail are the possession of brown male flower, minute, less than 1.3cm long,

Origin, Classification and Distribution of Typha Species a Paradigm for Understanding the Biology and Ecology of the Wetland Emergent Plant Species

thickly clustered, anthers 1-3 mm long. Female flowers are tiny 2-3 mm long when in flower, 10-15 mm long when in fruit. Female fruiting spike are pale green when in flower, drying to brownish, later brackish brown or reddish brown in fruit. Seeds are minute and numerous". Flowers are in a dense, cylinder- shaped spike that often resembles a cigar. Flowers are on stalks that are usually taller than the leaves.

Furthermore, they are spread by creeping root stalks and seeds. After germination, common cattail develops two to four small leaves followed by two to six floating leaves before the erect leave emerge(Mitich, 2000). When shoot reaches 35 to 45 cm in length, rhizome formation begins this coincides with a deceasing growth rate of the emergent tissue. Once the rhizomes are 35 to 60 cm long, they form shoots. In a single season, approximately 100 shoots and lateral buds are produced. Plants originating from seeds do not flower during the first season (Mitich, 2000). *Typha spp.* can spread quickly and widely through aggressive rhizomatous growth and through sexual reproduction(Shih & Finkelstein, 2008).

Biological classification.

The genus *Typha* was erected in 1753 by Carolous Linnaeus in his genera plantarum. The genus *Typha* belongs to the family *Typhaceae* comprising about 30 species.These plants are known as reedmace or bulrush in British English and cattail in American English(Pandey & Verma, 2018).

The common name of *Typha* is Cattail grass(Mitich, 2000). It is known as Cooper's reed cumbungi (Australia), espadana comun (Spanish), giant reed- mace, great cattail, piriopie (Spanish) Roseau a des etangs (French), soft flag, tabua-larga (Portuguese) totora (Spanish), tule espidilla (Spanish). (DPIWE, 2006), It belongs to the class of Monocotyledons known as the Liliopsida and subclass commelinidae; order *Typhales*, Family *Typhaceae* and the genus *Typha*.(Vetayasuporn, 2007). In many parts of North America, cattails (*T. latifolia*, *T. angustifolia* and their hybrid, *T.X glauca*) have been identified as increasingly aggressive invaders of wetlands(Ciotir et al., 2013). Cattails are highly productive emergent plants that grow in a variety of wetland habitats throughout the World(Huisman et al., 2012). *Typha latifolia* and *T. angustifolia* largely share the same morphology. Both are erect, rhizomatous perennials(Y. Birnin Yauri, Abdullahi, M.L. Balarabe, 2019). Shoots are formed by long linear leaves sheathing at the base(Heinz, 2012).

Table 2.1 Taxonomic classification of *Typha* grass

Category	Taxa
kingdom	Plantae
Division	<i>Magnoliophyta</i> (Angiosperms)
Class	<i>Liliopsida</i> (the monocotyledons)
subclass	<i>commelinidae</i>
order	<i>Typhales</i>
Family	<i>Typhaceae</i>
Genus	<i>Typha</i>
species	<i>Angustifolia, latifolia and domingensis</i>

Origin, Classification and Distribution of Typha Species a Paradigm for Understanding the Biology and Ecology of the Wetland Emergent Plant Species

--	--

Source: M. Larry, 2000.

Many different species of *Typha* occur commonly in wet soil, marshes, swamps, and shallow waters throughout the world. They include: -

- *Typha angustifolia*- Narrow- leaved cattail
- *Typha latifolia*- Broad- leaved cattail
- *Typha glauca*- hybrid between the two species above and
- *Typha australis*. *Typha australis* is the specie found in Hadejia –Nguru wetland conservation area.

Apfelbaum, (1985) noted that there are three species of cattail that are common to North America. They include the broad –leaved (*T. latifolia*) , narrow –leaved (*T. angustifolia*) and tall cattails (*T. domingensis*). Broad –leaved cattail are found throughout North America except for the far North from sea level to 2134 (7000ft (Pérez, 2003).

Productivity in *Typha* Grasses (Yield).

Typha plants are among the most productive plant species; however, their performance is strongly influenced by the environment. The seed can germinate without oxygen (Vaccaro, 2005) (Henderson et al., 2000). According to Apfelbaum, (1985) productivity and growth rate in cattail can be measured and quantified. In Indiana this has been tried based on dry weight. *Typha* is the primary producer of estuarine ecosystems, which has the ability to concentrate elements and compounds from the polluted soils and water bodies and to metabolize molecules in its tissues. Consequently, it can incorporate large amounts of elements from the environment (Minkina et al., 2021). It was also found that Cattails contributed 700 kilograms (1543 pounds) of biomass per hectare (approximately 600lbs/acre) where it grew in monocultures. Aerial photographs showed cattail growth increase from 2 to 37.5 hectares (5-93 acres) from 1938 to 1982. in sedge- grass and prairie meadow vegetation as Cattail increased. At Horicon Marsh monotypic growths of cattail l increased from 30 to 80 percent cover from 1947 to 1971 (Apfelbaum, 1985).

2.2.11 Local Dispersal Methods.

Regeneration and spread takes place primarily through rhizome growth, but establishment with seed at shore line is also possible, especially when water level drops (M. Larry, 2000) *T. latifolia* seed may be transported by wind, in water, in mud on the feet of birds and livestock, or by humans and machinery. Up to 95% of all seed produced is viable (Miklovic, 2000). A single *Typha* inflorescence will produce 20,000 to 700,000 seeds, each with numerous gynophore hairs that facilitate wind dispersal when dry. (Vaccaro, 2005). *Typha* has parachute seeds that can be dispersed by wind (Baldwin & Cannon, 2007). *Typha* are monoecious, perennial, rhizomatous herbs that reproduce both clonally and through propagule dispersal. They are all obligate wetland indicator species (Bevington, 2007). Cattail plants produce a dense rhizome mat and the clustered leaves produce a thick litter layer (K. Motivans, 1987). *Typha* spreads rapidly via underground rhizomes and can heavily dominate sites with up to 90% cover (Elgersma et al., 2017).

In conclusion, *Typha* is a specie of aquatic plant that is cosmopolitan (found in every continent) except Antarctica. They are highly invasive because of their high rate of growth and spreading mechanism. They have wind dispersal mechanism by producing a large number of seeds and can spread vegetatively through their active rhizome mechanism. Their high rate of invasion and spread make them form a dense monoculture which have implication for biodiversity. In addition, they block waterways and caused siltation. They also provide habitat for some wildlife species. Most parts of the plant are edible and form a large amount of biomass per hectare where it grows in monoculture.

References

Agata Kurzawska, Danuta Gorecka, A. S. et al. (2014). The molecular and supermolecular structure of common cattail (*Typha*

- latifolia) starch. *Starch /Starke*, 66(September), 1–8.
<https://doi.org/10.1002/star.201300283>
- Albert Banunle, Bernard Fei-Baffoe, K. M. et al. (2021). Utilization potentials of invasive plants in Owabi Dam in the Ashanti Region of Ghana. *Bio Resources*, 16(2), 3075–3095.
- Aliero, Z. S., Singh, D., & Keta, J. N. (2022). *Typha angustifolia* L. Grass Hindering against Agricultural Productivity in Aliero River, Kebbi State, Nigeria. *Journal of Sustainability and Environmental Management*, 1(3), 339–343.
- Apfelbaum, S. I. (1985). Cattail (*Typha* spp.) Management. *Natural Areas Journal*, 5(3), 1–9.
- Baldwin, B., & Cannon, A. (2007). *Typha* review (Issue November).
- Bansal, S., Lishawa, S. C., Newman, S., Tangen, B. A., Wilcox, D., Albert, D., Anteau, M. J., Chimney, M. J., Cressey, R. L., Dekeyser, E., & Elgersma, K. J. (2019). *Typha* (Cattail) Invasion in North American Wetlands : Biology , Regional Problems , Impacts , Ecosystem Services , and Management. *Wetlands*, 39, 645–684.
- Bansal, S., Lishawa, S. C., Newman, S., & Wilcox, D. (2019). *Typha* (Cattail) Invasion in North American Wetlands : Biology , Regional Problems , Impacts , Ecosystem Services , and Management. *Wetlands*, 39, 645–684.
- Bevington, A. E. (2007). *ENVIRONMENTAL FACTORS AND TYPHA SPP. DOMINANCE IN CREATED WETLANDS*. College of William and Mary.
- Ciotir, C., Kirk, H., Row, J. R., & Freeland, J. R. (2013). Intercontinental dispersal of *Typha angustifolia* and *T. latifolia* between Europe and North America has implications for *Typha* invasions. *Biological Invasions*, 15(6), 1377–1390.
<https://doi.org/10.1007/s10530-012-0377-8>
- Ciotir, C., Szabo, J., & Freeland, J. (2017). Genetic characterization of cattail species and hybrids (*Typha* spp.) in Europe. *Aquatic Botany*, 3(March), 1–9.
<https://doi.org/10.1016/j.aquabot.2017.03.005>
- El-amier, Y. A. (2013). Spatial distribution and nutritive value of two *Typha* species in Egypt *Typha* (derived from the Greek word Typhos for marsh) is the only genus in the family. *Egypt Journal of Botany*, 53(1), 91–113.
- Elbersen, W. (2005). *Typha* for Bioenergy.
- Elgersma, K. J., Martina, J. P., Goldberg, D. E., & Currie, W. S. (2017). Effectiveness of cattail (*Typha* spp.) management techniques depends on exogenous nitrogen inputs. *Elementa Science of the Anthropocene*, 5(19), 1–13.
- Grahame, A. (1970). *The Incredibly Usable Cattail*.
- Heinz, S. I. (2012). *Population biology of Typha latifolia L. and Typha angustifolia L.: establishment, growth and reproduction in a constructed wetland*. TECHNISCHE UNIVERSITÄT MÜNCHEN.
- Henderson, I., Wilson, A., & Steele, D. (2000). Population Estimates & Habitat Associations of Breeding Waders in Northern Ireland, 1999 : The Results of an Extensive Survey. In *BTO Research Report* (Issue 234).
https://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKewj_wNXIktTMAhVeFMAKHQx2DV4QFggdMAA&url=http://www.bto.org/file/335755/download?token=NWUpcF_I&sg=AFQjCNEkt2MRFIGuBS22cnVyXvoNAeKLjA&cad=rja
- Huisman, K., Graeff, A., & Laureto, P. J. (2012). HYBRIDIZATION DYNAMICS OF INVASIVE CATTAIL (TYPHACEAE) STANDS AT PIERCE CEDAR CREEK INSTITUTE : A MOLECULAR ANALYSIS. *The*

- Michigan Botanist*, 51(2008), 89–99.
- K. Motivans, S. A. A. (1987). *North American Cattails* (Vol. 22209, Issue 703).
- Li, S., Lissner, J., Mendelssohn, I. A., Brix, H., Lorenzen, B., & Mckee, K. L. (2010). Nutrient and growth responses of cattail (*Typha domingensis*) to redox intensity and phosphate availability. *Annals of Botany*, 105, 175–184.
<https://doi.org/10.1093/aob/mcp213>
- Miklovic, S. (2000). *Typha angustifolia* Management : Implications for Glacial Marsh Restoration. *Restoration and Reclamation Review*, 6(2), 1–11.
- Minkina, T., Fedorenko, G., Nevidomskaya, D., Konstantinova, E., Pol, T., Fedorenko, A., Chaplygin, V., Mandzhieva, S., Dudnikova, T., & Hassan, T. (2021). The Morphological and Functional Organization of Cattails *Typha laxmannii* Lepech. and *Typha australis* Schum. and Thonn. under Soil Pollution by Potentially Toxic Elements. *Water*, 13, 227–247.
- Mitich, L. M. (2000). Common Cattail , *Typha latifolia* L . Intriguing World of Weeds. *Weed Technology*, 14(2), 446–450.
[https://doi.org/10.1614/0890-037X\(2000\)014](https://doi.org/10.1614/0890-037X(2000)014)
- Olayinka, M., Musa, J., Rufai, A., Johnson, A., Escribano, S., Richard, K., Eva, I., Maidala, A., Amos, M., Chana, M., Hannatu, C., & Sunday, O. (2022). Cattail (*Typha domingensis*) silage improves feed intake , blood profile , economics of production , and growth performance of beef cattle. *Tropical Animal Health Science and Production*, 54(48).
<https://doi.org/10.1007/s11250-022-03066-1>
- Pandey, A., & Verma, R. K. (2018). Taxonomical and pharmacological status of *Typha* : A Review. *Annals of Plant Sciences*, 7(3), 2101–2106.
- Pérez, M. (2003). Table of contents. *WD Info*, 2004.
- Origin, Classification and Distribution of Typha Species a Paradigm for Understanding the Biology and Ecology of the Wetland Emergent Plant Species*
<https://doi.org/10.1002/ejoc.201200111>
- Salako, G., Sawyerr, H., Olalubi, O., & Salako, G. (2016). Does *Typha* spp. Contribute to Wetland Waterloss and Health Risk: A Case Study of Hadejia Nguru Wetlands (HNW) System NE Nigeria. *Open Journal of Ecology*, 6(6), 151–158.
<https://doi.org/10.4236/oje.2016.64015>
- Shih, J. G., & Finkelstein, S. A. (2008). RANGE DYNAMICS AND INVASIVE TENDENCIES IN *TYPHA LATIFOLIA* AND *TYPHA ANGUSTIFOLIA* IN EASTERN NORTH AMERICA DERIVED FROM HERBARIUM AND POLLEN RECORDS. *Wetlands*, 28(1), 1–16.
- Shingare, R. P., Nanekar, S. V, Thawale, P. R., & Karthik, R. (2017). Comparative Study on Removal of Enteric Pathogens from Domestic Wastewater using *Typha latifolia* and *Cyperus rotundus* along with Different Substrate. *International Journal of Phytoremediation*, March, 1–35.
<https://doi.org/10.1080/15226514.2017.1303809>
- Vaccaro, L. E. (2005). *PATTERNS, MECHANISMS, AND ECOLOGICAL IMPLICATIONS OF CATTAIL (TYPHA SPP.) DOMINANCE IN GREAT LAKES WETLANDS*. Cornell University.
- Vetayasuporn, S. (2007). Using cattail (*Typha latifolia*) as a substrate for *pleurotus ostreatus* (FR) Kummer cultivation.pdf. *Journal of Biological Sciences*, 7(1), 218–221.
- Xu, Z., Feng, Z., Yang, J., Zheng, J., & Zhang, F. (2013). Nowhere to Invade : *Rumex crispus* and *Typha latifolia* Projected to Disappear under Future Climate Scenarios. *PLoS ONE*, 8(7), 1–10.
<https://doi.org/10.1371/journal.pone.0070728>
- Y. Birnin Yauri, Abdullahi, M.L. Balarabe, A. K. A. (2019). Ecology and control of *Typha* species in Hadejia-Nguru Wetlands

, Nigeria. *Bonorowo Wetlands*, 9(2), 71–91.
<https://doi.org/10.13057/bonorowo/w090203>

Zungum, IU; Imam, T. et. a. (2019). Impact of

Typha Grass on Biodiversity Loss of Hadejia-Nguru Wetland Located between Jigawa and Yobe States of Nigeria : A Review. *Journal of Applied Science and Environmental Management*, 23(10), 1847–1853.

Clients' Needs and Satisfaction in Construction Industries

Alhaji Attahir Hussaini¹ and Babagana Kachalla²

Department of Civil Engineering Technology
Mai Idriss Aloomaa Polytechnic Geidam, Yobe state Nigeria
¹Email: husseni2010@gmail.com, Phone number: 08038134351

Abstract

Management of clients and stakeholders has become a potential changes that affecting construction industries and the professional ethics at large. Clients' needs and satisfaction has been a problematic issue in many countries in the world. This is because many construction industries projects failing to fulfill the client need and satisfaction result expectation. Client need and satisfaction in the field of construction play an essential role in suggestion whether the project will be successful in the implementation or phases. Customer satisfaction in the construction aspect has been considered as a dimension of quality. This paper has consulted many literatures' regarding Client need and satisfaction, majority of the responds was not satisfactory at the end of project completion. If the client needs can be properly identified and address, then their needs and satisfaction can be sought with more optimism or else client needs and satisfaction will remain at random practice.

Key words: Client's needs, satisfaction, construction industries.

Introduction

Construction client satisfaction concept developed based on the concept of customer satisfaction in the perspective of business. Client is the sponsor of services and the prime business decision maker in the project team. In contrast perspective client is often regarded as employer as well as responsible for paying bill (Fewing, 2013). Client need and satisfaction in the field of construction play an essential role in suggestion whether the project will be successful in the line of implementation or phases. Identifying and satisfying the needs of client for the present and global aggressive of the construction industries has become critical. Client need and satisfaction is essential and is becoming necessary for the construction participant to improve their performance for their sustainability in the global market. The need and satisfaction has been motivated as a result of the globalization that has become now essential for persistence of service Providers such as consultants and contractors. Satisfaction is a complex phenomenon that has to do with psychological concept and is difficult to measures. Dissatisfaction that experienced by the client in the construction sector and other blames are mostly related to the attribute of over running project costs, delayed completion, sub-standard performance of service providers including contractors and consultants (NAO, 2001). Therefore client need and satisfaction can be considered as “comparison between the product, service and a certain standard” (Churchill and Serprenant, 1982; Churchill, 2001).

Construction industry has been ranked among the top four out of about twenty economic sectors in terms of inter-sector linkages. The importance of this sector as an agent of development is enhanced by its ability to provide gainful employment for the teeming population of the nation. According to Roy (2005) “it is evidenced that noticeable development and the aesthetic transformation of the environment is bound up with and predicated on the construction industry”. Construction industry is a major index as a factor in the social and political integration of the society and ranks as one of the major budgetary areas of developing economies (Nwachukwu, 2008).

The Objectives of the Study

The study is aimed at identifying and analysing client's needs and satisfaction in construction industries. What the clients determined as their need and satisfactions that has related to quality, cost and time in construction industries regardless the client is private, commercial, quasi-government and government client. The analysis will reflect the strength of each category of client's needs and satisfactions and what the majority of the clients get satisfy and what are the success of both the clients and industries during the project work in order to reduce disputes and conflicts between two parties that in most cases ended to the court decision.

Methodology

The researcher has used secondary data and qualitative analysis method in providing information that has to do with clients' need and satisfactions in construction industries. The literature review of this present research also focused on clients' need and satisfactions that has to do with the clients' satisfaction in relation to quality, cost and time in construction industries regardless the client is private, commercial, quasi-government and government client. The analysis of the results finding obtained from journals, articles, online papers, hard and soft copies books that reflect the strength of each category of client's needs and satisfactions and what the majority of the clients get satisfy and what are the success of both the clients and industries of both the clients and industries during the project work in order to reduce disputes and conflicts between two parties that in most cases ended in court decision.

Concept of Need and Satisfactions

Right from the time when human was created, satisfaction has been a main concern. Satisfaction is a complex phenomenon, because it is something that has to do with psychological concept that is very difficult to measure advocated that “satisfaction was an act of comparison between an individual's insight of an outcome and its expectation for that outcome. The levels of satisfaction achieved hence are

dependent on an individual's perception thinking" (Oliver, 1999; Oliver, 1989).

Customer Satisfaction

Customer satisfaction and customer emphasis have become indispensable in aggressive step up in all area of production (Kotler, 2000). The important of customer satisfaction in the market place of competition is becoming intense (Jones and sasser, 1995). Companies use customer need and satisfaction strategy or measures in improving, monitoring, assessing products and service approach as well as encouraging and compensating workers. Similarly, satisfaction measurement improves community among the parties that permit mutual understanding and consensus as well as progress in the point targets and change. Customer satisfaction in the construction aspect has been considered as a dimension of quality as an important factor that indicating a project success (Palaneeswan et al., 2006). There is an argument with respect to adaptation of Total Quality Management (TQM) and progress toward the construction process, service quality and progress when determining feature of customer. Need and satisfaction has also gained attention in construction scheme (Koltler, 2006).

Construction Client Needs and Satisfactions

Construction client's need could be described as desire for modern facilities, refurbishment activities to improve the current facilities from sub-standard to desirable standard. In construction practice, there is no indication on whether there is a single approach to the need and satisfaction assessment (Koltler, 2006). Clients' needs-assessment in construction is described as:

- Client priorities appraisal mostly been ignored (Hughes, 2006).
- Client needs and satisfaction are often not seriously taking by the professional in the construction (Green, 1994).
- Client briefs are given insufficient time to develop (Green, 1994) etc.

Client need and satisfaction has a number of most commonly referred model that used in measurement and development in construction

industries which are employed in determining quality of services, excellence and performance (Cheng, 2008). Expectations that determine customer satisfaction is based on the assumption of the anticipation made on the basis of past experience. In a situation whereby clients have no experience, the client anticipation is hoped to be stronger of the production service process and have no effect on satisfaction. Basically, two general conceptualizations of customer satisfaction have been realized. Firstly, "transaction-specific that is specific and individual experience satisfaction. The second one is the cumulative satisfaction that is built on current experience, past experience and all anticipated future experience" (Koltler, 2006). Moreover, the background of the client experience takes essential roles in providing relevant standard of the contract and therefore affects the outcome of satisfaction assessment (Smith et al., 1967). Client satisfaction measurement is usually related with performance and quality assessment in the setting of product and service received by the client. Measurement of client need and satisfaction may ease finding innovative solution with respect to the project delivery, improvement for service providers such as consultants and contractors in the construction industries (Soetanto and Proverbs, 2004).

Parasuraram et al., (1988) argued that despite that any service industry is unique in some of their aspect or position. There are five broad universally dimensions of service quality that are applicable. These are: Tangibles, Reliability, Responsiveness, Assurance and Empathy. These are the basic on which ServQual model dimension was developed. Moreover, Zeithaml et al., (1981) defined the most common ten dimensions cited by clients in judging quality. These are:

- Tangible.
- Reliability.
- Responsiveness.
- Competence.
- Courtesy.
- Credibility.
- Security.
- Access.
- Communication and
- Understanding the client.

Clients' Needs and Satisfaction in Construction Industries

If the client needs can be properly identified and address, then their needs and satisfaction can be sought with more optimism or else client needs

and satisfaction will remain at random practice (Koltler, 2006).

Table 3.1 (Chinyio, 1999)

Key Categories	Satisfaction Attributes
COST	Project is carried out within contractually agreed budget
	Cost of changes are fairly priced
	Ability of client to make payments
	Payment for project is made as contractually agreed
	Ensures that cost estimates are in accordance with my requirements
	Allows flexibility for changes or modifications
QUALITY	Project quantity estimates are accurately billed
	Quality of project is of the desired standard
	Project design contains sufficient and accurate details
	Good client service
	Effective communication
	Contracting body has a record of recognised kite awards (credibility & reliability)
	Client actions and interactions
	Tender assessment of quality, not just price
	Project consultants are responsive to questions & clarifications
	Minimal reworks & defects
Project supply specifications contains sufficient details	
SAFETY and environment	Health & safety procedures are with no incidents
	Strategies for managing and assessing any project risks are in place
	Trusts my capability to deliver
TIME	Ensures that there is minimal defects in supply
	Project schedules are detailed & easy to understand
	Each phase of the project process is completed on time
	Ability to meet deadlines/ on-time delivery
	Communication flow is consistent
	Response to complaints is quick & productive

Chinyio Nzekwe-Excel

50

Chapter 3: Development of Satisfaction Attributes

	Changes and cost of changes are introduced as early as possible
	Early involvement of contractor
	Sufficient time is allowed for tender

Strategic Decision Made by Construction Client

Decision making by the client in the construction scheme have to be plan. Initially client must make a decision whether first hand building service should be involved or not. It is from there that the underlined priorities will be attached to the project. The client main objective is then translated into goals. Identifying the client in the decision criteria accurately, evaluate as well as the client usage would definitely progress the Chances of delivering the project successfully. Strategic is used to point out decision concerning activities and resources that are critical which usually affect the project performance in the construction or organization. The choice made by the client or firm in construction scheme are

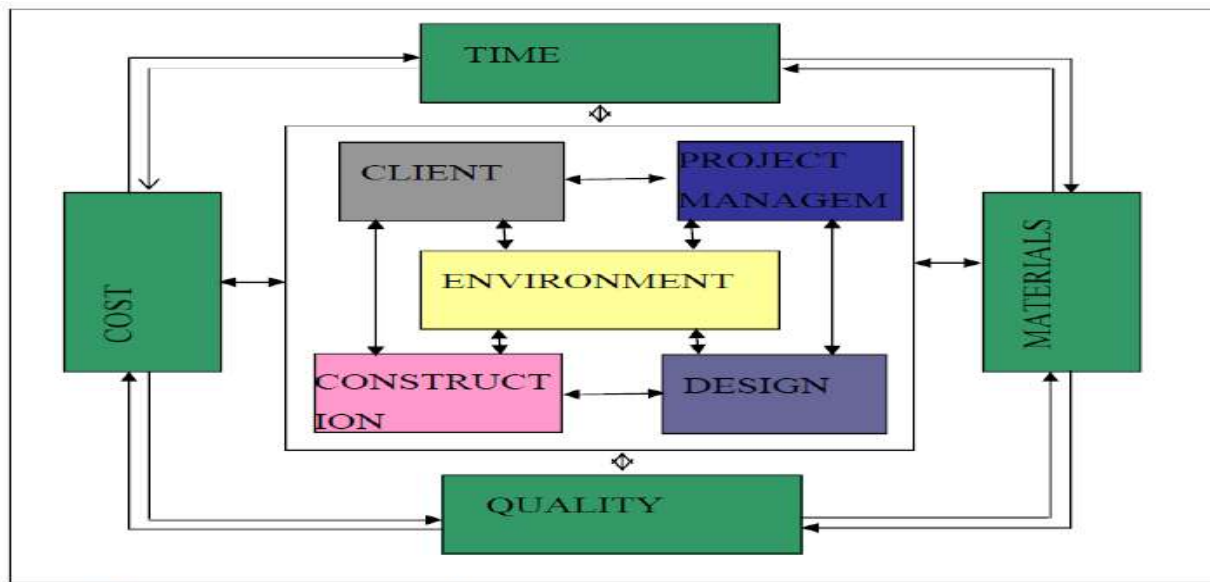
usually complicated and uncertain in form, the decision made by the client should also involve the goal of the activities formulation, identifying problems and evaluation(Koltler, 2006). The improper information from the client with respect to time for the purpose of satisfying sponsor of the project leads to decision predicament. Executive and decision makers of the industries help the client in coming out with positive conclusion (Schwenk, 1984). Lim and Ling (2002) understood that assigning of appropriate project team in delivering the project on time and budget, management competency, construction experience may all have essential effect on achieving a successful project. The business cases of the client also determine the client priority such as time certainty, price or function.

Relationship Between Client and Project Manager/Team

There is gross understanding of the effect on the project outcome with respect to good inter-relationship between the client and project team. "Project successes that link to harmonizing team aiming at the best result for the Client Companies' or individuals reports are many". Similarly, good number of events has happened where the role of the parties or project team were not defined or understood different from what others in the team judge and lastly the outcome were less than expected. Therefore establishing good relationship between the client and the project team right from the beginning of the project will largely determine how successful your project will be. Therefore spiritual co-operation, support and respect should look after right from the beginning because of essentiality. When project operate in argument, opposition,

certainly the objective will not be achieved. Therefore significant attention and detail should be taking care of, in relationship of project among the relevant parties. It will be also very good for the construction team to understand the role and responsibilities of each team as well as individuals that make up the overall team. The client is the one who determine the outcome require which then submitted to the project manager before any work commence. Clear inspiration of document written in detail with time baseline, grip point, precise detail is necessary because it facilitate understanding of the both parties sides. Project manager will be answerable for the outcome of project with respect to all deliverable such as performance, cost, time and scope. It is the responsibilities of project manager to determine the procedure of the project and not one of the team members. Project manager will equally ensure that project operated with proper care and attentiveness within the contractual stipulated time (Sweet, 2003).

The Construction Project Management Success Interactive Model



Clients Need and Satisfaction Grouping (Chinyio, 1999):

- ✓ **Aesthetics:**
 - Beautiful working artifact.
 - Reputation building.

Clients' Needs and Satisfaction in Construction Industries

- ✓ **Economic:**
 - Less price
 - Price of the product run into the budget.
 - Reducing tendering costs by inviting few buyers.
 - Harmonizing between capital and lifespan costs.
 - Take full advantage of taxation benefits.
 - Indication of steady price with minimal disparity.
- ✓ **Functionality:**
 - Structure to be competent with intended purpose.
 - Long lasting building.
 - Keep existing buildings active in the course of construction.
- ✓ **Quality:**
 - Quality of the product to match up with current standards.
 - Innovative design involving modern technology.
 - The building should reveal the client undertaking and appearance.
 - Ready for money value.
- ✓ **Relation:**
 - Quarrel avoidance.
 - Familiar with the contractor.
 - Wishes to be actively participate and kept informed throughout the project cycle.
 - Non-argumentative with the contractor.
 - Full of accountability throughout the project life cycle.
- ✓ **Safety:**
 - Less risk for the client exposure.
 - Foreseen of risk and doubtful related with the project.
- ✓ **Commitment:**
 - Clear distribution of obligation.
 - Flexibility to change the design in the course of construction
- Stay away from claims.
- Certainty on construction or product.
- ✓ **Time:**
 - Shortage construction period.
 - Safe time of approval.
 - Past speed of design along the construction.
 - Immediate to start.
 - minimum delay with the activities

Key Ways to Be a Successful CLIENT (A guide for clients, first edition 2003):

- ✓ Offer strong leadership of client.
- ✓ Provide sufficient time at the right time.
- ✓ Gain knowledge from your own and other successful project.
- ✓ Build up and communicate a well-defined brief.
- ✓ Make a realistic financial obligation from the beginning.
- ✓ Agree to participate the course of action.
- ✓ Find the right people for the contract.
- ✓ Response and participate to the framework.
- ✓ Dedicate to sustainability.
- ✓ Endorse all key stage.

Successful Project/ Construction Industries

According to Cleland et al., (1986) a construction project termed as successful “if it pass four test criteria; completed on time, completed within the stipulated budget, completed in accordance with the primary agreed performance and quality standard and client’s satisfaction”. That is accepted by the intended clients or users regardless of the client is internal or from outside the organization. The above mention criteria demand for successful project implementation by the use of recognized management practices or skills of planning, organizing, directing and controlling. The concept of project lifecycle management, time management, conflict and management, networking, contract management, project choice and quality are also key factors that lead to a successful project. Critical Path Method (CPM) and Programme Evaluation and Review Techniques (PERT) equally assist to project success because it encourage to the profession

discipline through the definition of project scope, time scale or schedule and cost.

Changing of The Construction Industries

According to the lecture of Angela Nash (2013) on strategy construction project and programme management, the most efficient way of introducing change to sustained client as well as the construction industries, professional body from the blame, should undertake the following measures:

- Define the business terms or case.
- Describe what has to be achieved.
- Develop a plan and operate to the plan.
- Make use of resources in the working team environment.
- Successful delivery of the project should be accountable by the sponsor.
- Proper use of project manager skills to plan, monitor and sustaining process.
- Project manager skill should employ on the workers.
- Cordial relationship should be involve among the working team in the project.

Conclusion

The service providers in the construction industries including contractors and consultants should try to advance the understanding phenomenon of client need and satisfaction and develop associate measure criteria that would help to improve service quality and overall performance for better client needs and satisfaction as well as the profession at large.

Recommendations

This study strongly recommends that competent professionals in construction industries should insist in modern project management planning and control techniques used as a method of achieving the required targeted quality, cost and time frame in project implementation and execution process. Moreover, there is need for further research in how leadership affect the clients' and satisfaction in construction industries as well.

Reference

- Cheng, J. (2008) the impact of strategic Decision on Construction Client Satisfaction [online]. Ph.D. Thesis, University of Wolverhampton. [Accessed 20 February 2022]. Available at: <<http://www.Wlv.openrepository.com/wlv/bitstream/2436/47313/cheng-phD%20thesis>.
- Chinyio, E.A. (1999) An Evaluation of Construction Clients' needs and Preferences [online]. Ph.D Thesis, University of Wolverhampton. [Accessed 21 February 2022]. Available at: <<http://www.Wlv.openrepository.com/wlv/bitstream>.
- Churchill, G. A., Jr. (2001). Basic marketing research (4th Ed.). Fort Worth, TX: Dryden Press, pp. 144–145.
- Churchill, Gilbert A. Jr. and Carol suprenant (1982) “An investigation into the Determinant of customer satisfaction”. *Journal of marketing research*, 19 (November) 491-504
- Cleland, D.I (1986) *Project management Handbook*, Second Edition, New York, U.S.A Van Nostrand Reinhold, pp 964
- Fewing, P. (2013) *Construction Project Management. An Integrated Approach*. 2nd ed. Abington: Rout ledge.
- First Ed. (2003) *Creating Excellent Building: A guide for Clients* [online]. London: CABE [Accessed 18 February 2013]. Available at: <<http://www.webarchive.nationalarchives.gov.uk/20110118095356/www.cabe.org.uk/files/creating-excellent-building>.
- GreenBook. (2015). *GreenBook Industry Trends Report*, 17th ed., New York, p. 40.
- Hughes, W.P., Hillebrandt, P., Greenwood, D.G. and Kwawu, W.E.K. (2006) *Procurement in the construction industry: the impact and cost of alternative market and supply processes*. London: Taylor & Francis.
- Jones, T.O. and Sasser Jr, W.E. Jr. (1995). Why Satisfied Customers Defect: A version of article appeared in the November–December 1995 issue of *Harvard Business Review*.

- Kotler, P. & Keller, K.L. 2006. Marketing management 12e. Upper Saddle River: Pearson Education Inc.
- Ling, L. (2002) Model for predicting clients' contribution to project success. *Journal of engineering construction and Architecture management*, 9(5/6): 388-395.
https://www.researchgate.net/publication/280209425_Model_for_predicting_clients%27_contribution_to_project_success
- Nash, A. (2013) Fundamental of Project Management. Lecture 1: Strategic construction project and programme and management [online]. [Accessed 28 January 2013]. Available at: <<http://wolf.wlv.ac.uk/>>.
- National Audit Office (2001). Modernising Construction: scrutinises public spending on behalf of Parliament, London. <https://www.nao.org.uk/wp-content/uploads/2001/01/000187.pdf>
- Nwachukwu, C.C., and Emoh, F.I. (2011) American Journal of Social and Management Success as a Critical issue in Real Estate development and Investment [online]. 2 (1) pp. 56-75 [Accessed 23 February 2013]. Available at: <<http://www.scihub.org/AJSMS/PDF/2011/1/AJSM-2-1-56-75>>
- Oliver, R.L. (1999). Whence consumer loyalty. *Journal of Marketing*. Volume 63, pp 33-44.
- Oliver, Richard L. (1989), "Processing of the satisfaction response in consumption: A suggested framework and research propositions," *Journal of satisfaction, dissatisfaction and complaining behavior*, 2, 1-16.
- Parasuraman, A.Q., Berry, L.L. (1991). *Marketing Services*, New York, the Free Press
- Roy, P.D. (2005) The Construction Project Manager and Human Group Theories Cost Engineering, vol. 31 No. 7 p10
- Schwenk, CR (1997) Diversity eccentricity and devil's advocacy. In V Papadakis and P Barwise (eds), *Strategic decisions* 83-94. Boston, MA: Kluwer Academic Publishers.
- Smith, S. M., & Albaum, G. S. (2005). *Fundamentals of marketing research*. Thousand Oaks, CA: Sage, p. 349.
- Soetanto, R. and Proverbs, D.G. (2002). Modelling the satisfaction of contractors: the impact of client performance. *Engineering, Construction and Architectural Management*, 9(5/6), pp. 453-465.
- Sweet, C., A., F., and Stillwel, L. (2005) The Third South African Conference on Base Metals: The Relationship between the Client, Client team and the EPCM Project Team [online]. South Africa. Institute of Mining and Metallurgy. [Accessed 25 February 2013]. Available at: <<http://www.saimm.co.za/conferences/Bm2005/127-134-sweet>>
- Zeithaml, V. A., Bitner, M. J. & Gremler, D. (2009) *Services Marketing - Integrating Customers Focus across the Firm*, Fifth Edition, Boston: McGraw-Hill.

Evaluation of efficiency of neem seed oil against *Dermestes maculatus* and *Necrobia Rufipes* in stored smoked fish; *Clarias gariepinus*

Bukar A^{1.}, Mustapha A.U^{2.}, Jinjiri B. A^{2.}, Idriss M.M^{2.}, and Nguru M. I^{2.}

¹(Department of Agricultural Technology, Mohamet Lawan College of Agriculture, P. M. B. 1427, Maiduguri, Borno State.)

²(Department of Science Laboratory Technology, Mai Idris Aloomo Polytechnic, P.M.B 1020, Geidam, Yobe State, Nigeria.)

Abstract: Laboratory experiment was conducted at Mohamet Lawan College of Agriculture, Maiduguri, Nigeria to evaluate the efficacy of neem seed oil in protecting dried *Clarias* fish; *Clarias gariepinus* against infestation by *Dermestes maculatus* and *Necrobia rufipes*. The experiment was laid out in a complete randomized design (CRD) with five treatments and untreated control replicated four times. In each block the dried fish *C. gariepinus* was assigned to the main plots while the botanical; neem seed oil (NSO) was assigned to the sub-plots. Neem seed oil was applied at various concentrations of 0ml (untreated control), 0.5 ml, 0.7ml, 1.0 ml, 1.2 ml and 1.5 ml. The mortality of adult *D. maculatus* and adult *N. rufipes* at 7, 14 and 21 days after treatment were recorded and compared with the untreated control. All concentrations of neem seed oil used recorded higher mortality than the untreated control. However, there was significant difference between the mortality of adult *D. maculatus* and *N. rufipes* among the NSO at different concentrations and the control. Higher mortality rates of both study pests were recorded after applying higher doses of NSO at 21days post treatment. NSO concentration at 1.5ml caused significantly the highest mortality of adult *D. maculatus* and *N. rufipes* respectively and it is therefore recommended as a protectant on stored, dried fish; *C. gariepinus*.

Keywords: *Dermestes maculatus*, *Necrobia rufipes*, *Claria gariepinus*, NSO.

Evaluation of efficiency of neem seed oil against Dermestes maculatus and Necrobia Rufipes in stored smoked fish; Clarias gariepinus

Introduction

Fish protein is one of the best and cheapest sources of animal protein (Banie *et al.*, 2003; Adewolu and Adeota, 2010). Cured fish with low moisture content provides food for beetles, particularly the larvae and to a lesser extent, the adults of *Dermestes maculatus* and *Necrobia rufipes*. The damage caused by insect infestation is an important cause of economic and physical loss of dried fish in tropical countries (Amusan and Okerie, 2002). Losses by *D. maculatus* and *N. rufipes* occur in two ways: by the actual feeding activity of larvae and adults and by cross-infestation resulting in lowering of the value of other commodities in the store (Anonymous, 2005). About 40% flesh of the dried fish is lost annually during storage (Aderohu and Akpabio, 2009; Adedire and Hajide, 2000). A considerable amount of dried fish is lost in Nigeria due to infestation by hide and copra beetles in storage conditions (Aderolu and Akpabio, 2009). *D. maculatus* and *N. rufipes* are cosmopolitan insect pests causing considerable damage to stored commodities such as copra (dried coconut), cheese, dried fish, ham and other products rich in protein contents (Akunne, 2006). Damage by the feeding of the larvae is a serious problem in the storage of dry fishes for off-season consumption and export purpose (Al-jufiah and Opera, 2006). Their presence on high value commodities such as dried fish, copra, ham or processed meat, etc. can lead to produce reduction and serious losses (Azam *et al.*, 2004; Amusan and Okerie, 2002). Insect infestation with dry fishes caused an increase in the anti-nutritional factors such as phytic acid, trypsin inhibitor activity and crude fibre as well as a decrease in starch and protein contents of stored produce (Ayuba and Omeji, 2006). The need to protect smoked fish from insect pests infestation is suggested because dry fish plays a prominent role in the diets of human being. Besides, dry fish commodities are the

cheapest and most accessible sources of animal proteins (Akinwumi *et al.*, 2007). Although many synthetic chemicals are effective against the pests of many stored products, the general use of such chemicals to protect stored fish has been hampered due to health hazards, higher costs and development of resistance by dermestid larvae (Amusan and Okerie, 2002; Odeyemi *et al.*, 2000). Based on these problems, botanical insecticides are the alternative to synthetic chemical pesticides since the botanical compounds are biodegradable and less persistent in the environment (Wanyika *et al.*, 2009; Michaelraj and Sharma, 2006). Plants are the rich source of insecticidal compounds and the effectiveness of these compounds has been demonstrated against many stored product insects (Sabbour and Shadia E-Abd-El-Aziz, 2007). *Piper guineense* spice powder has been reported to be effective in preventing oviposition in *Callosobruchus maculatus* and *D. maculatus* (Fasakin and Aberejo, 2002), and reducing the longevity of the insect. Similarly, (Rajashekar *et al.*, 2010) noted that both the powder and extract of *P. guineense* and *D. tripetela* inhibited adult emergence of *C. maculatus* and *Sitophilus zeamais* completely. *Azadirachta indica*, is known to possess potential insecticidal compounds. Various neem products, oils, cakes, extracts, powder e.t.c. prepared from leaves and seeds are used as protectants against pests in storage. Since there is a pressing need to preserve fish using safer means better than the toxic and unsafe chemical means, this research focusses mainly on the efficacy of NSO on the adult *D. maculatus* and adult *N. rufipes* infesting dried fish; *C. gariepinus*.

Materials and Methods

Experimental location

Evaluation of efficiency of neem seed oil against Dermestes maculatus and Necrobia Rufipes in stored smoked fish; Clarias gariepinus

The experiment was carried out at Entomology Laboratory of Mohamet Lawan College of Agriculture Maiduguri, Nigeria. Located at latitude 11°51N and longitude 13°15E. All experiments were carried out under ambient environmental condition.

Experimental design

The experiment was laid in complete randomized design (CRD) with five treatments and control replicated four times. In each block the dried fish *C. gariepinus* was assigned to the main plots while the botanical neem seed oil (NSO) at the concentrations of 0.5ml, 0.7ml, 1.0ml, 1.2ml, 1.5 ml and 0.0 ml (untreated control), were assigned to the sub-plots.

Source of materials

The initial source of culture was obtained from infested smoked *C. gariepinus* collected from a dried fish market in Baga fish market, Maiduguri, Nigeria. Samples of African mud-fish *C. gariepinus* were obtained from tashan baga; a reputable dried fish market in Maiduguri metropolis while The neem seed oil was obtained from previously processed neem seed kernel from the faculty of Agriculture, University of Maiduguri. Borno State, Nigeria.

Methodology

The source of culture (smoked fish infested by *D. maculatus* and *N. rufipes*) of the study pests obtained were maintained separately in Kilner jars covered with muslin cloth under laboratory conditions and kept at a temperature of $34\pm 2^{\circ}\text{C}$ and a relative humidity of $70\pm 5\%$. All bioassay jars were disinfected before commencement of the experiments. New generations were prepared by removing adults of the insect species from a stock culture, placing them on fresh uninfected fish, there after the

parent adults were removed after three (3) weeks of oviposition period. Samples of African mud-fish *C. gariepinus* were obtained from a reputable dried fish market in Maiduguri metropolis. Smoked fish with broken or damaged parts were not considered in the experiment. Sound, fresh smoked fish were then sterilized by sunning for one week to kill insects before commencement of the experiment. The neem seed oil was obtained from previously processed neem seed kernel which is maintained in the laboratory under good management condition before the commencement of the experiment. Insect species were introduced into each respective bottles and covered with muslin cloth to provide movement of air in and out from the treatment bottles. The Neem seed oil were applied at concentrations of 0.0 ml (untreated control), 0.5, 0.7, 1.0, 1.2 and 1.5 ml, was thoroughly sprayed onto the body of 80g of dry smoked fish and placed into a respective bottles measuring 500ml capacity. All treatments were arranged in laboratory shelf under ambient condition. Mortality counts of *D. maculatus* and *N. rufipes* adult were done at 7, 14 and 21 days post treatment and data were recorded. Dead weevils were removed and discarded after every count.

Data analysis

Data obtained on the mortality counts of the weevils caused by the neem seed oil were subjected to analysis of variance (ANOVA) using Tukey-kramer's HSD Test at $p>0.05$ significant levels of probability.

Results and discussion

Table 1 shows that at 7 days after treatment application, the highest dose of NSO at 1.5ml caused significantly higher mean mortality of adult *N. rufipes* and *D. maculatus* (71.6^a and 73.3^a) when compared with treatment with NSO

Evaluation of efficiency of neem seed oil against Dermestes maculatus and Necrobia Rufipes in stored smoked fish; Clarias gariepinus

at the lowest concentration of 0.5ml and untreated control which were 0.0^b and 0.7^b respectively.

Table 2 shows the effect of different concentrations of NSO on the mortality of *N. rufipes* and *D. maculatus* adults, 14 days after treatment. The results obtained also revealed that adult mortality is dose dependent, increasing with increase in concentration of the NSO. Significantly higher mean mortality of the two adult insects were recorded after treatment with NSO at 1.50ml which were 93.3^a and 100^a respectively, while significantly lower mean mortality of the adult insects was recorded at the lowest dose of NSO and untreated control which were 1.0^b and 0.3^b respectively. The result further revealed that *D. maculatus* is more susceptible NSO than *N. rufipes* because treatment by NSO at the rate of 1.2ml caused 100% mortality of *D. maculatus* while at same rate of NSO (1.2 ml), 86% mean mortality was recorded for *N. rufipes*.

Results on the effect of different concentrations of NSO after 21 days of exposure period was presented in table 3. The data obtained showed that increasing the concentration of NSO and duration of storage significantly increased the mortality of the adult weevils. Significantly higher mean mortality was recorded for *N. rufipes* after treatment with NSO at 1.0 ml, 1.2 ml and 1.5 ml which were 93.3^a, 96.7^a and 100^a respectively. Similarly, significantly higher mean mortality of adult *D. maculatus* was recorded after exposure for 21 days and treatment with 1.0 ml, 1.2 ml and 1.5 ml which was 100^a % for all the three doses. The results obtained from the present study showed that the efficacy of the NSO against the two adult weevils is dose dependent, in which the mortality of both study insects increase with increase in concentration of the botanical, NSO. Treatment by NSO caused significantly higher mortality of *D. maculatus* and *N. rufipes* (adult) than the control. However, even at the lowest

concentration and at 21 days post treatment was capable of evoking more than 60% mortality in the adult of both species.

The results obtained in this study is in agreement with the work of (Okorie *et al.*, 1990, Egwunyenga *et al.*, 1998; Okonkwo and Okoye, 2001) who reported that 93% of *D. maculatus* larvae were killed and total mortality of all adults was recorded when treatment was done with 2g of neem seed powder per 25g Tilapia species. Similarly, Fasakin and Aberejo, (2002) reported that pulverized plant materials from *P. guineense* inhibited egg hatchability and adult emergence of *D. maculatus* Degeer in smoked catfish (*Clarias gariepinus*) during storage. Baba *et. al.*, (2014) also reported that after the application of neem kernel extract to control *D. maculatus* the emergence of F1 generation (Adult) from the late instar larvae was highly suppressed by the effect of NKO and NKP at 1ml and 5g respectively per 35g dried fish than NLP (5g/35g dried fish) after 8weeks PTA. Mufutau (2012) reported that after the application of neem seed oil to protect dried fish against infestation by *D. maculatus*, the fish were protected for 6 months against *D. maculatus* and the efficacy of the neem seed oil as a treatments was found to be dosage dependent, the LD50 was 0.125 while 0.275ml significantly halted hatchability and development of the pest. He recorded 100% adult mortality at high doses within the first 10 days.

This work supports other researches on the use of plant materials as bioinsecticides in protecting stored products. Essential Plant oils produced by different plant genera have been reported to be biologically active and are endowed with insecticidal, antimicrobial and bio regulatory properties (Ahmed *et al.*, 2009; Kumar *et al.*, 2007; 2008; Swella and Mushobozy, 2007). The advantage of insecticides of plants origin is that they are easy to apply (Parugrug and Roxas,

Evaluation of efficiency of neem seed oil against Dermestes maculatus and Necrobia Rufipes in stored smoked fish; Clarias gariepinus

2008). Plant materials have been used successfully in suppressing the population of storage pests (Rajapakse, 2006; Parurug and Roxas, 2008; Asawalam and Emosairue, 2006; Akunne *et al.*, 2014). Similarly, neem seed oil and powder has been reported to be effective in preventing oviposition on *C. maculatus* and *D. maculatus* (Rupp, 2006). Arong *et al.*, (2011) also reported that neem seed oil has shown to possess phytochemicals that confer on it significant insect repellent and insecticidal value (Watt, 2010). The results obtained from this study imply that for better results, higher concentrations of neem seed oil should be used against adult of *D. maculatus* and *N. rufipes*. Time of exposure of *D. maculatus*

and *N. rufipes* to plant oils of neem is a factor to be considered in the control of *D. maculatus* and *N. rufipes*. The highest concentration (1.5ml) used caused more adult mortality. Neem seed oil are safer as control measures and should be used in preserving dry fish. However, the dosage of 1.5ml oil concentration per 80g of dried fish is recommended in the control of adult of both *D. maculatus* and *N. rufipes*. Neem seed oil should be renewed in wider scope for effective control of stored product insect pests. Protein supply is lower than its demand, therefore to boost animal protein (especially fish) proper control measures should be taken against insect pests' infestation at the larval and adult stage.

Table 1: Mean (%± SE) of adult mortality of *Necrobia rufipes* and *Dermestes maculatus* after 7 days exposure to NSO to protect *C. gariepinus*

Treatment (ml)	<i>N. rufipes</i>	<i>D. maculatus</i>
0.0	0.0±0.0 ^b	0.7±0.3 ^b
0.5	35.7±6.7 ^{ab}	46.0±11.5 ^a
0.7	46.7±6.7 ^a	53.3±11.5 ^a
1.0	53.3±13.3 ^a	60.6±6.11 ^a
1.2	60.0±11.5 ^a	66.7±6.7 ^a
1.5	71.6±6.7 ^a	73.3±6.7 ^a

Means followed by the same letter are not significantly different from each other at p>0.05

Table 2: Mean (%± SE) of adult mortality of *Necrobia rufipes* and *Dermestes maculatus* after 14 days exposure to NSO to protect *C. gariepinus*

Treatment	<i>N. rufipes</i>	<i>D. maculatus</i>
0.0	1.0±0.6 ^b	0.3±0.3 ^b
0.5	46.7±0.6 ^b	60.0±11.5 ^{ab}

Evaluation of efficiency of neem seed oil against Dermestes maculatus and Necrobia Rufipes in stored smoked fish; Clarias gariepinus

0.7	63.3±13.7 ^{ab}	66.7±6.7 ^{ab}
1.0	73.3±6.7 ^{ab}	93.3±6.7 ^a
1.2	86.3±3.7 ^a	100.0±0.0 ^a
1.5	93.3±6.7 ^a	100.0±0.0 ^a

Means followed by same letter are significantly different from each other p>0.05

Table 3: Mean (%± SE) of adult mortality of *N. rufipes* and *D. maculatus* after 21 days exposure to NSO to protect to protect *C. gariepinus*.

Treatment	<i>N. rufipes</i>	<i>D. maculatus</i>
0.0	2.0±0.0 ^c	1.0±0.6 ^b
0.5	73.3±17.6 ^b	86.7±6.79 ^a
0.7	86.7±13.3 ^b	96.7±6.79 ^a
1.0	93.3±6.7 ^a	100.0±0.0 ^a
1.2	96.7±6.7 ^a	100.0±0.0 ^a
1.5	100.0±0.0 ^a	100.0±0.0 ^a

Mean followed by same letter are not significantly different from each other at P>0.05

Conclusion

In view of the high mortality rates caused by NSO on both the adults of *D. maculatus* and *N. rufipes*, it can be concluded from this work that NSO is as effective as synthetic insecticides in suppressing these beetle's population and providing maximum dry fish protection. It is therefore recommended for fish farmers and dry fish sellers to adopt and practice the use of neem seed oil in protecting stored dried Clarias and other dry fishes against infestation by the beetles; *D. maculatus* and *N. rufipes* since NSO has shown to be effective, cheap and safe for human consumption. Moreover, the use of synthetic insecticides has several disadvantages such as high cost of procurement, development of

resistance by pests, introduction of toxic residues into the food of man and other mammals.

References

- Adedire, C. O. and Lajide, L. (2000). Effect of pulverized plant materials on fish damage and growth performance of the fish beetles *Dermestes maculatus* (Degeer). *Entomological Society of Nigeria Occasional Publication*. 32: 215-221.
- Aderohu, B. and Akpabic, F. (2009). Evaluation of neem products (*Azadirachta indica* A. Juss) (*Dermestes maculatus* Deeger) (Coleoptera: Dermastidae) on

Evaluation of efficiency of neem seed oil against Dermestes maculatus and Necrobia Rufipes in stored smoked fish; Clarias gariepinus

- dried fish. *Nigeria Journal Entomology*; 20: 105-115
- Aderolu, A. Z. and Akpabio, V. M. (2009). Growth and economic performance of *Clarias gariepinus* juveniles fed diets containing velvet bean, *Mucuna pruriens*, seed meal. *African Journal of Aquatic Science*. 34: 131- 135(5).
- Adewolu, B. and Adeota, L. (2010). Insecticidal activity of *Dennettia tripetala* Baker F. and *pepper guineensis* Schum. against (*Dermestes maculatus*) degeer (coleoptera: dermestidae) and *Necrobia rufipes* (coleoptera: claridae) on dried fish. *Nigeria Journal Entomology*; 18:109-117
- Ahmed, S., Zainab, A., Nisar, S., Rana, N. (2009) Effect of new formulations of neem products on biology of *Tribolium castaneum* (herbst) (Tenebrionidae: Coleoptera). *Pakistan Entomology* 31: 133-137.
- Akinwumi, A., Ivbijaro, R., and Mehta, U. (2007). Toxicity of neem (*Azadirachta indica* A Juss). To *Sitophilus oryzae* of stored maize. *Protection Ecology*; 5: 335-357
- Akunne, C. E. and Okonkwo, N. J. (2006) Pesticide: Their Abuse and Misuse in our Environment. Book of proceedings of the 3rd Annual National Conference of the Society for Occupational Safety and Environmental Health (SOSEH) Awka 130-132.
- Akunne, C.E., Afonta, C.N., Mogbo, T.C., Ononye, B.U., Ngenegbo, U.C. (2014) Evaluation of the Efficacy of Mixed Powders of *Piper guineense* and *Zingiber officinale* against *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae). *American Journal of Biology and Life Sciences*; 2(2):63-67.
- Al-jufiah, A. and Opera, M. (2006). Fish processing technology in the tropical national institute for fresh water fisheries research, New Bussa, Nigeria, ISSN-13:9781770457, pp 403
- Amusan, O. and Okerie, A. B. (2002) Different effect of some botanicals on *Callosobruchus maculatus* (F) (Coleoptera: Bruchidae). *International Journal pest management*.46:109-11
- Anonymous, R. (2005). Quality changes of Nigerian traditionally processed fresh water fish species. Nutritive and organoleptic changes. *Journal of food Technology*, 19: 333-340
- Arong, G. A., Oku, E.E., Obhiokhenan, A. A., Adetunji, B. A., Mowang, D. A. (2011). Protectant Ability of *Xylopi aethiopica* and *Piper guineense* Leaves against the Cowpea Bruchid *Callosobruchus maculatus* (Fab.) (Coleoptera: Bruchidae). *World Journal of Science and Technology*; 1(7):14-19.
- Asawalam, E. F. and Emosairue, S.O. (2006) Comparative Efficacy of *Piper guineense* Schum and Thonn and Pirimiphos Methyl on (*Sitophilus zeamais* (Motschulsky)). *Tropical and Subtropical Agro-ecosystem* 2006; 6:143-148.
- Ayuba, S. and Omeji, B. (2006) evaluation of insecticide dips as protectants of stored dried fish from Dermestid beetle
- Evaluation of efficiency of neem seed oil against Dermestes maculatus and Necrobia Rufipes in stored smoked fish; Clarias gariepinus***

- infestation. *Journal stored product Research*; 23: 47-56
- Azam, K., Ali, M. Y., Asaduzzaman, M., Basher, M. Z. and Hossain, M.M. (2004) Biochemical assessment of selected fresh fish. *Journal of Biological Sciences*, 4: 9-10
- Baba G.O., Erhabor T.A., Sulaiman Y.D., Ayanrinde F.A., Majolagbe M.O., Fadoyin A.S., & Musa Kabiru (2014). Biopesticidal effect of neem plant products (*azadirachta indica a. Juss*) on the mortality of late instar larvae and emergence of f1 generation of dermestid beetle (*dermestes maculatus degeer*) on dried fish (*clarias* sp). *G. J. B. A. H. S.*, Vol.3 (1): 314-321
- Banie, I. J and Clacas, A. M. (2003). Fish handling preservation and processing in the tropics: part ii report of the tropical development and research institute, 145, pp: 144
- Egwunyenga, O. A., Alo, E. A. and Nmorsi, O. P. G. (1998). Laboratory evaluation of the repellency of *Dennettia tripetela* Baker (Anonaceae) to *Dermestes maculatus* (F) (Coleoptera: Dermestidae). *Journal of Stored Product Research*. 34: 195-199.
- Fasakin, E. A., Aberejo, B. A. (2002) Effects of some pulverized plant material on the developmental stages of fish beetle *Dermestes maculatus* Degeer in smoked catfish (*Clarias gariepinus*) during storage. *Bioscience Technology* 2002; 85:173-177.
- Kumar, R., Kumar, A., Prasad, C.S., Dubey, N. K and Samant, R. (2008) Insecticidal activity *Aegle marmelos* (L.) Correa essential oil against four stored grain insect pests. *International Journal of Food Safety* 10: 39-49.
- Kumar, S., Bhadauria, M., Chauhan, A.K.S., Chandel, B.S. (2007) Use of certain naturally occurring herbal grain protectants against *Sitophilus oryzae* Linn. (Coleoptera: Curculionidae). *Asian Journal of Experimental Science* 21: 257-263
- Michaelraj, S and Sharma, R. K. (2006) Efficacy of vegetable oils as grain protectant against *Sitophilus oryzae* (L.) and *Rhyzopertha dominica* (F.) in stored maize. *Annals Plant Protection Science* 14: 332-336.
- Mufutau, A. A. (2012). Evaluation of the efficacy of Neem Seed Oil (NSO) extract for the control of *Dermestes maculatus* Degeer, 1774 (Coleoptera: Dermestidae) in *Clarias gariepinus* (Burchell, 1822) (Pisces: Claridae). *Munis Entomology & Zoology*, 7 (2): 1188-1194
- Okonkwo, E. O and Okoye, W. I. (2001). Insecticidal activity of *Dennettia tripetala* Baker F. and *Piper guineense* Schum and Thonn against *Dermestes maculatus* Degeer (Coleoptera: Dermestidae) and *Necrobia rufipes* Degeer (Coleoptera: Cleridae) on dried fish. *Nigeria Journal of Entomology*. 18: 109-117.
- Okorie, T. O., Siyanbola, O. O. and Ebochuo, V. O. (1990). Neem used powder as protectant for Dried Tilapia against *Dermestes maculatus* Degeer infestation. *Insect Science and*

Evaluation of efficiency of neem seed oil against Dermestes maculatus and Necrobia Rufipes in stored smoked fish; Clarias gariepinus

- 11(2): 153-157.
- Osuji F.N.C. (1974). Beetle infestation of dried fish purchased from a Nigerian market, with special reference to *Dermestes maculatus* Degeer, *Nigeria Journal of Entomology*. 1(1): 69-79.
- Parugrug, M. L., Roxas, A.C. (2008) Insecticidal Action of Five Plants against Maize Weevil, *Sitophilus zeamais* Motsch. Coleoptera: Curculionidae. *KMITL Science and Technology Journal*; 8(1):21-38.
- Rajapakse, R. H. S. (2006). The Potential of Plants and Plant Products in Stored Insect Pest Management. *Journal of Agricultural Science*; 2(1):11-21.
- Rajashekar, Y., Gunasekaran, N., Shivanandappa, T. (2010) Insecticidal activity of the root extract of *Decalepis hamiltonii* against stored-product insect pests and its application in grain protection. *Journal of Food Science and Technology* 47: 310–314.
- Rupp, M.M.M., Da Cruz, S.M.E., Schwan-Estrada, K.R.F, Souza Junior, S.P, Collella, J.C.T. (2006) Toxic effect of vegetable extracts on adults of *Sitophilus zeamais* Mots. 1855 (Coleoptera: Curculionidae). 9th International Working Conference on Stored Product Protection.
- Sabbour, M.M., Shadia E-Abd-El-Aziz (2007) Efficiency of some bioinsecticides against broad bean beetle, *Bruchus rufimanus* (Coleoptera: Bruchidae). *Research Journal of Agricultural Biology Science* 3: 67-72.
- Swella, G.B. and Mushobozy, D.M.K. (2007) Evaluation of the efficacy of protectants against cowpea bruchids (*Callosobruchus maculatus* F.) on cowpea seeds (*Vigna unguiculata* (L.) Walp.). *Plant Protect Sci* 43: 68–72.
- Wanyika, H. N., Kareru, P. G., Keriko, J. M., Gachanja, A. N., Kenji, G. M. (2009) Contact toxicity of some fixed plant oils and stabilized natural pyrethrum extracts against adult maize weevils (*Sitophilus zeamais* Motschulsky). *African Journal of Pharmacology* 3: 66-69.
- Watt, M. (2010) Essential oil safety: The known and the unknown.

Innovative Approaches for Climate Change Mitigation in Transport Institutions in Nigeria

Alhaji Attahir Husseini¹, Babagana Kachalla²

^{1&2}Department of Civil Engineering Technology,

Mai Idris Aloomo Polytechnics, Geidam Yobe State, Nigeria

¹ Mobile phone: 08089206221, E-mail: husseni2010@gmail.com

Abstract

Accelerating the national and international innovative approaches for climate change mitigation is one of the key drivers for the achieving the objectives especially in developing countries like Nigeria where the policy implementation is becoming very difficult. Transport agencies reducing their greenhouse gas emissions are not in their self-interest because the domestic costs outweigh the domestic benefits according to their tradition. Several inter-governmental agencies are now incorporating innovative climate change mitigation such as managing transportation demand as much as possible by reducing the need to travel. This paper aims to review these programs with paired goals of assessing their success in promoting these innovation, and identifying newly formed innovation Instruments. The paper concludes that all programs reviewed have promoted the innovative approaches for climate change mitigation in transport agencies despite with incomplete implementation of these policies. The research has recommended that the international practices for innovative climate change mitigation approaches should be adopted in Nigeria in order to reduce incidents cause by climate change. Similarly, in future programs, part of the funding of the transport agencies should be dedicated to programs, doing research for new innovative approaches for climate change mitigation in transport agencies and development as well.

Key words: Climate change, innovation, transport, mitigation.

Introduction

Transport infrastructure is one of the pillars of economic development of society and at the same time the largest contributor to greenhouse gases (GHG) emission that largely driven by the road and air transport. Global transport-related GHG emissions are expected to double by 2050 (Organisation for Economic Cooperation and Development, 2012). Transportation is significant to any nation economy, its quality of life and at the same time responsible for the greenhouse gases (GHG) emissions that are warming our planet. Scientists warn that global emissions caused by human activities must be adjusted in order to prevent its consequences within a timeframe of a decade or we face the consequences especially in developing countries where the large majority of the population of the world lives and where the susceptibility to climate change impacts is extreme. The International Panel on Climate Change (IPCC) defines adaptation as the “adjustment in natural or human systems to a new or changing environment”. Whereas the International Panel on Climate Change (IPCC) defines mitigation as: “An anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases.” In 2007, scientists from the International Panel on Climate Change predicted that the warming of oceans and melting glaciers or ice can create the rise of sea level up to 5 meters by the year 2100. Transportation activities are responsible for up to 23% of world energy-related greenhouse gas (GHG) emissions. Besides this, the transport sector is the second largest and second fastest growing source of global GHG emissions (Renukappa, 2013). Global transport-related greenhouse gas emissions (GHG) are expected to double by 2050 if no new innovations and policies have been put in place (Organisation for

Economic Cooperation and Development, 2012). Evidence from scientists has confirmed and claims that climate change presents serious global risks for various sectors of endeavor such as water resources, food security, biodiversity, human settlement, health, living conditions, and international peace and security. Therefore, climate change demands a serious global attention and coordinated response on multiple levels (Renukappa, 2013).

The Paris Climate Conference held in December 2015, countries of more than 160 submitted their Intended Nationally Determined Contributions (INDCs) as their plan to decrease greenhouse gas (GHG) emissions and increase resilience. 140 countries INDCs identify transport as an important source of GHG emissions and an area where action is needed. 23 countries INDCs identify their target on transport GHG emission decline and 105 nation states INDCs define their mitigation actions (Löhr, Perera, Hill, Bongardt and Eichhorst, 2017)

There are different innovations used in reducing the greenhouse gas emission in transportation by various countries in the world. The transportation sector is really a major GHG emission contributor that has a lot of discussion but how to decarbonise the sector are still not defined (Löhr, Perera, Hill, Bongardt and Eichhorst, 2017). The United States of America prospect to cut its GHG emissions from the transportation sector in cost-effective and more efficient up to 65 percent below 2010 levels by 2050 is through the improvement of vehicle efficiency, shifting to less carbon intensive fuels, travel behavior change, and operating as well (Greene, Baker Jr, Steven and Plotkin, 2011). Climate models suggest that Africa's climate will generally become more variable, with high levels of uncertainty regarding climate projections in the

Innovative Approaches for Climate Change Mitigation in Transport Institutions in Nigeria

Africa Sahel zone. Temperatures in West Africa, and particularly the Sahel, have increased more sharply than the global trend (Federal Ministry of Environment, 2010).

For Nigeria, a recent study by Department for Food and International Development (DFID) (2009) predicts a possible sea level rise from 1990 levels to 0.3 m by 2020 and 1m by 2050, and rise in temperature of up to 3.2°C by 2050 under a high climate change scenario. This is based on IPCC climate change assumptions, latest research findings and results of a consultation exercise in Nigeria. The low estimate predictions are for sea level rise of 0.1 m and 0.2 m by 2020 and 2050 respectively, and a temperature increase of 0.4 to 1°C over the same time periods (Federal Ministry of Environment, 2010).

This paper has focused on the innovation used in Nigeria for mitigation of climate change causes by transport, their impact to climate change mitigation and the need to adopt new climate change mitigation practicing internationally in order to achieve our goals at national and international level. In Nigeria, The Federal Government's economic growth plan of Nigeria as of Vision 20:2020, Economic Transformation Blueprint (2009), has identifies the climate change as a threat to sustainable growth in the next decade. The federal government of Nigeria recognized climate change as a critical challenge to the world and, in Nigeria, as a potential driver of "damaging and irrecoverable effects on infrastructure, food production and water supplies, in addition to precipitating natural resource conflicts." This recognition is an important first step towards a climate change adaptation strategy and action plan in transformation Agenda 2011 – 2015. The agenda adapts the full priority policies and programs to suite into projects, purposely to ensure continuity,

consistency and commitment of national development determinations. It identified 1613 projects across from 20 Ministries; however, the policy and implementation framework did not adequately address issues of climate change. In order to reveal the increasing importance of climate change issues in Nigeria, the Federal Executive Council in 2012 adopted the Climate Change Policy Response and Strategy. To ensure an effective national response to the significant and multi-faceted impacts of climate change, Nigeria has accepted a broad plan, as well as a number of specific policies such as low carbon to obtain certain objectives. The Nigeria objective is to contribute by taking action to adapt climate change in reducing its impact intensity, increasing the resilience, sustainable wellbeing of all Nigerians, minimizing risks by adaptive capacity improvement, leveraging new opportunities, and facilitating collaboration inside Nigeria and global community as well (Pew Research Center spring, 2015)

Literature

Climate change is among of the greatest challenges that our planet is facing in the future. Transportation is a major contributor to greenhouse gas (GHG) emissions that result to global warming. About one-third of the province's total GHG emissions in Ontario are coming from the transport activities and more than 80% originating from road- based transportation. Combating climate change impact will require less carbon- rigorous forms from transportation and initiate strategies that will reduce the need to travel (Ministry of Transportation Ontario's, 2009). Transportation is essential to nation development, which provides access to goods and services, social and economic benefits but if not properly managed, it lead to the extent of severe environmental, social and economic damage. UNDESA has conducted

a researched which predicted that the world population will reach 9 billion by 2075 and most people will live in cities by 2025. So far this is already the case in industrialized nations; with rapid changes in developing countries that will need assistance to shift toward more sustainable development direction. Health concerns and down fall of living conditions caused by traffic congestion and pollution has become necessary to invite for more efficient, economical, socially acceptable and environmentally viable transport structures and defining limits to fossil fuel resource use for climate change (Commission on Sustainable Development 9 and 18, 2000 and 2010)

Innovation and technology will be an essential in provide responses to climate change, energy security and economic growth. The solutions are achievable, affordable and realistic but will require full determination work and international cooperation to be successfully implemented. To achieve this, we must have a double foresight immediately to apply the available decision in order to minimize this global emission by the year 2020 and spend in the technologies of the future in order to build the capacity to make long-term cuts decision. Copenhagen is the moment for the world to signal this commitment and clearly signpost the path to a sustainable future (The Climate Group, 2009).

In the context of the work of the Commission on Sustainable Development, the transport theme was included in Agenda 21 and the Johannesburg Plan of Implementation as a result of the World Summit in Rio de Janeiro in 1992 and since then part of intergovernmental discussions, among others highlighted in climate smart department (CSD 9) in the year 2000 and (CSD18) in 2010. Transport will also be part of the negotiations at the CSD in 19 May 2011 and an important theme in the United Nation Climate Smart Department

(UNCSO) in 2012. In order to keep the global temperature increase below 2 degrees Celsius, as recommended in the Copenhagen Accord, industrialized countries will need to reduce emissions up to 25-40% below 1990 levels by 2020. With regards to developing nations, they would need to reduce GHG emissions of 15-30% below Business as Usual (BAU) by 2020. For the transport sector alone this would turn to 0.6-1.3 GtCO₂-eq/yr reduction by 2020. This will require determined and coordinated action on the side of developing countries with combines domestic action and internationally support actions through: (a) traditional development, including the multilateral development banks (MDBs), (b) special climate funds like Global Environmental Facility (GEF) and Clean Technology Fund (CTF), as well as (c) dedicated climate mechanisms in the form of Clean Development Mechanism (CDM) and Nationally Appropriate Mitigation Actions (NAMAs) (Commission on Sustainable Development 9 and 18, 2000 and 2010).

Emission from air transportation is expected to increase with income growth in developing countries and an emission from shipping is expected to grow by 150-250% compared to emission levels in 2007. According to the International Energy Agency, transport accounts for 13% of all global GHG emissions and 23% of global carbon dioxide emissions. Transport energy consumption increased by 37% between 1990 and 2005 while carbon dioxide emissions from transport anticipated increasing by 57% between 2005 and 2030. Road transport alone accounted 89% of energy use attributed to transport in 2005, and grew by 41% between 1990 and 2005, compared to 13% growth in emissions related with non-road modes of transport. Almost 60% of total global road transport emissions originate from North America and Western Europe. China ranks third

***Innovative Approaches for Climate Change Mitigation
in Transport Institutions in Nigeria***

in transport related energy consumption and emissions behind the USA and Europe, and tripled its consumption of transport related energy between 1990 and 2005 (United Nations Environment Programme, Green Economic Review, 2011)

The Kyoto Protocol (KP) is a treaty between industrialised and non-industrialised nations that was discussed in Kyoto, December 1997 in Japan under the United Nations Framework Convention on Climate Change (UNFCCC). The treaty was then opened for signing in 1998, closed in 1999, and became active later in February 2005. Under this treaty, industrialised countries are required to reduce their greenhouse gas emissions by 5.2% compared to 1990 levels of emissions but the agreement has not been endorsed by the USA and a few other leading industrialised nations. Nevertheless, the targets for the European Union are set at 8%, the US 7%, Japan 6% and Russia 0%, while increases of 8% has been permitted for Australia and 10% for Iceland. The introduction of the carbon economy has profound implications for competitiveness of cities. The direct implications are that cleaner production. The post-Kyoto discourse on climate change and the need to reduce GHG emissions has taken many twists and turns. At first, the science behind climate change projections was subject to serious inspection by governments which were unwilling to contemplate the large changes that would be required to offset the progression of global climate change effects. The recent United Nations Framework Convention on Climate Change (UNFCCC) in Copenhagen in 2009 failed to ensure that a legally binding deal was signed. Prior to Copenhagen 2009, the Bali Climate Convention in 2007 agreed that negotiations would occur on two tracks with working groups dealing with long-term cooperative action (LCA) and the Kyoto Protocol

(United Nations Environment Programme, Green Economic Review, 2011)

The LCA working group was concerned with negotiations on long-term reduction targets for developed countries and on the role and potential of developing countries to engage in mitigation and adaption activities through technology transfer and support from developed countries. The KP working group was concerned with deeper emission cut targets for developed countries, potential amendments to KP, and the role of Clean Development Mechanisms (CDM), land use change, forestry etc. in reducing emissions. Both LCA and KP negotiations should have been concluded by the end of Copenhagen 2009. Perhaps the most significant development at Copenhagen was that the accord recognizes – for the first time – the need to restrict global warming below 2 degrees Celsius. Yet no binding agreement was obtained, and while a 25-40% reduction in GHGs is required of rich countries according to the IPCC. World Resource Institute study indicates that commitments by rich countries range between 13-19% (United Nations Environment Programme, Green Economic Review, 2011)

Paris Climate Conference held in December 2015, countries of more than 160 submitted their Intended Nationally Determined Contributions (INDCs) as their plan to decrease greenhouse gas (GHG) emissions and increase resilience. 140 countries INDCs identify transport as an important source of GHG emissions and area where action is needed. 23 countries INDCs identify their target on transport GHG emission decline and 105 nation states INDCs define their mitigation actions. A high level analysis of the NDC documents carried out by GIZ showed that transport has been recognized as one sector of key relevance for climate change. Due to the imperfect level of information provided in the

official NDC documents, more analysis at the country level is needed to be able to assess the role of transport in the INDC development and implementation process. To gain such insight for the transport sector in rapidly-motorising countries, seven case studies were carried out in the following countries namely: Bangladesh, Colombia, Georgia, Kenya, Nigeria, Peru and Vietnam. Data for the analysis was gathered through literature investigation and stakeholder interviews and complemented by experiences from GIZ's and Ricardo's day-to-day work in countries. Some of the lessons learnt from these countries are (Löhr, Perera, Hill, Bongardt and Eichhorst 2017):

- Lack of transport data limits the sectorial ambition.
- Not in cooperating key transport actors is essential for ambitious sector targets.
- NDC should be more closely associated with transport sector strategies.
- Transport authorities need more climate change expertise.

There are different innovations used in reducing the greenhouse gas emission in transportation by various countries in the world. Transportation sector is really a major GHG emission contributor that has a lot of discussion but how to decarbonise the sector are still not defined (Löhr, Perera, Hill, Bongardt and Eichhorst, 2017).

The scientific evidence is clear that human activity is causing the global climate to change and this activities will still persist that will cause more extreme changes. The need to begin reducing emissions of CO₂ and other GHGs from all human activities sources in transportation sector is supported by many independent scientific sources. The 2010 America's Climate Choices report by the U.S. National Academy of Sciences (NAS, 2010) makes it clear that the earth's climate is changing and majority of these

changes are due to human activity. The NAS concludes that climate change is occurring, caused largely by human activities which causes threat generally to human and natural systems" (NAS, 2010). A report by the U.S. Environmental Protection Agency (EPA) in 2010 identified a number of climate change indicators already evident today. For example, sea surface temperatures have been warming in the last three decades than any other time since large-scale measurement began in the late 1800s, and Arctic sea ice in 2009 was 24 percent below the 1979 to 2000 historical average. In the United States, seven of the top 10 warmest years on record for the lower 48 states have occurred since 1990 (EPA, 2010e). To mitigate future climate impacts, curbing GHG emissions from all sectors including the transportation sector must begin now (Greene, et.al, 2011).

Transportation will have to severely reduce its GHG emissions by 2050 to mitigate the effects of climate change. The three scenarios how different combinations of policies, technologies and behavior could reduce transportation's CO₂ emissions by anywhere from 15 to 65 percent below 2010 levels by 2050. However, at present, it is not possible to conclude with confidence precisely how great a reduction in transportation sector could happen by 2050 (Greene, et.al, 2011).

Reducing GHG emissions from all sectors must begin now in order to minimize climate impacts. While the role of GHGs in changing global climate is well established, there are disagreements about what might constitute unacceptable damage and a range of projected temperature changes and resulting impacts. Many governments in developed countries have called for GHG emissions to be cut by up to 80 percent by 2050 in order to stabilize atmospheric concentrations of GHG. Transportation accounts

about fifth of global GHG emissions, reducing emissions from this sector must be a key part of a global strategy to combat climate change (Greene, et.al, 2011).

Vehicle ownership in Nigeria is currently low by international standards, standing at approximately 29 cars per 1,000 people as of 2010. However, ambition for car ownership is high due to the status of increasing income levels expected to bring Nigeria into line with other countries based on expected per capita income levels. The combined impact of population growth and growing car ownership is expected to increase the private car fleet in Nigeria from 4.65 million to over 20 million over the forecast period. However, growth in public transport and commercial vehicle numbers and activity is expected to be even more pronounced. Passengers traveling by public transport are typically served by para-transit, minibuses etc. These vehicles are usually privately owned and operated to serve the interests of the owner/operator, with intense competition among drivers. GHG emissions are forecast to increase significantly in Nigeria over the forecast period, driven by increasing population, economic activity, and wealth, reaching over 187 Mt by 2035. So far, Nigeria has no stated CO₂ emissions standards for cars. The current average emissions level across the Nigerian private car fleet is estimated to be 214g CO₂/km. This is clearly far behind the standards being adopted in Europe. To put this into context, by 2035, emissions levels in Nigeria are likely far to exceed the level currently generated by the road transport sector across Sub-Saharan Africa as a whole (133 Mt in 2008) (Federal Government Gazette, 2011). In order to reflect the increasing importance of climate change issues in Nigeria, the Federal Executive Council adopted in 2012 the Nigeria Climate Change Policy Response and Strategy. To ensure an effective national response to the significant

and multi-faceted impacts of climate change, Nigeria has adopted a comprehensive strategy, as well as a number of specific policies. The strategic goal of the Nigeria Climate Change Policy Response and Strategy is to foster low-carbon, high growth economic development and build a climate resilient society through the attainment of the following objectives (Federal Government Gazette, 2011):

- ✓ Implement mitigation measures that will promote low carbon as well as sustainable and high economic growth;
- ✓ Enhance national capacity to adapt to climate change;
- ✓ Raise climate change related science, technology and to a new level that will enable the country to better participate in international scientific and technological cooperation on climate change;
- ✓ Significantly increase public awareness and involve private sector participation in addressing the challenges of climate change;
- ✓ Strengthen national institutions and mechanisms (policy, legislative and economic) to establish a suitable and functional framework for climate change governance.

The country Nigeria is considerably impacted by climate change. The north of the country, for example, is highly vulnerable to drought. A recent Bench Research Center global attitudes survey found that 65% of Nigerians are very concerned about the threat climate change poses, ahead of global economic instability (48%). HE President Buhari has stated in his inaugural speech that Nigeria is committed to tackling climate change. Nigeria's intended nationally determined contribution (INDC) demonstrates its determination to contribute to the success of the

***Innovative Approaches for Climate Change Mitigation
in Transport Institutions in Nigeria***

Paris climate summit in December 2015 and to grow its economy sustainably while reducing carbon pollution. The INDC promotes sustainable development and delivering on government priorities. The policies and measures included in the Nigeria INDC will deliver immediate development benefits and do not compromise sustainable growth, on the contrary. Ambitious mitigation action is economically efficient and socially desirable for Nigeria, even when leaving aside its climate benefits. The policies and measures alleviate poverty, increase social welfare and inclusion, as well as improving individual well-being, which includes a healthy environment. Furthermore, by not undertaking these measures, Nigeria would incur significant adaptation costs from intensified climate change. Nigeria has been actively engaged in international climate policy negotiations since it became a Party to the UN Framework Convention on Climate Change (FCCC) in 1994 ratifying its Kyoto Protocol in 2004. Nigeria submitted its First National Communication (FNC) in 2003 and a Second National Communication in February 2014. Nigeria is host to a number of Clean Development Mechanism projects, as well as projects financed by the Adaptation Fund. In September 2012, the Federal Executive Council approved the Nigeria Climate Change Policy Response and Strategy. HE, President Muhammadu Buhari, The President of the Federal Republic of Nigeria on 26 November 2015, approved the Nigeria INDC (Pew Research Center spring, 2015)

Nigeria institutional framework

Nigeria has created a Special Climate Change Unit (SCCU) within the Federal Ministry of Environment with the Secretariat in Abuja, Nigeria. The Unit is created to implement the Convention and the protocol activities. The SCC Unit also has responsibility of coordinating the

activities of the Inter-ministerial Committee on Climate Change with representation from various; Finance, Agriculture, water Resources, Energy Commission, Nigeria National Petroleum Corporation (NNPC), Foreign Affairs, Nigerian Meteorological Agency (NIMET), industry, NGOs (Nigerian Environmental Study/Action Team), and Academic (Centre for Climate Change and Fresh Water Resources, Federal University of Technology Minna; Centre for Energy , Research and Development, Obafemi Awolowo University Ile-Ife; and Abubakar Tafawa Balewa University, Bauchi. There is also a Presidential Implementation Committee on the Clean Development Mechanism (CDM) in the Presidency. With regards to improving the national capacity to create observational climate data and climate monitoring systems, government upgraded the Department of Meteorology in the Ministry of Civil Aviation to a full-fledged Nigerian Meteorological Agency (NIMET) in 2003, which now has a Climate Research Unit for data generation and climatic information dissemination (Federal Ministry of Environment, 2010)

With regards to the political system of the Nigeria, the Senate has a standing committee on ecology (Senate Committee on Ecology) while the National House of Assembly has a standing Committee on Climate Change. Members of these Committees have facilitated the passing of a Climate Change Commission (CCC) Bill in both the House and Senate level. However, there is still no timeframe as to the time the CCC will take off. In addition to the Committees, there is a National Council on the Environment, made up of representatives of governments at the Federal and State levels. The Council meets at irregular intervals to discuss the state of the environment in Nigeria (Federal Ministry of Environment, 2010)

Innovative Approaches for Climate Change Mitigation in Transport Institutions in Nigeria

Climate Change Adaptation in Nigeria

The summary of impacts above shows Nigeria to be highly vulnerable to climate change. The 2014 World Climate Change Vulnerability Index, published by the global risk analytics company Verisk Maplecroft, classifies Nigeria as one of the ten most vulnerable countries in the world. A recent government study determined vulnerability across Nigeria's geographical regions, focusing on the three principal determinants of vulnerability: adaptive capacity, sensitivity and exposure. The relative vulnerability of the six geopolitical zones of Nigeria is shown below. There is a general south-north divide. The three northern zones show higher vulnerability than those in the south. This reflects the higher rainfall and socio-economic development of the south. The south-south shows highest relative variability among the three southern zones, reflecting the challenges of coastal flooding and erosion, as well as the impact of petroleum exploration and exploitation in that part of the country. The southwest is least vulnerable, the northeast, on the other hand, is most vulnerable. Understanding these spatial vulnerabilities is crucial to shaping climate-resilient development in Nigeria. Euro II standards (FGG 2011) were adopted at the end of 2011 for all new and imported vehicles. The import of two-stroke motorcycles was banned although import of large numbers of these high-polluting three-wheelers prior to the ban means that they are wide-spread in many parts of the country. The existing vehicle fleet is made up of aging, high-polluting vehicles, majority imported from western countries only when they approach the end of their economic life. Cars up to 8 years old can be imported, trucks younger than 15 years can be imported and buses less than 10 years old as well (Pew Research Center spring, 2015)

Business as Usual Emissions Projections in Nigeria

Nigeria's economy and population are both growing rapidly, and the population is attaining a higher standard of living. This growth will have a strong impact on future emissions. Following careful review of the re-based GDP data for 2010-2014 and official population projections the "business-as-usual scenario" was developed as part of the preparation of this INDC. This scenario assumes an economic growth at 5%, population growing at about 2.5% per year, all Nigerians to have access to electricity (both on-grid and off-grid) and demand is met, industry triples its size by 2030. Under this scenario, emissions are projected to grow 114% by 2030 to around 900 million tons around 3.4 tons for every Nigerian. Under a high growth scenario, with economic growth at 7%, this rises to over one billion tons (Pew Research Center spring, 2015)

Mitigation Potential Assessment of GHE Emission in Nigeria

The mitigation assessment in Nigeria could be difficult at the moment because the Nigeria is at the phase1 of the INDC. The mitigation actions, which could be undertaken, were assessed in a bottom up manner, building on expert assessments of both the challenges facing individual sectors, as well as a review of policies and measures already in place. The measures included in Nigeria's INDC are expected to deliver significant development benefits. The mitigation actions that bring the largest development benefit are reducing air pollution, indoors and outdoors, with enormous immediate health and social benefits. Secondly, innovation in "clean" technologies brings resource efficiency and produces more knowledge and jobs than those in "dirty" technologies. Thirdly, fiscal reform is proving an efficient mitigation action. This releases significant resources in the

Innovative Approaches for Climate Change Mitigation in Transport Institutions in Nigeria

budget that can fund investments in efficient infrastructure and other fiscal policies, thus creating jobs and fuelling growth. Beyond mitigation actions that could be quantified, several qualitative policies and measures have been identified (Pew Research Center spring, 2015).

Unconditional Contribution of GHE Mitigation in Nigeria

In the event an ambitious, comprehensive legally binding global agreement is reached at Paris convention on climate change, Nigeria will make an unconditional contribution of 20 per cent below BAU that is consistent with the current development trends and government policy priorities. The policies and measures that will deliver these savings are cost-effective, even at the current high interest rate, which constrains investment. They include improving energy

efficiency by 20 percent, 13 GW of renewable electricity provided to rural communities currently off-grid, and ending gas broadening (Pew Research Center spring, 2015)

Conditional Contribution of G Mitigation in Nigeria on International Support

Nigeria can make a significant additional contribution with international support, in the form of finance and investment, technology and capacity building. The combined policies and measures described below can deliver in a cost-effective manner direct development benefits to the country and reduce emissions 45 per cent below BAU. The key measures are an increased level of energy efficiency and a significant reduction in the use of generators, while providing access to energy for all Nigerians (Pew Research Center spring, 2015).

Aspect	Detail
Type of objective	Reduction from Business as Usual (BAU)
Target year	2030
Implementation Period	2015-2030
Base data period	2010-2014
Summary of objective	Economic and social development: grow economy 5% per year, improve standard of living, electricity access for all
Unconditional and conditional mitigation objectives	20% unconditional, 45% conditional
Key measures	<ul style="list-style-type: none"> • Work towards ending gas flaring by 2030 • Work towards Off-grid solar PV of 13GW (13,000MW) • Efficient gas generators • 2% per year energy efficiency (30% by 2030) • Transport shift car to bus • Improve electricity grid • Climate smart agriculture and reforestation
Trajectory [update figure once agreed]	
Emissions per US\$ (real) GDP	0.873 kg CO ₂ e (2015) [0.491 kg CO ₂ e (2030)]
GDP per capita (US\$)	2,950 (2014) 3,964 (2030: real 2015 US\$)

Source: Nigeria's INDC

Short-Term GHE Emission Mitigation in Nigeria

Introduced regulation related to engine technology, prohibiting the import of two-stroke motorcycles and adopting Euro 2 standards as a minimum for all vehicles imported or sold from the end of 2011 (FGG 2011) although import of large numbers of these high-polluting three-wheelers prior to the ban means that they are wide-spread in many parts of the country. The existing vehicle fleet is made up of aging, high-

polluting vehicles, majority imported from western countries only when they approach the end of their economic life. Cars up to 8 years old can be imported, trucks younger than 15 years can also be imported and buses less than 10 years old as well (Pew Research Center spring, 2015).

Long-Term GHE Emission Mitigation in Nigeria (Pew Research Center spring, 2015):

- Modal shift from air to high speed rail
- Moving freight to rail

Innovative Approaches for Climate Change Mitigation in Transport Institutions in Nigeria

- Upgrading roads
- Urban transit
- Toll roads/ road pricing
- Increasing use of Compressed Natural Gas (CNG)
- Reform petrol/ diesel subsidies

International Policy and Implementation on GHE Emission Mitigation on Transport

Business Planning

Any organization that carries a business activities, operation or services must have principles and certain characteristics peculiar to it. Applying the principle of GHG emission mitigation as business priorities, funding requirements and performance measures will ensure that the desirable results and outcomes of the program will be achieved efficiently and cost effectively. Similarly, the implementation stages should go along with evaluation, reporting as feedback for the purpose of correcting any mistake in the policy or during the implementation periods (Ministry of Transportation Ontario's, 2009).

Standard and Practices

Standardization in any aspect is very important especially in transportation system. Incorporating standard in designing, construction, operation and maintenance will seriously help in economy, social and environmentally. Pavement design standard make road construction more sustainable by maximizing the lifespan of the pavement reduces noise, use of raw material, reuse and recycle. These practices will assist in use less energy and less GHG emission (Ministry of Transportation Ontario's, 2009).

Environmental Impact Assessment

Transportation infrastructure is one of the major contributors to climate change and therefore need environmental assessment in carrying any project. Transportation impacts are well-understood and some can be predicted based on experience. Therefore, it will be steward to study any project that will be undertaken to pass all necessary consideration that may affect the environment and offer a proper recommendation (Ministry of Transportation Ontario's, 2009).

Stakeholder/Shareholder

Appropriate communication and involvement of Stakeholders' will add considerable value to the program. The earlier they are involved, the better the result, involving the stakeholders are a powerful mover for change, while ignoring them can lead to failure. Their involvement should include (British Standard Guideline, 2010):

- (a) Focus groups;
- (b) facilitated workshops;
- (c) Early prototyping;
- (d) Simulations.

Employee Education and Awareness:

Employees are important tools that any organization use to initiate, implement any new programs. Therefore, it will be necessary to educate them the basic aspect of the GHG emission mitigation in a formal and informal approach. This can be obtained through (Ministry of Transportation Ontario's, 2009):

- Developing workshop
- Lunch and learn
- Ride-sharing
- Provision of shuttle services

Employee Recognition

Recognizing staff to incorporate sustainable business practices will help drastically in full awareness of the subject matter. There is need for celebrating any achievement or initiative contributes by any staff because this will encourage them to continue to find means to integrate GHG emission mitigation into their activities (Ministry of Transportation Ontario's, 2009).

Legislation and Regulation:

Legislation and regulation is one of the parameters the planners used in trying to stabilize the transportation system. For instant, mandating the use of speed limiters in determining speed, prohibition of old age vehicles will all help in reduces GHG emissions, road safety and fuel economy (Ministry of Transportation Ontario's, 2009).

Infrastructure:

The choices we plan in building infrastructure, how and where to build and how long to stay in operation has an impact to our GHG emission. Expansion of road to reduce congestion, protecting natural and agricultural land and asses the environmental impact before and after the project completion is vital (Ministry of Transportation Ontario's, 2009).

Public Education:

GHG emission issues are all about changing of people behavior in respect to their daily activities for better living. There is need people to be educated on what are expected to change their behavior. Medium that is used to achieve this are (Ministry of Transportation Ontario's, 2009):

- ❖ Incorporating GHG emission in beginners' drivers education curriculum,

- ❖ Preparing and distributing books to schools,
- ❖ Educating people impact on climate change,
- ❖ Educating people on sustainable mode, available mode, travelling information as well as the implication of each,
- ❖ Organizing conferences for all sort of organization.

Benefits of GHE Emission Mitigation on Transportation (Raji, (2017) :

- Shifting to green transportation would help clear the atmosphere of toxic gases since these modes of transportation have few to zero emissions.
- Saves you money by embracing green transportation modes like bicycles, multiple occupant cars, electric motorcycles, ride sharing etc. This will save you a lot from costs related to buying fossils fuels at the filling station.
- Manufacturing and distribution of green vehicles will go along with improving existing transport systems. This will lead to creation of more jobs in the transport sector, hence, minimizing social-economic disparities and building up a sustainable economy.
- Minimize over-reliance on fossil fuels, which drain an economy.
- Improved health by producing green vehicles that are not harmful to human health, so embracing green transportation will only improve a country's health status.
- Reducing the cost of travel due to traffic congestion.

Challenges of GHE Emission Mitigation on Transportation

Increase in Population

Innovative Approaches for Climate Change Mitigation in Transport Institutions in Nigeria

UNDESA has undertaken that the world population will reach 9 billion by the year 2075 and by 2025 most people will live in cities. This situation has already manifested itself in industrial countries and many developing countries are rapidly changing. Improper management of such increase in the population will lead to air pollution, shortage of transport infrastructure, deterioration of water quality and so forth (Ministry of Transportation Ontario's, 2009).

Congestion

A reliable transportation network is essential giving access to goods and services to people. Transportation system is the most vital components of business logistic cost in economic activities. One third to two third of the expenses of enterprises logistic cost is spending on transport (Jeon, 2005). The biggest influence of population in transportation system is traffic congestion. Congestion cost losses in business to significant figure of money from £7b to £20b on different estimate. Therefore relieving congestion is good to economic, social and environmentally (Joseph, 2000).

Creating Green Economy/Reaching Zero Waste

Transportation network is one of the key drivers in any society, hence we do not have chosen between environmental protection and a sound economy. New opportunities can occur from protecting the natural environment and reduces our GHG emission (Ministry of Transportation Ontario's, 2009).

Methodology

The researcher has used secondary data to carry out this piece of research. Some of the reasons that lead to secondary data and not primary

source, there is not much literature on the context of GHG emission even at the federal government of Nigeria level talk less on private sector in the country. Therefore, the researcher has used Intended Nationally Determined Contributions (INDCs) documents submitted by Federal Republic of Nigeria, International Panel on Climate Change (IPCC), UN Framework Convention on Climate Change (FCCC) in 1994 ratifying its Kyoto Protocol in 2004, U.S. National Academy of Sciences and other few journals on GHG emission mitigation in Nigeria. Nigeria is one of the African countries that are located in West Africa which is the most populated country in the entire Africa, with about 155 million people in 2011, about one-sixth of the entire continent. The country is predicting to be among strongest 20 economic countries in the world and therefore call for GHG emission mitigation is equally important before the scenario of negative impact on climate change become out of control.

Results and Discussion

Transportation system is one of the organs of any developed or developing nation which cannot do without it. The functionality of any sector in the world will never be operated efficiently without good existence of transport. Movement of goods, services and companies rely on transportation activities to make their function are all part of transport family. Therefore, human being cannot adopt full live without transportation system and at the time transportation system is one of the major contributor of greenhouse gas emission that create a lot of negative impact in our planet. From what is happening today and base on experience, live is not complete without transportation system. Since we cannot escape from this sector, there is need to improve how transportation system carry out their day to day activities including other companies that rely

their function on transport to reduces this greenhouse gas emission to our planet. There are a lot practices adopted in the world with the intention of mitigation the greenhouse gas emission in transportation activities to our planet such as improvement of technology, human behavior, changing of fuel technology among other.

Nigeria has been actively engaged in international climate policy negotiations since it became a Party to the UN Framework Convention on Climate Change (FCCC) in 1994 ratifying its Kyoto Protocol in 2004. Nigeria submitted its First National Communication (FNC) in 2003 and a Second National Communication in February 2014. Nigeria is host to a number of Clean Development Mechanism projects, as well as projects financed by the Adaptation Fund. In September 2012, the Federal Executive Council approved the Nigeria Climate Change Policy Response and Strategy. Recently, His Excellency, President Muhammadu Buhari, The President of the Federal Republic of Nigeria on 26 November 2015, approved the Nigeria INDC. According to the World Climate Change Vulnerability Index, published by the global risk analytics company Verisk Maplecroft in 2014, Nigeria has been classified as one of the ten most vulnerable countries in the world. Secondly, Nigeria's economy and population are both growing rapidly, and the population is attaining a higher standard of living. This growth will have a strong impact on future emissions.

A recent government study determined vulnerability across Nigeria's geographical regions, focusing on the three principal determinants of vulnerability. The relative vulnerability of the six geopolitical zones of Nigeria shows that the three northern zones illustrate higher vulnerability than those in the south. This reflects the higher rainfall and socio-

economic development of the south. The south-south shows highest relative variability among the three southern zones, reflecting the challenges of coastal flooding and erosion, as well as the impact of petroleum exploration and exploitation in that part of the country. The southwest is least vulnerable, the northeast, on the other hand, is most vulnerable. Understanding these spatial vulnerabilities is crucial to shaping climate-resilient development in Nigeria. Therefore, Nigerian has understood and experienced the negative impact of GHG emission to our planet. The submission of Intended Nationally Determined Contributions (INDCs) by the Nigeria government is a positive movement in supporting the international community in trying to reduce or mitigates greenhouse gas emission to our planet. So far Nigeria is at the phase 1 of the INDC submitted documents that is not more preparation and planning of the implementation stage. Nevertheless, Nigeria government were able to introduced regulation as start and short term GHG emission mitigation related to engine technology, prohibiting the import of two-stroke motorcycles and adopting Euro 2 standards as a minimum for all vehicles imported or sold from the end of 2011 (FGG 2011) although import of large numbers of these high-polluting three-wheelers prior to the ban means that they are wide- spread in many parts of the country. The existing vehicle fleet is made up of aging, high-polluting vehicles, majority imported from western countries only when they approach the end of their economic life. Cars up to 8 years old can be imported, trucks younger than 15 years can also be imported and buses less than 10 years old as well. The assessment of mitigation measures start by Nigeria government is too early mention due to the lack of comprehensive data and measuring mechanism on GHG emission in the country. Therefore, the researcher looks as progress to Nigeria government and Nigerian

citizens as well in term of GHG emission mitigation or control.

Conclusion

Greenhouse gas emission has become a global issue which requires much attention and cooperation among the developed or industrialised nations and developing countries as well in order to reduce its impact on our planet. Nigeria has been actively engaged in international climate policy negotiations since it became a Party to the UN Framework Convention on Climate Change (FCCC) in 1994 ratifying its Kyoto Protocol in 2004. Recently, His Excellency, President Muhammadu Buhari, The President of the Federal Republic of Nigeria on 26 November 2015, approved the Nigeria INDC documents submitted in the Paris climate summit in December 2015 as a support and participation on the international effort in trying to mitigate the negative impact on GHG emission as a result of the human activities and in particular on transport sector as a major contributor. This paper has found that the initiative of the Federal Republic of Nigeria on GHG emission mitigation on transportation sector can bring some changes as per as the phase 1 of the INDC documents is concern. It is too early and difficult to obtain reason data collected on GHG emission on transport that can be access on the implementation of the INDC official documents submitted by the Federal Republic of Nigeria.

Secondly, almost all the parameters used in determining the level or intensity of GHG emission by country or sectors are being aided and access by the international mechanism. Thirdly, there are still shortages of skills personals or experts on transportation sector in Nigeria that can give correct figures on the intensity or amount of GHG emission mitigation achieve based on the INDC documents submitted by Federal Republic of Nigeria. Lastly but not the

least, according to the World Climate Change Vulnerability Index, published by the global risk analytics company Verisk Maplecroft in 2014 which Nigeria is involved, most of transport agencies staff are not involved in this GHG emission mitigation business. Nevertheless, Nigeria will achieve its goal on states, regions; national and international standards as far as these phases of INDC official documents submitted by Nigeria government in the Paris climate summit in December 2015 will be fully adopted and implemented.

Recommendation

According to the literature review on climate change mitigation in Nigeria and the researcher view, the following points must be adopted with respect to climate change mitigation in Nigeria to achieve the objectives:

- Nigeria government cannot fully implement the climate change mitigation as require by industrialised nations without the international funding aid.
- There is need for Nigeria government to provide its GHG emission level by the cars.
- There is need for the Nigeria government to provide the measuring mechanism that will provide precise data on the GHG emission emitted by transport.
- In cooperating key transport actors is essential for achieving the goals in transport sector.
- Special budget should be arrange for climate change mitigation in Nigeria
- Private sector participation and investment into climate change opportunities.
- Climate change mitigation is not an issue of single handle responsibility but need the involvement of 36 states and 774

local government areas in the country for the achievement of the goals.

- Transport authorities must be involves in GHG emission policies and planning for the success of the programmes.
- Nigeria need more transport expert on climate change mitigation for precise and available data.
- There is need for Nigeria government to adopt the international climate change mitigation practices around the world.

References

- British Standard (2010) Principle and Guideline for the Management of Projects: Guide for Construction London.
- Commission on Sustainable 9 and 18 (2000 and 2010) Regional Environmentally Sustainable Transport Forum for Latin American Region Rio de Janeiro.
- Federal Government Gazette (2011) National Environmental: Control of Vehicular Emissions Petrol and Diesel Engines Regulations. Abuja Nigeria.
- Federal Ministry of Environment (2010) Special Climate Change Unit: National Environmental, Economic and Development Study (Needs) for Climate Change Abuja Nigeria.
- Greene, Baker Jr, Steven and Plotkin (2011). Reducing Greenhouse Gas Emissions from U.S. Transportation. Pew Center on Global Climate Change.
- Jeon, C., M. (2005) definitions, Indicators and Metrics: Addressing Sustainability in Transportation system Spriger -Verlag GimbH Berlin Germany.
- Joseph, S. (2000) Institute of Civil Engineers: Integrated Transport Policy JISC Journal UK HE and FE Institutions and Research Councils...
- Löhr, Perera, Hill, Bongardt and Eichhorst (2017) Transport in Nationally Determined Contributions (NDCs): Lessons learnt from case studies of rapidly motorising countries Synthesis Report Bonn Germany.
- Ministry of Transportation Ontario's, (2009) Sustainability: Sustainability Strategy Ontario, Canada.
- Organization for Economic Co-operation and Development (2012) Toward a Green Investment Policy Framework: Mobilizing Private Investment in Sustainable Transport; Better policies for better lives Canada.
- Raji, (2017) Green Transportation: Controlling Obnoxious Emissions: National Environmental Standards And Regulations Enforcement Agency (NESREA) Ilorin Nigeria.
- Renukappa, S. (2013) Climate Change and Transport Infrastructure Sector. Wolverhampton University (lecture)
- The Climate Group (2009) Breaking the Climate Deadlock: Technology for a Low Carbon Future. The office of Tony Blair: Tomlinson.
- United Nations Environment Programme, Green Economic Review (2011) Sustainable, resource efficient cities: Making it happen Green Economic Review.

Interactive Effects of Crude Oil Price and Exchange Rate on Economic Growth in Nigeria

¹Ali Kole, ²Mohammed Girgir & ³Abba Muktar

^{1,2}Department of Marketing, Mai Idris Aloomo Polytechnic, Geidam, Yobe state, Nigeria.

³Department of Public Administration, Mai Idris Aloomo Polytechnic, Geidam, Yobe state, Nigeria.

Corresponding author: Ali Kole: e-mail: kolegursulu@gmail.com.

ORCID: <https://orcid.org/0000-0003-3033-8144>

Abstract.

This study examined the interactive effects of crude oil price and official exchange rate on economic growth in Nigeria. The estimation was carried out on annual time series data spanning from 1986 to 2021 with the aid of ARDL model. The data for the study were sourced from World Bank Database and Statistical Bulletin of the Organisation of Petroleum Exporting Countries (OPEC). Two distinct but interwoven models were estimated. Findings from model 1 and model 2 show evidence of co-integration. The results from model 1 further revealed that crude oil price and official exchange rate have significant and positive relationship with economic growth in the long-run period. In the short-run, only crude oil price has significant and positive relationship with economic growth. However, model 2 result shows that the interaction between crude oil price and official exchange rate have significant and positive influence on economic growth both in the short-run and long-run periods. The long-run results were corroborated by the robustness check conducted using Robustness Least Square (RLS). However, ARDL model 1 result shows only a significant evidence of short-run negative relationship between rate of inflation and economic growth in Nigeria during the study periods. Though, findings from RLS did show a significant and negative long-run relationship between inflation rate and economic growth in Nigeria.

The study recommends that policy makers in Nigeria should enact policies, programs and exercise the needed commitment to change the narrative from mono-cultural economy that hugely depend on oil export to a diversified export-oriented economy. These can be achieved through increased investment in mechanised agriculture and industrialisation. Government should encourage private investment in local refineries as an antidote for subsidy removal and a remedy for draining huge forex from the importation of refined oil. It is hope that this will increase Nigeria's foreign exchange earnings thereby appreciating foreign exchange rate of the Naira, attaining a unified foreign exchange rate and subsequently achieving a sustained economic growth.

Keywords: Economic Growth, Crude Oil Price, Official Exchange Rate, Inflation Rate, ARDL Model.

Introduction

Crude oil has been recognised as one of the most important natural resources endowment on earth. Crude oil drives the global economy such that any changes in its prices have direct or indirect bearing on the economic growth and standard of living of people around the globe. The ongoing conflict between Russia and Ukraine further vindicated the important of crude oil in the global economic stage where the conflict led to a dramatic increase in crude oil prices with attendant consequences on the global economy. The conflict further buttressed that crude oil prices are usually volatile and this poses a great advantage on one side and high risk on the other side to countries dependent on oil in running their fiscal finances. During oil boom, resources endowed countries may rely upon the revenue from oil to propel the growth and development of their economies. The proponent of staple theory assert that poor but resource abundant economies have the potential to utilise oil income to overcome the challenges of lower capital base and to provide public goods in order to uplift the general wellbeing of their citizenries (Oyefusi, 2007). Eregba and Mesagan (2016) reported that crude oil is one of the keys to country's growth and development. Fascinatingly, some oil resources countries especially in the developed countries have used oil income in the provision of infrastructures, and social security that improves the general wellbeing of their people. Despite the role played by oil resources in facilitating economic growth and development, theories and empirics from 1980's to the recent time provided a contrary evidence especially in developing countries. For instance, in Sub-Saharan Africa, the huge resources endowment could potentially have been used to providing infrastructures and social security but exchange rate volatility, corruption and inability to save oil money during rainy days to cushion the effect of capital flight have continued to kneel down the African economy for years.

This study will particularly focus on Nigeria where crude oil remained the major source of foreign exchange earnings to the government. Recently, Nigeria's crude oil production had suffered a huge setback ranging from the effect of covid-19 pandemic, the ongoing conflict in Ukraine to the activities of oil theft in the Niger Delta. Covid-19 pandemic plunged the global economy into recession where Brent crude oil price fell down from \$63.65 per barrel in January, 2020 to its lowest ebb of \$18.38 per barrel in April, 2020. The ongoing conflict in Ukraine rose the prices of crude oil from \$97.13 per barrel in February, 2022 to \$117.25 per barrel in March, 2022 which Nigeria have the potential to raise its foreign exchange earnings from its OPEC production quota of 1.8M barrel per day. Unfortunately, the activities of oil theft in the Niger Delta brought a significant reduction in crude oil production. Recently, crude oil production fell from 1.183M barrel per day in July, 2022 to an unprecedented low ebb of 937,766 barrel per day in September, 2022 indicating a decline of 245,234 barrel per day just in the span of two months. During same period, Nigeria battle with higher refined oil subsidy payment resulting from upsurge in the prices of refined oil in the global market amidst dwindling crude oil revenue occasioned by low production in the Niger Delta. For example, oil subsidy dramatically rose from \$3.8Billion in 2021 to \$6.2Billion in the first quarter of 2022.

In Nigeria, the dwindling foreign exchange earnings have been exacerbating the exchange rate crises making it difficult for the monetary authority to maintain her official exchange rates let alone to narrow the margin between the official exchange rate and parallel market rates. For example, the official exchange rate fell from 419.973 per USD in August, 2022 to 428.750 in September, 2022. Therefore, the objective of this study was to examine the effect of crude oil price and exchange rate on economic growth in Nigeria. this study is particularly significance in terms of unravelling the challenges posed by crude oil price shocks

and its interaction with exchange rate volatility on economic growth in Nigeria which was not explicitly examined in the literature. The interactive role of crude oil price and exchange rate cannot be underscored in the open macroeconomic environment like Nigeria. The outcome of this study will also help in providing enabling environment for investment flows in the oil sectors. Also, the research output will be relevant to researchers that are interested in expanding the research frontiers in the area under study and it equally equip policy makers in the local and international economic space with adequate policy tools in dealing with such issues in the oil and gas sector. Rest of the paper anchored on review of related literature, methodology, results and discussion while the last section focused on conclusion and policy recommendations.

Review of Related Literature

In the literature, the relationship between crude oil price and economic growth as well as exchange rate and economic growth were extensively examined in Nigeria. However, the interactive roles of crude oil price and exchange rate have not been studied and is the major gap which this study seeks to bridge. In the perspective of oil price, exchange rate and economic growth nexus, Isola, et al. (2016) applied ARDL model on data spanned from 1980 to 2013 to examine the exchange rate fluctuation and Nigeria economic growth. The study found that exchange rate fluctuation has effect on economic growth only in the short-run but not in the long-run. Similarly, Magaji and Singla (2020) used ARDL model and investigated the impact of oil price shocks on exchange rate and economic growth in Nigeria on annual time series data from 1981 to 2019. The study reported that oil price had significant positive relationship on economic growth both in the short run and long-run. However, the study does not establish long-run relationship between oil price and exchange rate. Daniel (2021) examined the asymmetric relationship of exchange rate and inflation on economic

growth in Nigeria using annual data from 1981 to 2020. After applying a NARDL, the study found that in the long-run, exchange rate positively affects economic growth. To examine the asymmetric effect of oil price on exchange rate and stock price in Nigeria, Ajala, Sakanko and Adeniji (2021) employed Nonlinear Autoregressive Distributed Lag (NARDL) model on a monthly time series data from 1996:01 to 2020:09 and the study revealed that changes in oil price impacted asymmetrically on the exchange rate and stock price both in the short-run and long-run.

Musa, et al. (2019) investigated the impact of crude oil price and exchange rate on economic growth in Nigeria using an ARDL model from 1982 to 2018. The result found that crude oil price and exchange rate have significant positive impact on economic growth in both the long-run and short-run periods. Nitami and Hayati (2021) investigated the effects of crude oil price fluctuations on economic growth, inflation and exchange rate in Indonesia using annual time series data from 1967 to 2019. The study employed VAR/VEC method and the results revealed that oil price fluctuations had significant positive effect on economic growth in the long-run but exert a significant negative impact on inflation and exchange rate in the long-run. Manyo and Ugochukwu (2017) investigated the impact of exchange rate volatility on economic growth in Nigeria using time series data covering from 1981 to 2015. GARCH (1, 1) result found a persistent volatility of the Nigerian Naira against the US Dollar. In contrary, the results from the GMM revealed a significant negative impact of exchange rate and FDI on economic growth in Nigeria. However, government expenditure and external reserve had significant positive impact on economic growth in Nigeria. To explore the impact of crude oil volatility on exchange rate in Nigeria, Henry (2019) used ARDL model on data spanning from 1986 to 2015 and found that oil price had significant negative effect on exchange rate in the long-run. Bidemi, (2019) investigated exchange rate variation and

economic growth in Nigeria using annual time series data from 1981 to 2018. The result from the ARDL model revealed that exchange rate variation had significant positive effect on economic growth in the long-run but negative in the short-run. Also, exchange rate had significant negative effect on economic growth both in the short-run and long-run. Nweze and Edame (2016) empirically studied oil revenue and economic growth in Nigeria using annual time series data from 1981 to 2014. The study applied Johansen Cointegration test and Vector Error Correction Mechanism. The study found the existence of cointegration between economic growth and the explanatory variables except government expenditure. The result further showed that oil revenue is significant and positively related with economic growth in the long-run but negative in the short-run. In examining the dynamic nexus between oil revenues and economic growth in Nigeria, Aminu and Raifu, (2019) applied Non-Linear Autoregressive Distributed Lag (NARDL) model, Autoregressive Distributed Lag (ARDL) model, and Threshold Autoregressive Error Correction Model (TAR-ECM) on a data spanning from 1981 to 2016. The results found a long-run relationship between oil revenues and economic growth. Also, the results from ARDL, NARDL and TAR-ECM showed significant positive relationship between oil revenue and economic growth both in the short-run and long-run. Aragbeyen and Kolawole, (2015) examined the relationships among oil revenue, government spending and economic growth in Nigeria using annual data from 1980 to 2012. The study employed OLS, VECM and Granger Causality test. The results revealed that oil revenue granger caused economic growth in the period under study. Also, the relationship between oil revenue and economic growth is significant and positive both in the short-run and long-run. Ikue, et al. (2021) investigated the impact of oil revenue and the activities in the oil industry on per capita income of Nigerian from

1980 to 2019. The study used ARDL model and the result found a positive and significant impact of oil revenue on economic growth both in the short-run and long-run.

It can be deduced from the empirical literature that there was a mixed result on the relationship between oil price and exchange rate on economic growth in Nigeria. However, the theoretical postulation of the relationship between oil price and economic growth on one hand and exchange rate and economic growth on the other hand is positive and direct.

Methodology

This study employed annual time series data from 1986 to 2021. The data were sourced from World Bank Database and Organization of Petroleum Exporting Countries (OPEC). The study used Autoregressive Distributed Lag (ARDL) Model to determine both the long-run and short-run relationship among the variables in the models. Economic growth is the dependent variable and was proxy by Gross Domestic Product (GDP) at constant US\$ 2010. The explanatory variables were Crude Oil Price, COP (USD per barrel), Official Exchange Rate, EXR (USD per LCU), Interaction between Crude Oil Price and Official Exchange Rate (COP*EXR), and Inflation rate (INF).

Two distinct but interwoven models were estimated. Model 1 separately estimated the effects of crude oil price and official exchange rate on economic growth in Nigeria while model 2 estimated the interactive effects of crude oil price and official exchange rate on economic growth in Nigeria. The econometric form of the model is in the spirit of Musa, et al. (2019) but differs in its explicit consideration of the interactive effects of crude oil price and exchange rate on economic growth which has not been previously examined in the literature. The models were expressed in a simple log-linear form as shown below:

$$\ln GDP_t = \alpha_1 D(\ln COP)_{t-p} + \alpha_2 D(\ln EXR)_{t-p} + \alpha_3 D(\ln INF)_{t-p} + c_1 + \varepsilon_{1t} \dots \dots \dots 3.1$$

$$\ln GDP_t = \beta_1 D(\ln COP * EXR)_{t-p} + \beta_2 D(\ln INF)_{t-p} + c_2 + \varepsilon_{2t} \dots \dots \dots 3.2$$

Where; $\ln GDP_t$ stand for natural log of Gross Domestic Product, $\ln COP_t$ is the natural log of Crude Oil Price, $\ln EXR_t$ is the natural log of Official Exchange Rate, $\ln COP_t * EXR_t$ stand for the natural log of the interaction between Crude Oil Price and Official Exchange Rate, and :

$$\Delta y_t = \beta Z_{t-1} + \sum \delta_i \Delta Z_{t-i} + Bx_t + c_0 + \varepsilon_t \dots \dots \dots 3.3$$

Where, Δ is first difference operator, Z_t is a vector of both x_t and y_t , y_t is $k \times 1$ vector of dependent variables, x_t is $k \times k$ matrix representing a set of explanatory variables, t is time trend, β is long run multiplier matrix, δ_i is

$$\beta = \begin{pmatrix} \beta_{yy} & \beta_{yx} \\ \beta_{xy} & \beta_{xx} \end{pmatrix} \dots \dots \dots 3.4$$

Therefore, the selected series can be either I(0) or I(1) such that if $\beta_{yy} = 0$, then y_t is I(1). However, if $\beta_{yy} < 0$, then y_t is I(0). This is because the diagonal elements of the matrix are unrestricted (Pesaran, Shin and Smith, 2001). Note that the ARDL bound test for cointegration was used because of its advantages over other test of cointegration. Notably, the ARDL approach can be used irrespective of the order of integration of the variables. Thus, it can be applied whether the variables are integrated of I(0), I(1) or fractionally integrated. Secondly, it gives unbiased estimates of the long run model. Thirdly, it can be used efficiently and

$\ln INF_t$ stand for natural log of Inflation rate and α_{jIS} , and β_{jIS} , are coefficients, ε_{jIS} are error terms, c_{iIS} are constants.

Therefore, the general form of VAR is given as follows

short run coefficient matrix, c_0 is constant and ε_t is $k \times 1$ vector of innovation. Also, the long run multiplier matrix can be re-written as follows

conveniently under a small and finite sample data size. Lastly, ARDL bound approach yield a consistent estimates of the long run coefficients that are asymptotically normal whether or not the regressors are I(0) or I(1) (Pesaran and Shin 1997).

After ascertaining the existence of cointegration between the variables included in the models, the ARDL approach was used to estimate the coefficient of short run Unrestricted (conditional) error correction model otherwise known as Over parameterized model and the corresponding Error Correction Term (ECT) specified as follows.

$$\ln GDP_t = \alpha_1 D(\ln COP)_{t-p} + \alpha_2 D(\ln EXR)_{t-p} + \alpha_3 D(\ln INF)_{t-p} + c_1 + \theta_1 (ECT_{t-1}) + \varepsilon_{1t} \dots \dots \dots 3.5$$

$$\ln GDP_t = \beta_1 D(\ln COP * \ln EXR)_{t-p} + \beta_2 D(\ln INF)_{t-p} + \theta_2 (ECT_{t-1}) + \varepsilon_{2t} \dots \dots \dots 3.6$$

θ_1 and θ_2 are magnitude of error corrected each period. To achieve long run equilibrium, these values must be negative and statistically significant. ECT_{t-1} is Error Correction Term

and defined as the speed of adjustment which will converge the disequilibrium in the short-run into equilibrium in the long run. The diagnostic checks conducted include serial

correlation, heteroscedasticity, normality test, specification test and stability test.

Results and Discussion

This study began the estimation by testing the time series properties of the variables (lnGDP, lnCOP, lnEXR, lnCOP*EXR, lnINF) included in the models. Specifically, the Augmented Dickey Fuller (ADF) and Phillip Peron (PP) tests were applied to find out whether the basis for using ARDL had been established. That is,

whether the variables are of order 1(1), 1(0) or mixed. Table 1 depicts the results of the unit root test and all the variables are integrated at first difference 1(1) except log of inflation rate (lnINF) which was integrated at level 1(0). The unit root test results for ADF and PP are similar which further corroborate the efficacy and reliability for the application of ARDL model.

Table 1. Unit root test using Augmented Dickey Fuller (ADF) and Phillip Peron (PP) test

Variables	Level		First Difference		1(d)
	ADF	PP	ADF	PP	
	const. & trend	const. & trend	const. & trend	const. & trend	
lnGDP _t	-1.735 (0.7143)	-1.824 (0.6713)	-4.620 (0.0040)	-4.618 (0.0040)	1(1)
lnCOP _t	-1.978 (0.5928)	-1.978 (0.5928)	-5.366 (0.0006)	-5.363 (0.0006)	1(1)
lnEXR _t	-2.865 (0.1854)	-2.865 (0.1854)	-6.269 (0.0001)	-6.605 (0.0000)	1(1)
lnCOP _t *lnEXR _t	-2.449 (0.3499)	-2.449 (0.3499)	-5.273 (0.0008)	-8.083 (0.0000)	1(1)
lnINF _t	-3.715 (0.0344)	-3.720 (0.0340)	-	-	1(0)

Source: Eviews 12. Note, ***, **, & * stand for 1%, 5% & 10% levels of significance and values in the parenthesis are the P-values.

Having established the reliability for using ARDL model, the long-run relationship of the models were tested to ensure whether or not the variables co-move in the long-run. The result from table 2 shows the bound test of cointegration. The null hypothesis of no co-integration ($H_0: \alpha_1 = \alpha_2 = \alpha_3 = 0$) was tested against the alternative hypothesis of existence of co-integration ($H_1: \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq 0$). Table 2 results indicated that both model 1 and model 2 co-move in the long-run. In each case, the null hypothesis of no co-integration can be rejected within the study periods at 1% significance

level. Specifically, in model 1, the F-statistics of 10.635 exceeded the critical upper bound value of 4.66 at 1% significance level. This model implies that ln GDP co-moves with its regressors (lnCOP, lnEXR, lnINF) in the long-run. Similarly, the F-statistics value of 7.114 exceeded the critical upper bound value of 5 in model 2 at 1% significance level. This result vindicated the existence of long-run relationship between ln GDP and its regressors (lnCOP*EXR, lnINF).

Table 2. Bound test results

Models	F-statistics	Critical values	
		1(0)	1(1)
F(lnGDP/lnCOP,lnEXR,lnINF) K=3, n=32	10.635***	3.65	4.66
F(lnGDP/lnCOP*lnEXR,lnINF) K=2, n=32	7.114***	4.13	5

Source: Authors' computation using Eviews 12. Note that, *** implies 1% significance level.

Having established that both model 1 and model 2 have long-run relationship, the study estimated the long-run coefficients of the models. In table 3, the long-run estimates for model 1 shows the existence of significant positive relationship between economic growth and crude oil price, such that, a percentage increase in crude oil price leads to 0.976 or 98% increase in economic growth. This result shows that Nigerian economic growth relies heavily on crude oil price and it further shows that the economy is much depended on oil price. This result is consistent with previous studies by Musa et al. 2019; Magaji and Singla, 2020; Nitami and Hayati, 2021 whose studies equally found that increase in oil price accelerates economic growth in the long-run. Similarly, model one reported that official exchange rate was found to have a significant positive relationship with economic growth in the long-run. This is because a percentage increase in official exchange rate will caused economic growth to increase by 0.413 or 41%. This result vindicated the importance of appreciation of naira exchange rate against its foreign currencies in accelerating economic growth. This result coincides with findings by Henry,

2019; Musa et al. 2019 and Daniel, 2021. Nevertheless, this finding is not in line with the findings by Nitami and Hayati, 2021 whose study found that exchange rate brings about a decline in economic growth in the long-run. Model 1 result did not find any evidence on the significance of inflation rate in influencing economic growth in the long-run.

Model 2 results was also presented in table 3 where the long-run relationship between the interaction of crude oil price and official exchange rate with economic growth was estimated as positive and significant. This is because, a percentage increase in the interaction between crude oil price and official exchange rate will leads to 0.723 or 72% increase in economic growth in Nigeria at 1% significant level. This result clearly shows the significance of the interaction and this estimation has not been considered previously by other studies in Nigeria. Just like in model 1, model 2 result did not find the significance of inflation rate in influencing economic growth in Nigeria within the study periods.

Table 3. Estimated long-run results

Dependent variable, lnGDPt		
Regressors	Model 1	Model 2
Constant		
lnCOPt	0.976*** (13.038)	-
lnEXRt	0.413*** (12.859)	-
LnCOPt*lnEXRt	-	0.723*** (7.158)
lnINFt	-0.022 (-0.478)	0.264 (0.874)

Source: Author's computation using Eviews 12. Note that, the t-statistics are reported in parenthesis while ***, ** & * stand for 1%, 5% & 10% levels of significance respectively.

This study estimated the short-run relationship of the models in table 4. In table 4, model 1 result shows that crude oil price is significant and positively related to economic growth. The result shows that a percentage increase in crude oil price leads to 0.297 or 30% increase in economic growth. This result is similar to the long-run relation between crude oil price and economic growth in Nigeria during the study periods. This result is indifferent to the one reported by Musa et al. 2019 and Magaji and Singla, 2020. Unlike in the long-run, the short-run relationship between official exchange rate and economic growth is insignificant. However, the relationship between inflation rate and economic growth is negative and significant in the short-run. The short-run model 2 result is indifferent to its long-run. This

is because the interaction between crude oil price and official exchange rate leads to a significant positive increase in economic growth. Therefore, a percentage increase in the interaction between crude oil price and official exchange rate will exert a significant positive increase in economic growth by 0.20 or 20%. Similarly, like its long-run, the short-run effect of inflation rate on economic growth is insignificant as reported in model 2. The Error Correction Model (ECM) reported in table 4 for both model 1 and model 2 are significantly negative and are in line with their apriori expectations. The ECM results imply that the disequilibrium in the short-run will converge into equilibrium in the long-run at the speed of 48% and 29% for model 1 and model 2 respectively.

Table 4. Estimated short-run results

Dependent variable, $\Delta \ln \text{GDPT}$		
Regressors	Model 1	Model 2
$\Delta \ln \text{COPt}$	0.297*** (6.064)	-
$\Delta \ln \text{EXRt}$	0.090 (1.3112)	-
$\Delta \ln \text{COPt} * \ln \text{EXRt}$	-	0.201*** (4.748)
$\Delta \ln \text{INFt}$	-0.117*** (-3.575)	-0.058 (-1.563)
ECM (-1)	-0.478*** (-8.105)	-0.292*** (-5.762)

Source: Author's computation using Eviews 12. Note that, the t-statistics are reported in parenthesis while ***, ** & * stand for 1%, 5% & 10% levels of significance respectively.

The models were subjected to diagnostic checks in order to examine their healthiness and reliability for usage. This is because any unhealthy results are unfit for usage. The result of the diagnostic checks reported in table 5 shows that model 1 is free from autocorrelation. This is because the null hypothesis of no serial correlation cannot be rejected as the F-statistic is insignificant and thus we conclude that there is no serial correlation. Similarly, model 1 is free from heteroscedasticity problem as the null hypothesis of no heteroscedasticity in the BPG test cannot be rejected since the F-statistic is insignificant and therefore, we conclude that the model is homoscedastic in nature. Likewise, model 1 is normally distributed as the null hypothesis of not normally distributed can be rejected as the Jacque-Bera is insignificant. However, the Ramsey Reset result in table 5 shows that model 1 result is not correctly

specified as the null hypothesis of not correctly specified cannot be rejected at 10% significance level. The failure of model 1 to pass the specification test does not invalid the results since it has passed the rest of the diagnostic checks. Model 2 was also subjected to diagnostic checks and available evidences show that the model passed all the diagnostic checks. Obviously, as reported in table 5, model 2 is free from autocorrelation, since the null hypothesis of no serial correlation cannot be rejected. Also, model 2 is free from heteroscedasticity as the null hypothesis of no heteroscedasticity cannot be rejected as shown in the BPG test. Likewise, the model is normally distributed since the null hypothesis of not normally distributed can be rejected. In contrary to model 1, model 2 is found to be correctly specified since the null hypothesis of not correctly specified can be rejected. In all,

both model 1 and model 2 are healthy and could be relied upon in making policy analysis and prescriptions.

Table 5. Diagnostic test results

Variables	Model 1	Model 2
Serial Correlation LM test	1.807 (0.198)	0.023 (0.9776)
Heteroscedasticity (BPG test)	0.854 (0.6127)	1.004 (0.4858)
Normality test (Jarque-Bera)	0.336 (0.845)	0.761 (0.683)
Ramsey Reset test	3.469 (0.0810)*	0.919 (0.3511)

Source: Author's computation using Eviews 12. Note that, the p-values are reported in parenthesis while * stand for 10% level of significance.

To ensure the stability of the long-run relationship of the models, both model 1 and model 2 were subjected to stability test using CUSUM. The CUSUM test is based on the cumulative sum of recursive residuals on the number of a given observation. In figure 4.1,

the plot of the residual lies within a 5% critical band implying the long-run stability of model 1. Similarly, figure 4.2 shows the plot of the residual lying within a 5% critical band indicating the long-run stability of model 2.

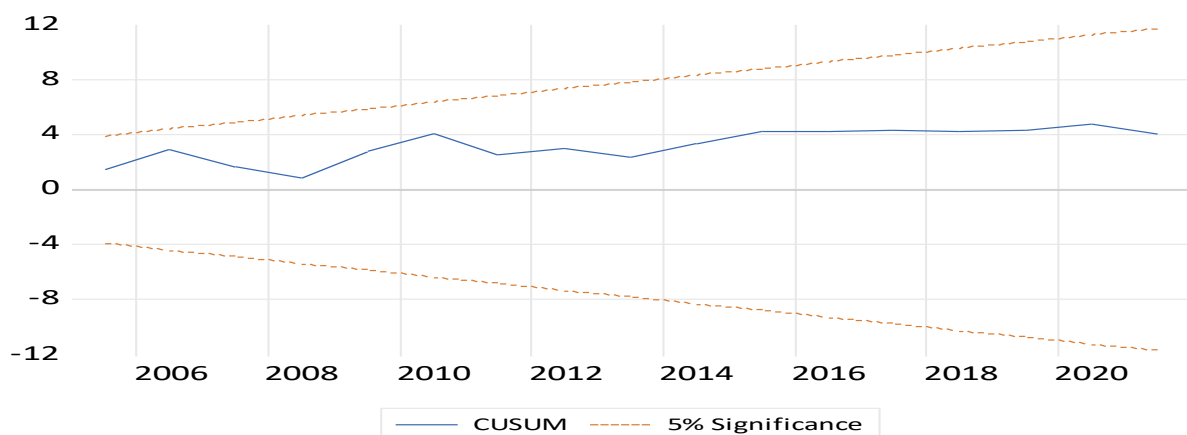


Fig. 4.1. CUSUM test for model 1

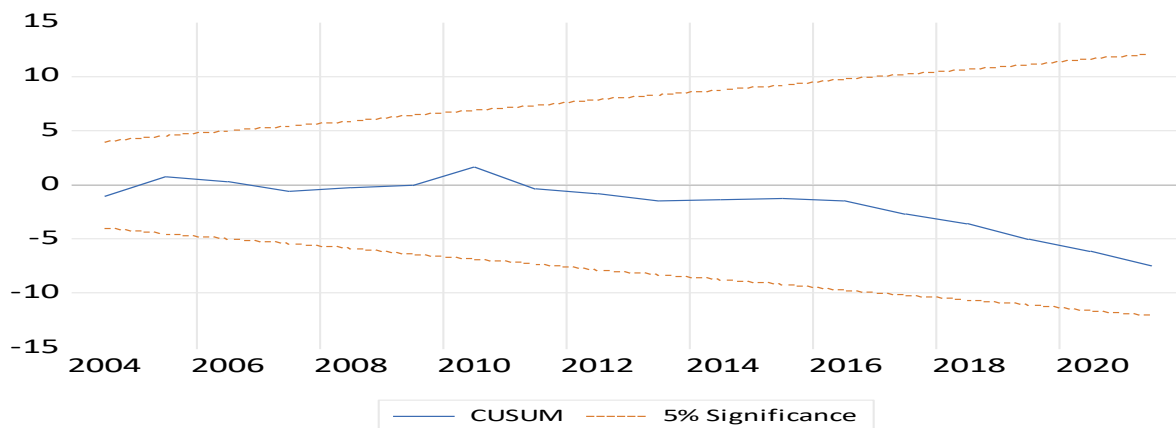


Fig. 4. 2. CUSUM test for model 2.

Robustness checks

To determine the robustness of the models used in the study, apart from the ARDL model, the long-run relationship of the models were estimated using Robustness Least Square (RLS). The results of the RLS was reported in table 6 and it shows that the long-run estimate is indifferent with what was obtained using ARDL model. This is because, in model 1, the long-run relationship between crude oil price and economic growth is significantly positive just similar to what was reported using ARDL. In the same vein, RLS result in model 1 shows that official exchange rate has a significant positive long-run relationship with economic growth. This is also in tandem with what was obtained using ARDL. In model 1, RLS result shows that inflation rate is insignificant and it was reported the same way using ARDL.

In model 2 as reported in table 6, the RLS long-run result shows that the interaction between crude oil price and official exchange rate is significantly positive. The same long-run relationship was reported for model 2 using ARDL. However, the only difference is with regard to the relationship between inflation rate and economic growth. The RLS result as reported in table 6 shows that inflation rate is significant and positive in influencing economic growth in the long-run. Therefore, a percentage increase in inflation rate leads to 0.149 or 15% increase in economic growth in the long-run in Nigeria during the study periods. In all, the ARDL model used in the study is reliably sufficient as attested by the results of the Robustness Least Square (RLS).

Table 6. Estimated long-run results using Robustness Least Square (RLS)

Dependent variable, lnGDPT		
Regressors	Model 1	Model 2
LnCOPt	1.144*** (12.189)	-
LnEXRt	0.170*** (2.714)	-
LnCOPEXRt	-	0.574*** (23.408)
LnINFt	0.011 (0.186)	0.149** (2.109)

Source: Author’s computation using Eviews 12. Note that, the standard errors are reported in parenthesis while ***, ** & * stand for 1%, 5% & 10% levels of significance respectively.

Conclusion and Policy Recommendations

In conclusion, this study investigated the interactive effects of crude oil price and official exchange rate in Nigeria covering periods from 1986 to 2021. The study employed ARDL model to estimate two distinct but interwoven models using data sourced from World Bank and OPEC. The stationary properties of the variables were tested and found to be of mixed integration of order 1(0) and 1(1) justifying the use of ARDL model. Evidence from the bound test results show that both model 1 and model 2 are co-integrated, implying the co-movement of the variables in the long-run. Other findings from model 1 show both long-run and short-run relationship between crude oil price and economic growth in Nigeria. However, official exchange rate had a significant and positive relationship with economic growth in Nigeria only in the long-run period. Findings from model 2 results revealed a significant and positive relationship between the interaction of crude oil price and official exchange rate in Nigeria in the long-run and short-run periods. However, neither model 1 nor model 2 results show any evidence of significant relationship between inflation rate and economic growth in the long-run. However, in the short-run, model 1 shows a significant negative relationship between inflation rate and economic growth in Nigeria. The ARDL results was corroborated by the results of the robustness check using Robustness Least Square (RLS). RLS results show evidence of a significant long-run negative relationship between inflation rate and economic growth in Nigeria within the study periods.

The results clearly revealed the huge dependent of Nigerian economy on crude oil price, hence, policy makers should increase the diversification drive of the economy from crude oil export to non-crude oil export such as mechanized agriculture and industrialization. The non-oil export drive should be supported by encouraging investment in domestic refineries to reduce the reliance on oil import that has been draining the

large chunk of Nigeria's foreign exchange earnings. More so, investment in local refineries will serve as an antidote for petroleum subsidy removal which has been the political nightmare of successive governments in Nigeria. If these recommendations are carefully undertaken, it will strengthen not only Nigeria's foreign reserve but also appreciate the Naira against foreign currencies. The recommendations will serve as an incentive to the monetary policy makers in enacting policies that will ensure the unification of the Naira foreign exchange rate and consequently leading to a sustained economic growth.

Funding

The authors did not receive any financial support for conducting the research, authorship and/or publication of this article.

Conflicts of Interest

The authors hereby declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Reference

- Ajala, Kamaldeen; Sakanko, M.S., & Adeniji, S.O. (2021). The Asymmetric Effect of Oil Price on Exchange Rate and Stock Price in Nigeria. *International Journal of Energy Economics and Policy* 11(4), 202-208.
<https://doi.org/10.32479/ijeep.10977>
- Aminu, A., & Raifu, I.A. (2019). Dynamic Nexus between Oil Revenues and Economic Growth in Nigeria. *Economics Bulletin*. 39(2), 1556-1570.
- Aregbeyen, O., & Kolawole, B.O. (2015). Oil Revenue, Public Spending and Economic Growth Relationships in Nigeria. *Journal*

- of Sustainable Development. 8(3), 1913-9071.*
- Bidemi, O.J. & Chioma, G.A.C. (2019). Exchange Rate Variation and Economic Growth in Nigeria. *International Journal of Management and Economic. 1(3), 01-04.*
- CBN Statistical Bulletin (2022). Central Bank of Nigeria Database. *A Publication of the CBN.*
- Daniel, A.A. (2021). Economic Growth and Exchange Rate Dynamics in Nigeria. *Imo State University Business and Finance Journal. 12(1) 36-48.*
- Henry, T.H. (2019). Impact of Oil Price Volatility on Exchange Rate in Nigeria. *International Journal of Research and Innovation in Social Science. 3(2), 2454-6186.* www.rsisinternational.org
- Ikue, N.J., Amabuiké, L.I., Denwi, J.O., Muhammed, A.U., & Musa, A.U. (2021). Economic Growth and Crude Oil Revenue in Nigeria: A Control for Industrial Shocks. *International Journal of Research in Business and Social Science. 10(8), 218-227.*
- Isola, L.A., Oluwafunke, A.I., Victor, A. & Asaleye, A. (2016). Exchange Rate Fluctuation and the Nigerian Economic Growth. *EuroEconomica 2(35) 1582-8859.*
- Kole, A. (2020). Trilemma Policy Paths and Real Output Nexus in Nigeria. *International Journal of New Economic and Social Science. Vol.*
- Magaji, M., & Singla, S. (2020). The Impact of Oil Price Shocks on Exchange Rate and Economic Growth in Nigeria. An ARDL Bound Test Cointegration Approach. *Journal of Economic and Environment. Vol 1(2).* [https://doi.org/10.47277/JEE/\(1\)16](https://doi.org/10.47277/JEE/(1)16)
- Musa, K.S., Maijama'a R., Shuaibu, H.U., & Muhammad, A. (2019). Crude oil price and Exchange Rate on Economic Growth: ARDL Approach. *Open Access Library Journal. 6, e5930.* [https://doi.org/10.4236/oalib.1105930.](https://doi.org/10.4236/oalib.1105930)
- Nitami, S.A., & Hayati, B. (2021). Relationship between Crude Oil Price Fluctuations, Economic Growth, Inflation and Exchange Rate in Indonesia. *AFEBI Economic and Finance Review. 6(2)*
- Nweze, N.P., & Edame, G.E. (2016). An Empirical Investigation of Oil Revenue and Economic Growth in Nigeria. *European Scientific Journal. 12(25)1857-7881.*
- OPEC Annual Statistical Bulletin (2022). OPEC Reference Basket (ORB) and Corresponding Components Spot and Prices (\$/b).
- Pesaran, M. H., & Shin, Y. (1997). "An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis". First Version: February, 1995, Revised: January, 1997.
- Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). "Bounds Testing Approaches to the Analysis of Level Relationships." *Journal of Applied Econometrics.*
- Sabina, N.E., Manyo, T.S., & Ugochukwu, U.S. (2017). Modelling Exchange Rate Volatility and Economic Growth in Nigeria. *Nobel International Journal of Economic and Financial Research. 2(6), 88-97*

World Bank Group (2022). World Bank Open
Data for Nigeria. Washington D.C. USA.
www.macrotrends.net

Occupational Stress and Its Effects on Organizational Performance in Higher Education Institution of Yobe State

(Case Study of Mai Idris Aloomaa Polytechnic, Geidam)

Alhaji Umar Alhaji Mallum¹, Mohammed Zannah² Abdullahi Ahmed Tahir³,

Abubakar Usman .A⁴, Saidu Ali⁵,

umarmallum@gmail.com

¹⁻³Department of Business Administration and Management

⁴Department of social development

⁵Fane-Fane Library

Mai Idris Aloomaa polytechnic Geidam yobe state

Abstract

The study investigated and evaluated occupational stress and its effects on organizational performance on how work-related stress could affect the productivity of staff of Mai Idris Aloomaa Polytechnic in the it identified convinced factors which contribute occupational stress among staff of the Polytechnic. The systematic sampling technique was used to select 141 participants the study. The result of this study exposed that workload was the major grounds of occupational stress among staff of this polytechnic. It was supplementary observed that respondents, in order to relieve stress often walk around and visit other colleagues in their offices to discuss matters unrelated to work in so doing affecting productivity at the polytechnic. Health-wise, some members of the staff of the polytechnic had developed chronic back pain as result of long sitting hours at work. Management commitment to employee-related issues such as paying attention to workload conflict, supervisors' recognition of outstanding output of the staff and the overture of proper stress management training program were perceived as significant steps which if embraced, were identified as major contributory factors that could contribute to improve productivity of staff and heighten output of the staff.

Keyword: work-related, workload, occupational, stress, performance

Introduction

Workplace stress has become an observable fact experienced by many employees in the region of the globe. The reasons for this can be accredited to the increasing wave of globalization, the forceful and competitive business environment, amongst other factors. In view of the fact that the consistent performance of any organization depends on the on the whole wellbeing of its employees, the area under discussion of workplace stress requires urgent investigation.

Stress is a universal element experienced by employees around the globe. Stress has become a major problem for employers particularly in developing nations where the employer doesn't realize the impact of stress on employee performance which ultimately results in critical managerial dilemmas (Shakil, 2010). Occupational stress has been of great apprehension to the management, employees, and other stakeholders of organizations. Occupational stress researchers agree that stress is a serious problem in many organizations (Cooper, C. L. and Cartwright, 1994), (Varca, 1999), and (Ornelas, S. and Kleiner, 2003) Occupational stress is defined as the perception of a discrepancy between environmental demands (stressors) and individual capacities to fulfill these demands (Topper, 2007), (Vermunt, R. and Steensma, 2005), (Ornelas, S. and Kleiner, 2003) and (Varca, 1999). (Topper, 2007) defines stress as a person's psychological and physiological response to the perception of demand and challenge. (Christo, B. and Pienaar, 2006) for example, argued that the causes of occupational stress include perceived loss of job, and security, sitting for long periods of time or heavy lifting, lack of safety, complexity of repetitiveness and lack of autonomy in the job. In addition, occupational stress is caused by lack of resources and equipment; work schedules (such as working late shifts or overtime) and organizational climate

are considered as contributors to employees stress. According (Malta, 2004), occupational stress is defined as any discomfort which is felt and perceived at a personal level and triggered by instances, events or situations that are too intense and frequent in nature so as to exceed a person's coping capabilities and resources to handle them adequately.

In addition, occupational stress is caused by lack of resources and equipment, work schedules such as working late or overtime and organizational climate are considered as contributors to employees stress. Occupational stress often shows high dissatisfaction among the employees, job mobility, burnout, poor work performance and less effective interpersonal relations at work (Manshor, A. T., Rodrigue, F. and Chong, 2003). (Johnson, 2001) similarly argued that interventions like identifying or determining the signs of stress, identifying the possible causes for the signs and developing possible proposed solutions for each signs are required. Therefore, this research will try to find out the effects of stress on occupational stress on job performance and interventions that can be applied by management and employees to manage stress effectively at Mai Idriss Aloomaa polytechnic, Geidam. To acquire a deeper understanding of the variables (occupational stress) we will first consider the broader topic of stress in general and then zero in on the variables within the context of Mai Idriss Aloomaa Polytechnic, Geidam Yobe State. Sources of stress according to (G, 2001) stress can be experienced from four basic sources.

The Environment- the environment can bombard you with intense and competing demands to adjust. Examples of environmental stressors include weather, noise, crowding, pollution, traffic, unsafe environment, substandard housing and crime.

Social Stressors- we can experience multiple stressors arising from the demands of the

Occupational Stress and Its Effects on Organizational Performance in Higher Education Institution of Yobe State

different social role we occupy, such as parent, spouse, caregiver and employee. Some examples of social stressors include deadlines, financial problems, job interviews, presentations, disagreements, demands for your time and attention, loss of a love once, divorce and co-parenting.

Physiological- situation and circumstances affecting our body can be experienced as physiological stressors. Examples of physiological stressors include rapid growth of adolescence, menopause, illness, aging, giving birth, accidents, lack of exercise, poor nutrition and sleep disturbances. Thoughts your brain interprets and perceives situations as stressful, difficult, painful or pleasant. Some situations in life are stress provoking, but it is our thought that determines whether they are a problem for us.

Types of stressors

Situations that are considered stress provoking are known as stressors. Stress is not always a bad thing. Stress is empty the body response to change that create taxing demands. Many professionals suggest there is a difference between what we perceive as positive stress and distress which refers to negative stress. In daily life, we often use the term stress to describe negative situations. This lead person to believe that all stress is bad for you, which is not true. (Ornelas, S. and Kleiner, 2003). **Positive stress** has the following characteristics: motivates focuses energy is in short term, is perceived as within our coping abilities, feels exciting and improves performance. In contrast, **negative stress** has the following characteristics: causes anxiety or concern , can be short or long term and is perceived as outside of our coping abilities, feeling unpleasant, decreases performance, can lead to mental and physical problem. It is somewhat hard to categorize stressors into objective list of those that cause positive stress

and those that cause negative stress, because different people will have perceptions and reactions to particular situations. However, by generalizing, we can compile a list of stressors that are typically experienced as negative or positive to most people and most time. Examples of negative personal stressors can include: conflict in interpersonal relationships, bankruptcy/money problem, sleep problem, children's problem at school, legal problems, inadequate or substandard housing, excessive job demands, job insecurity, conflicts with teammate and supervisors, lack of training necessary to do the job, making presentation in fronts of colleagues or clients, unproductive and time consuming meeting, commuting and travelling schedules (Ornelas, S. and Kleiner, 2003). Examples of positive personal stressors might include: receiving a promotion at work, starting a new job, marriage or commitment ceremony, having a home, having a child, transfers, taking or planning a vacation, holiday season, retiring, taking educational classes or learning a new hobby (Ornelas, S. and Kleiner, 2003).

Statement Of Problems

The current messy environments in which some workers accomplish their work require that organizations check up their practices. Working in tertiary level is an inherently stressful profession with long working hours, heavy workload, difficult students and conflicting demands. The physical and psychological demands of workers at the tertiary level of education make them more vulnerable to high levels of stress. The effect of the stress are evidenced as increased errors in memoranda, high medical bills, lateness to work, low productivity and increased sick leaves. Despite the extremely negative effects of occupational stress on the human body and work performance,

many organizations, with Mai Idris Aloom Polytechnic Geidam not being an exception has not put any concrete measures to address these stress related conditions that negatively affect productivity. Furthermore, there has been a conscious establishment of a linkage between occupational stress and its negative effect on productivity. It is in the light of these problems that this research seeks to bring to the fore the implication of occupational stress on the overall performance of institutions. In view of the above stated problem the researchers come up with the following objectives these are:

1. To examine the effects of stress on workers in the performance of their jobs.
2. To evaluate management competencies for controlling and reducing stress at work
3. To assess the support for those people who are suffering from stress.
4. To assess how work related stress can affect the health of workers.

Based on the objectives stated, the research sought to ask the questions these are:

1. What factors contribute to low productivity among the staff of Mai Idris Aloom polytechnic, Geidam?
2. Are there any strategies which could be adopted to prevent or reduce stress among staff of Mai Idris Aloom polytechnic, Geidam?
3. What can be done to help staff of Mai Idris Aloom polytechnic, Geidam with stress related problems?
4. Does job stress have any effect on the health of Mai Idris Aloom polytechnic, Geidam staff?

Methodology

Occupational Stress and Its Effects on Organizational Performance in Higher Education Institution of Yobe State

Research Setting

Mai Idris Aloom polytechnic was established by the enactment of the Yobe state polytechnic Geidam into law on 30th October 2002 by the Yobe state government after the law had been duly passed by the Yobe state house of assembly. The polytechnic was established with the mandate to offer courses of instruction (full time and part time) leading to award of diploma, certificates and other field in scientific, technological, managerial and such other subject at the level of manpower. Academic activities commenced in the polytechnic in 2004/2005 academic session with induction of 392 pioneer students admitted to department in three schools on 15th February 2005. With the following department these are: computer science, science laboratory technology, statistics, electrical and electronic engineering, civil engineering, mechanical engineering, architectural technology, business administration and management, accountancy, marketing, public administration, social development as full time course while in part time courses (consultancy unit) which they offer courses like diploma in environmental health technology, public health education and lastly center for entrepreneurship were trade certificates are offer in computer operation, inter logging, poultry, tailoring, cosmetology, printing technology and fishing.

With these above mention courses the aims of the polytechnic are providing opportunities for development, research and publications of research findings. The mission of the polytechnic is to provide career focused education and training at the tertiary level with emphasis on hands-on experience and entrepreneurship development to produce middle-level management personnel.

Recent report as of 2016 polytechnic activities were shown as one of the fastest growing

institution in Yobe state in terms of infrastructural facilities to meet the global challenge and the school currently operating under the leadership Engr. Hussaini Abacha Geidam with the total number of academic staff and non- academic staff amounted to 217 and the number of student running in school were about 2065.

Population

The study population was composed of a total 141 employees of Mai Idris Aloomaa polytechnic Geidam. The study population refers to the total collection of elements which one would like to study or make inferences (Cohen, L. Manion, L. & Morrison, 2013). The population aspect however refers to the individual participant or object on which the dimension is taken; it is the unit of study (Cooper, D., & Schinder, 2006). The population of this study comprised of all the employees of Mai Idris Aloomaa polytechnic Geidam because they were the groundwork of the

study and provided the relevant answers to the research questions. The management and staff Mai Idris Aloomaa polytechnic constitute the target population for this research. All the department of the polytechnic comprising of academic and non-academic staff took part in the exercise.

Sample and Sample Determination

Sampling is concerned with the choice of a subgroup of individuals from the target population in order to enable the estimation of the characteristics of the entire population (Singh, A. S., & Masuku, 2014). It is vital to use an adequate number of subjects so as to ensure a higher probability that results of the study will be more generalizable and interpretable (Mugenda, 2008). A sample size of 141 respondents was used for the study. The sample size was determined using Taro Yamane’s simplified formula corrected to proportion to determine the size for the study(Taro, 1985). It is defined as:

$$n = \frac{N}{1+N(e)^2} \dots\dots\dots\text{Eqn (1)}$$

Where N= Total population

n = sample size

e = precision

$$n = \frac{217}{1+217(0.05)^2} \dots\dots\dots\text{Eqn (2)}$$

Sample size drawn from both academic and non-academic = 141

Respondents	Population	Sample
Academic staff	104	67.58%
Non-academic	113	73.42%
Total	217	100%

Sampling Technique

Occupational Stress and Its Effects on Organizational Performance in Higher Education Institution of Yobe State

The systematic sampling method was used to select participants for the study. The systematic sampling technique is a way of selecting respondents which determines how to select members of a population that will be studied. By this method every n^{th} member is selected from the total population for inclusion in the sample population. The respondents were selected from a starting member of a group example non-academic and then the means was repeated in other group to select the other respondents. This technique is more efficient because it improves accuracy of estimates.

Procedure of Data Collection

The register of staff members was collected from Human Resource Department. The 1st four names were selected and then the difference of four was used as an interval to select the rest of the respondents. Copies of the questionnaire were personally handed to respondents at their offices. After some minutes the researcher went back and collected the answered questionnaire because the respondents may forget to fill in the questionnaire or misplace them entirely. The questions were thoroughly explained to the respondents after copies of the questionnaire were handed to them.

Research Instruments

Open and closed-ended questionnaires were designed for the respondents. The questionnaires were divided into various sections to capture the critical areas spelt out in the objectives for the study. The questionnaires were administered personally and the contents explained to some staff who requested to be guided. A total of one hundred and forty one (141) questionnaires were sent out and were distributed to both administrative and academic staff of the polytechnic out of one hundred and forty one

(141) only one hundred and forty (140) were successfully collected.

Research Design

(Cooper, D., & Schinder, 2006) suggested that the research design is the structure of investigation aimed at identifying variables and their relationships to one another. It refers to the blue print, plan and guidelines utilized in data analysis with respect to the study. It is a necessary step required in a research process if research problems and hypothesis are to be adequately addressed. Descriptive research design and causal research design as well as the survey method were used. Descriptive research design was used to describe some phenomena because it aids a researcher in gathering, summarizing, presenting and interpreting information for the purpose of clarification while the causal research design was used to describe the effect of one variable on another that is establish cause and effect relationship (Mugenda, O. N., & Mugenda, 2003).

Data Analysis

Simple frequency distribution and percentage were used to analyze the data collected. Tables and other inferences were made from the data gathered. Representations like bar charts; pie chart was used to ensure easy and quick interpretation of data. Responses were also expressed in percentages. The items in the questionnaire were group based on the responses given by the respondents and coded. This method was used because it is the best instrument to identify, compare, describe and reach conclusion.

Data Analysis and Discussion of Results

Demographic Analysis

Table 1: Gender of Respondents

RESPONDENT	FREQUENCY	PERCENTAGE
Male	100	71.43%
Female	40	28.57%
Total	140	100%

Source survey 2017

Table 1 shows that 100 (71.43%) of the respondents were males with the remaining 40 (28.57%) being females. The result is not surprising as there are more males workers in the polytechnic than females.

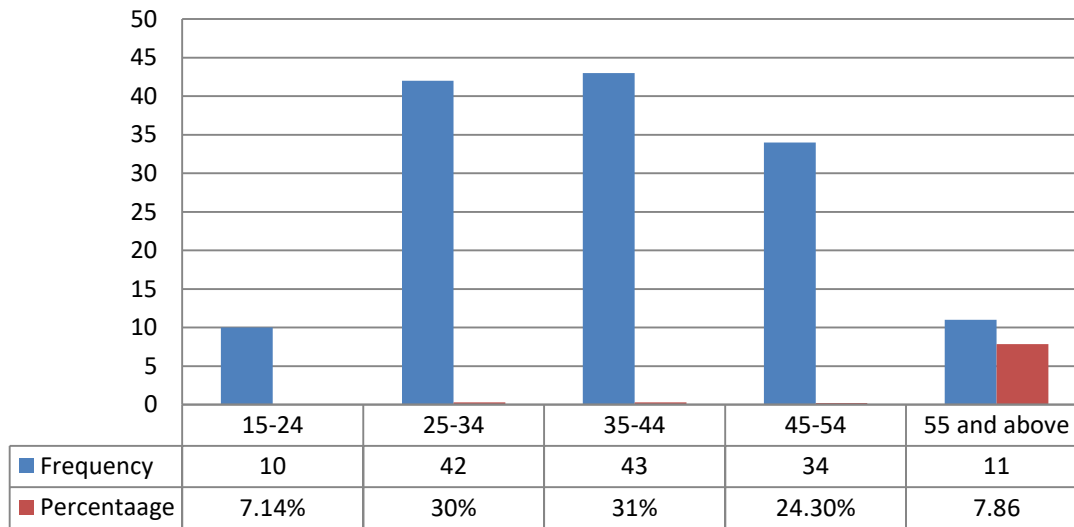


Figure 1: Age of Respondents

Source: Filed survey, 2017

Figure 1 which shows the age distribution of the respondents indicates that 10 (7.14%) and 42 (30.0%) of the respondents respectively fell in the 15-24 and 25-34 age brackets. 43 (31.1%) and 34 (24.307%) respectively fell in the 35-44 and 45-54 age bracket. The remaining 11 (7.86%) fell in

the 55 years and above age bracket. From the above it can be inferred that majority of the respondents are below the age of forty-five (45) years, thus Mai Idris Alooma Polytechnic Geidam has a youthful work force.

Table 2: Educational Qualification

Response	Frequency	Percentage
O'level/SSCE/WASSCE	4	2.9%
A' level	6	4.3%
Diploma holders	20	14.3%
HND holders	28	20%
1 st degree	50	50%
Master's degree	30	30%
Doctrine degree	2	1.4%
Total	140	100%

Source: Field survey, 2017

Table 2 reports that 50 (50%) and 30 (30%) of the respondents had a first degree and a master's degree as their highest level of education. 28 (20%) and 20 (14.3%) of them respectively had a HND holders and diploma holders. 4(2.95) and

6(4.3%) of the respondents had an O'level SSCE/WASSCE and A 'level respectively. It can be said that the cleaners and the clerks are those having at most a WASSCE or O'level, A 'level and diploma holders.

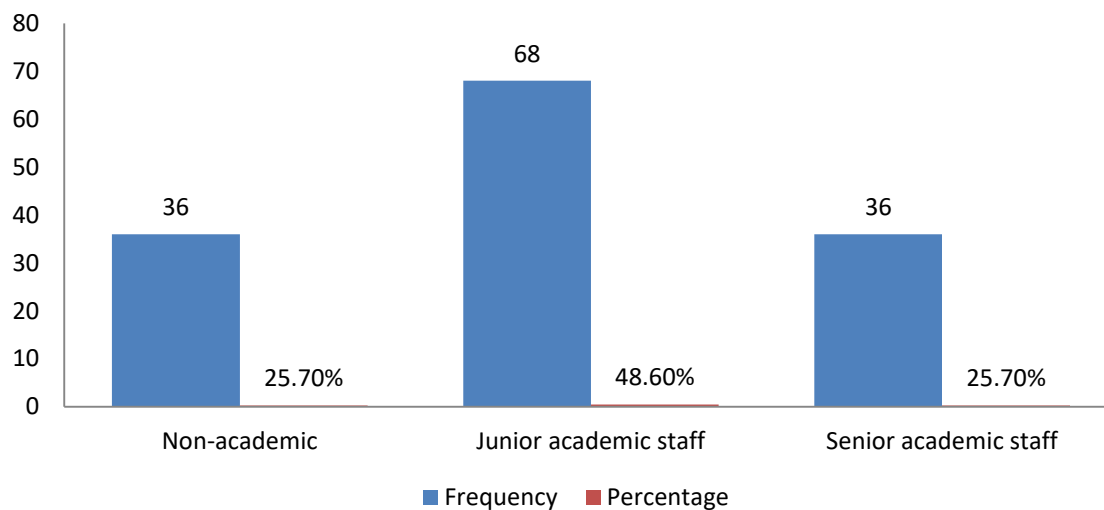


Figure 2: Status of respondents

Source: Field survey, 2017

Figure 2 shows that 68 (48.60%) and 36 (25.7%) of the respondents respectively were junior academic staff and senior academic staff. The remaining 36 (25.7%) were non-academic staffs.

Table 3: Marital Status of Respondents

Respondents	Frequency	Percentage
Married	100	71.4%
Single	40	28.6%
Total	140	100%

Source: Field survey, 2017

Table 3 shows that 100 (71.4%) were married men and woman while the remaining 40 (28.6%) were single.

The researcher in his bid find out whether respondents have heard about occupational stress asked, have you heard about occupational stress? Their response is presented below.

Occupational Stress and Job Performance

Table 4: Have you heard about occupational stress?

Respondents	Frequency	Percentage
Yes	135	96.4%
No	5	3.6%
Total	140	100%

Source: Field survey, 2017

It can be seen from Table 4 that as many as 135 (96.4%) of the respondents responded in the

affirmative with the remaining 5 (3.6%) responding in the negative

Table 5: To you, what constitute Occupational Stress?

Respondents	Frequency	Percentage
Workload	79	56.6%
Role overload	28	20%
Role ambiguity	29	20.7%
Other	4	2.9%
Total	140	100%

Source: Field survey, 2017

Table 5 indicates that 79 (56.4%) of the respondents mentioned workload as what constitute occupational stress. 29 (20.7%) and 28 (20%) of them respectively mentioned role ambiguity and role overload as what in their view

constitute occupational stress. The remaining 4 (2.9%) mentioned bad superior and subordinate practices. From the above, it can be concluded that the major constituent of occupational stress is workload.

Table 6: *What do you think are the signal of occupational stress?*

Respondents	Frequency	Percentage
Feeling anxious, irritable or depressed	48	34.3%
Apathy, loss of interest in work	45	32.1%
Problems sleeping and fatigue	25	17.9%
Trouble concentrating	20	14.3%
Other	2	1.4%
Total	140	100%

Source: Field survey, 2017

Table 6 shows that out of a total of 140 responses, 45 (32.1%) and 48 (34.3%) respectively went in favor of apathy, loss of interest in work and

feeling anxious, irritable or favor of trouble concentration and problems sleeping, fatigue and 2(1.4%) others as signals of occupational stress.

Table 7: *Have you ever experience any of the signs of occupational stress?*

Respondents	Frequency	Percentage
Yes	120	85.7%
No	16	11.4%
Don't know	4	2.8%
Total	140	100%

Source: Field survey, 2017

Table 7 shows that as many as 120 (85.7%) responded in the affirmative when they were asked whether they had ever experienced any sign of occupational stress. 16 (11.4%) of them

responded in the negative with the remaining 4 (2.8%) claiming they do not know. Respondents were then asked whether occupational stress can have any effect on ones performance at work.

Frequency

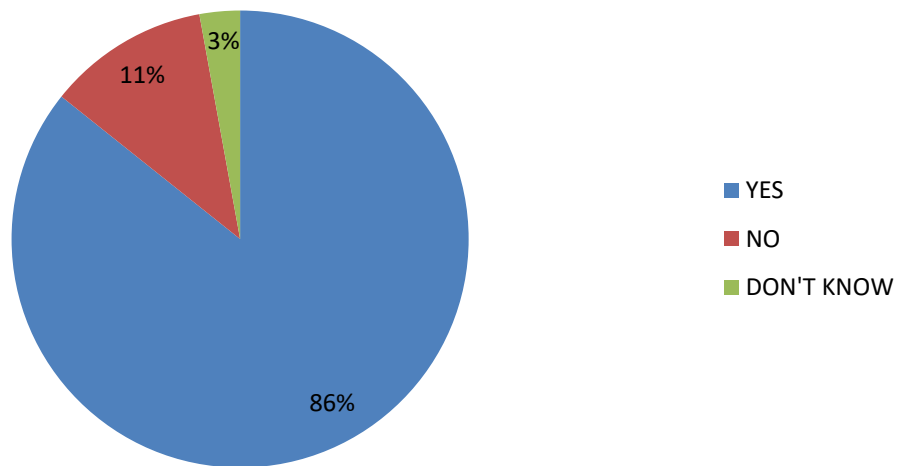


Figure 3: Does occupational stress have any effect on your performance?

Source: Field survey, 2017

Figure 3s reports once again that as many as 120 (85.70%) of the respondent were positive in their response that occupational stress can have an effect on one’s performance. 16 (11.40%)

responded in the negative with the remaining 4 (2.8%) claiming they have no idea. Table 8: shows the effects that respondents said stress has on them.

Table 8: What effects did it have on you?

Respondents	Frequency	Percentage
Absenteeism	45	32.1%
Reduced productivity	49	35%
Low morale	26	18.6%
Poor work relation	20	14.3%
Total	140	100%

Source: Field survey, 2017

Table 8 shows that 49 (35%) and 45 (32.1%) of the respondents respectively mentioned reduced productivity and absenteeism as the effect that they have experienced as a result of stress. 26

(18.6%) and 20 (14.3%) of them respectively also mentioned low morale and poor work relations are some effects that stress had on them.

Control Scale

Table 9: *How much influence do you have over the availability of supplies and equipment you need to do your work?*

Respondents	Frequency	Percentage
Very much	72	51.4%
Somewhat	20	14.3%
A little	30	21.4%
Not at all	18	12.9%
Total	140	100%

Source: Field survey, 2017

Table 9 shows that 72(51.4%) and 20(14.3%) of the respondents respectively claimed that they very much and somewhat have an influence on the availability of supplies and equipment's that they need to work with. 30 (21.4%) of the respondents said they have little influence on the availability of supplies and equipment's that they need to work with. The remaining 18 (12.9%)

claimed they have no influence at all on the availability of supplies and equipment's that they need to work with. An influence from the above is that majority of the respondents have the necessary influence over the supplies of equipment's that they need to carry out their jobs judiciously. By extension it can be said that most workers of Mai Idris Aloomaa polytechnic have the influence over the supplies of equipment that they need to carry out day to day duties.

Table 10: *How much influence do you have over in which perform tasks at work?*

Respondents	Frequency	Percentage
Very much	33	23.6%
Somewhat	33	23.6%
A little	46	32.8%
Not at all	28	20%
Total	140	100%

Source: Field survey, 2017

Table 10 which shows the distribution of the level of influence that the respondents have over the order in which they perform their task indicates that 33 (23.6%) persons each respectively

claimed they have a very much and somewhat influence. 46 (32.8%) said they have a little influence with the remaining 28 (20%) claiming they have no influence at all.

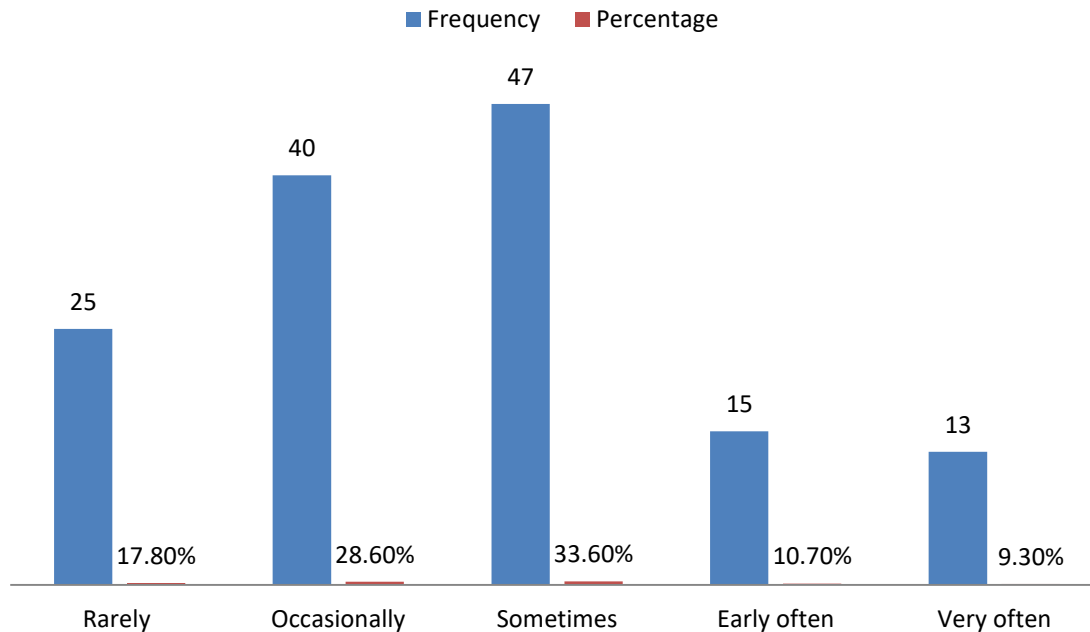


Figure 4: How often does your job leave you with little time to get things done?

Source: Field survey, 2017

Figure 4 shows that 25 (17.80%) and 40(28.60%) of the respondents respectively said the kind of job that they do rarely and occasionally leave them with little time to get things done. Again 47 (33.60%) and 15 (10.70%) of them respectively claimed the nature of their job sometimes and fairly often leave them with little time to get

things done. The remaining 13 (9.30%) claimed their job very often leave them with little time to get things done. From the above it can be said that quite a large proportion of the workers of the school do not get enough time to get things done. It therefore, means that they are always busy doing one thing or the other.

Table 11: Do you think occupational stress can be minimized?

Respondents	Frequency	Percentage
Yes	135	96.4%
No	5	3.6%
Total	140	100%

Source: Field survey, 2017

Table 11 shows that as many as 135 (96.4%) of the were of the view that occupational stress can be minimized. The remaining 5 (3.6%) person believed that occupational stress cannot be

minimized. An influence from the above is that occupational stress can be minimized. The response of respondents on how occupational stress be minimized is presented below.

Table 12: *How can occupational stress are minimized?*

Respondents	Frequency	Percentage
Work redesign	34	24.3%
Stress management training	61	43.6%
Management development	22	15.7%
Organizational	13	9.3%
Early detection	10	7.1%
Total	140	100%

Source: Field survey, 2017

Table 12 reports that 34 (24.35) and 61 (43.6%) of the respondents said occupational stress in their view respectively can be minimized through work redesign and stress management training 22 (15.7%) and 13 (9.3%) of the respondents mentioned management development and

organizational development. The remaining 10 (7.1 %) claimed the best way to use minimized occupational stress is through early detection. An inference from the above is that the best way to minimize occupational stress is through stress management.

Table 13: *How much does your immediate supervisor go out of his/her ways to do things make work life easier for you?*

Respondents	Frequency	Percentage
Very much	50	35.7%
Somewhat	41	29.3%
A little	40	28.6%
Not at all	9	6.4%
Total	140	100%

Source: Field survey, 2017

Table 13 shows that 50 (35.7%) and 41 (29.3%) of the respondents respectively said their immediate supervisors very much and somewhat make life easier for them at their workplace. 40 (28.6%) claimed their bosses only allow them a little room to make life easier for them with the

remaining 9 (6.4%) saying their supervisors do not make life easier for them at all. From the above it can be concluded that to a larger extent the supervisors of workers in Mai Idris Alooma polytechnic in their actions make life easier for their subordinates in their line of work.

Table 14: *How much do other people at work go out of their way to do things to make work life easier?*

Respondents	Frequency	Percentage
Very much	20	14.3%
Somewhat	62	44.3%
A little	53	37.8%
Not at all	5	3.6%
Total	140	100%

Source: Field survey, 2017

Table 14 above reports that 20 (14.3%) and 62 (44.35) of the respondents respectively claimed other colleagues in the polytechnic very much and somewhat make life easier for them in the performance of their job. 53 (37.8%) of them said they received a little support from their other colleagues in making their work easier with the

remaining 5 (3.6%) saying their colleagues staff members do not make their for them. An inference from the above is that once again to larger extent workers receive support from colleague staff in the course of carrying out their job to make life easier for them.

Occupational Stress and Health

Table 15: *Do you think your work can affect your health?*

Respondents	Frequency	Percentage
Yes	130	92.9%
No	10	7.1%
Total	140	100%

Source: Field survey, 2017

Table 15 responses shows that as many as 130 (92.9%) of the respondents say their work can

affect their health. The remaining 10 (7.1%) were negative in this response to whether their work

can affect their health. An inference from the above is that majority of the workers are undertaking stressful work schedule which

affects their health. Respondents were then asked how the stress affects their health. Their responses were presented below.

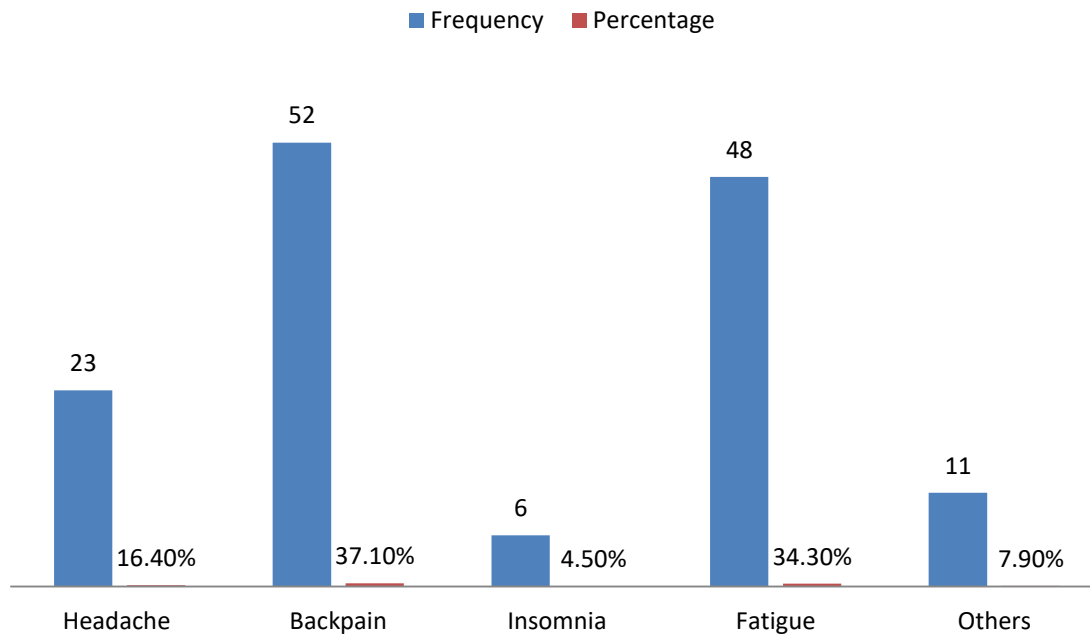


Figure 5: *How Does Your Work Affect Your Health?*

Source: Field survey, 2017

Figure 5 shows that 23 (16.40%) and 52 (37.10%) of the respondents respectively claimed they suffer headache and back pain. 6 (4.50%) and 48 (34.30%) of them respectively claimed that the resultant effect of the stress that they go through caused them to suffer insomnia and fatigue. The

remaining 11 (7.90%) mentioned migraine amongst others as the effect of stress on them. A conclusion from the above is that the two (2) main resultant effects on stress on the individuals are back pain and fatigue.

Table 16: *Do you know that occupational stress can cause cardiovascular disease as hypertension?*

Respondents	Frequency	Percentage
Yes	121	86.4%
No	19	13.6%
Total	140	100%

Source: Field survey, 2017

Table 16 shows that 121 (86.4%) of the respondents claimed they were aware of that occupational stress can cause hypertension which is a cardiovascular disease. The remaining 19 (13.6%) said they did not know that stress can cause a cardiovascular disease such as

hypertension. Respondents were further asked whether respondents were aware of the fact that exposure to stressors for long time can cause chronic health problems such as immune system dysfunction. Their response is presented below.

Table 17: *Did you know that exposure to stressors for long time can cause chronic health problems such as immune system dysfunction?*

Respondents	Frequency	Percentage
Yes	99	70.7%
No	41	29.3%
Total	140	100%

Source: Field survey, 2017

Table 17 shows that 99 (70.7%) of the respondents responded in the affirmative while the remaining 41 (29.3%) were negative about it. An inference from the above is that to a larger extent, respondents or the workers of the polytechnic Geidam are aware that exposure to stressors for a long time can cause chronic health problems such as immune system dysfunction.

Summary of The Findings

The principal purpose of the study was to investigate occupational stress and its effect on organizational performance in higher education institute of Yobe state. The study demonstrates support for the objectives of the study and further indicates a contrary relationship between occupational stress and job performance.

Recommendations

Based on the findings above the following recommendations have been made:

Mai Idris Aloomaa polytechnic has a working population which is youthful and therefore could be very competitive in the provision of quality

tertiary education by adopting a well-designed, organized and managed work helps to maintain and promote individual well-being. Since the job related stress from lack of support from supervisors in taught time and workload conflict was high among workers. The school administrative should pay attention to solve these issues; Lack of resources such as inadequate staff and lack of equipment must be advocated by the heads of the department or sections for the benefit of the staff. Performance is hindered by stress because the individual faces signals of stress which affects their productivity. Therefore, increasing formal organizational communication with employees reduces stress by lessening the role ambiguity.

Open communication has an advantage of resolving conflicts between supervisors and subordinates. Lack of effective communication could cause unresolved conflicts that increase stress level. Support from supervisors and colleagues are a major factor in reducing stress. Supervisors need to recognize the good work and outstanding contributions to employees in challenging times to keep them motivated.

Promoting a culture of support will set the example and it will make them realize that co-worker support is very important.

Conclusions

Based on the analysis of the data the following conclusions were drawn:

The profile of the majority of respondents were males (71.43%) with the remaining (28.57%) being females. The age groups falls within the age range from 35-44 and majority of the respondents fell below the age forty-five (45) years. Workload was identified as the major component of occupational stress to respondents as it chalked (56.6%). It was also realized that troubles concentrating on job was a signal to respondents that were under stress. It was noted that (85.7%) had experienced some of the signs of stress and (85.7%) report that occupational stress has affected their performance. Finally, it was observed that (35%) of respondents were of the view that occupational stress can be minimized. They suggested that management training (43.6%) should be instituted to help minimize the effect of work related stress as it will enhance productivity. Participants were satisfied with the support they receive from their immediate supervisors with a response rate of

(35.7%) as result of supervisors making life easier for them at work places. On the contrary, it was revealed by a (46.4%) that members of staff in tough times receive minimum support from their supervisors. This is very critical in reducing job stress In time of troubles as such these are times when workers would need some form of support from their superiors to help manage some of their stressors. An overwhelming (92.9%) of respondents were aware that job stress can affect their health negatively as most of the respondents observed that they could contract a cardiovascular disease as a result of job stress. It was noted that workers who experience job stress manifested in the form of back pain and fatigue which scored (37.1%) and (34.3%) respectively. Drawing from the consequences of the results, it could be concluded members of staff of Mai Idris Aloomo polytechnic mainly experience back pain and fatigue which could grow in other health implications leading to low output of those affected. In summary, the result of the study indicates that there is a negative relationship between job stress and job performance. Those workers who had high level of job stress had low job performance. All the factors contributing to job stress affected all the categories of staff of Mai Idris Aloomo polytechnic, Geidam.

Reference

- Christo, B. and Pienaar, J. (2006). South Africa Correctional Official Occupational Stress: The Role of Psychological Strengths. *Journal of Criminal Justice*, 34(1), 73–84.
- Cohen, L. Manion, L. & Morrison, K. (2013). *Research methods in education*. London UK: Routledge.
- Cooper, C. L. and Cartwright, S. (1994). Healthy Mind; Healthy Organization. A Proactive Approach to Occupational Stress,. *Journal of Human Relations*, 47(1), 455–471.

- Cooper, D., & Schinder, P. (2006). *Business research methods*. ((8th editi). New York: McGrawHill.
- G, M. (2001). *Levels of transaction: A cognitive science framework for operator stress* (P. H. & P. Demond, ed.). Mahwah: NJ Erlbaum.
- Johnson, S. J. (2001). *Occupational Stress Among Social Workers and Administration Workers within a Social Department*. University of Manchester.
- Malta. (2004). *Stress at Work. A Concept in*

- Stress*. Human Factors Limited. Business Psychology and Strategy Development.
- Manshor, A. T., Rodrigue, F. and Chong, S. C. (2003). Occupational Stress Among Managers: Malaysian Survey. *Journal of Managerial Psychology*, 18(6), 622–628.
- Mugenda, O. N., & Mugenda, A. G. (2003). *Research methods: Qualitative and quantitative approaches*. Nairobi: ACTS press.
- Mugenda, A. G. (2008). *Social science research: Theory and principles*. Nairobi: Kijabe Printers.
- Ornelas, S. and Kleiner, B. H. (2003). New Development in Managing Job Related Stress. *Journal of Equal Opportunities International*, 2(5), 64–70.
- Shakil, S. &. (2010). *Should Stress Management be Company Policy; Women in Management Review*. 4(2).
- Singh, A. S., & Masuku, M. B. (. (2014). Sampling techniques & determination of sample size in applied statistics research. *International Journal of Economics, Commerce and Management*, 2(11), 1–22.
- Taro, Y. (1985). *Statistics: An introductory Analysis* (3rd ed.). New York: Happer and Found Publishers.
- Topper, E. F. (2007). Stress in the Library. *Journal of New Library*, 108(11/12), 561–564.
- Varca, P. E. (1999). Work Stress and Customer Service Delivery. *Journal of Services Marketing*, 13(3), 229–241.
- Vermunt, R. and Steensma, H. (2005). *how can Justice be used to Manage Stress in Organizations*, in Greenberg, J. and Colquitt, J. A. (Eds.), (N. Erlbaum, Mahwah, Ed.). Handbook of Organizational Justice,.

Isolation of Microorganisms from Food Handler (Bread Sector) In Geidam Local Government Area, Yobe State, Nigeria

M. M. Idriss^{*1}; Mustapha A. U²; Fatima Mohammed Maina³

^{1&2}Department of Science Laboratory Technology, Mai Idris Aloomo Polytechnic Geidam, Yobe State,

³Faculty of Basic Medical Sciences, Federal University of Health Sciences, Azare, Bauchi State.

*Corresponding E-mail: mainadada2@gmail.com

Abstract

*Food handlers has become an important public health issue due to widespread of food-borne diseases and food vendors play an all-important role due to lack of adequate food safety measures. This study aims to assess microorganisms associated with food vendors in one of the most popular bread industries in Geidam LGA, Yobe state which is known as “Al heri bread industry”. Descriptive cross-sectional study and multistage sampling technique was adopted in this research, and a total of 64 food vendors were sampled. These food vendors were sampled using sterile swab sticks by aseptically swabbing their hands. The swabs were tested for bacterial and fungal contaminants. Among 64 food vendors (distributed into three group base on the kind of work the food handler is doing in the industry, i.e. 5 bakers, 8 loaders and 12 packagers.), a total of 376 bacteria and 59 fungi were isolated. The bacteria isolate from this study were *S. aureus* (21.01%), *E. coli* (23.14%), *Salmonella enterica* (13.03%), *Pseudomonas aeruginosa* (17.02%), *B. cereus* (11.70%), *Klebsiella spp* (10.90%) and *Serratia marcescens* (3.2%). The fungi isolates were *Aspergillus spp* (37.29%), *Microsporium canis* (15.25%), *Mucor spp* (11.86%), *Penicillium spp* (10.17%), and *Candida spp* (25.42%). The questionnaire and observatory study adopted in this research showed poor personal hygiene and sanitary practices among food vendors. The findings of this study emphasized the importance of food vendors as potential vehicles for transmitting food-borne diseases and thus the need to adopt food safety measures geared towards maximum food safety is required.*

Keywords: Food vendors also known as Food handlers, Food-borne disease, Hygiene, Sanitary practices.

Isolation of Microorganisms from Food Handler (Bread Sector) In Geidam Local Government Area, Yobe State, Nigeria

Introduction

Food handlers also known as food vendors are vital components in the interaction between the cooking environment and the food which is being prepared or served. WHO (1989) defined food handlers as those who, in the course of their normal routine work, handle food or items that may come into contact with food, such as eating and drinking utensils not meant for their personal usage. During food handling and preparation, microorganisms on raw foods can be transferred to the hands of a food worker and subsequently to other surfaces (such as water faucet handles) contacted by contaminated hands Agbodaze et al., (2005). Food handlers with poor personal hygiene working in a food service establishment could be potential sources of infection due to microorganisms Egbuim T.C. and Umeh S.Ogonna (2020). This study reports the microorganisms isolated from the palms of food handlers at Al heri bread industry in Geidam LGA in Yobe state.

Several reports have suggested that infected food handlers may play important role in food contamination and food-borne disease outbreaks. Purchasing ready-to-eat foods and ingredients from food handlers possess a considerable risk to public health, especially due to the observed poor hygienic practices of some food handlers. Lack of basic facilities like water and toilet also affect the safety of ready-to-eat foods handled by food handlers. Where food vendors lack water, they seldom wash their hands even when they visit the toilet or handle money. Most vendors are known to wash their hands only when the hands are visibly dirty Musab et al (2020). These practices tend to subject foods and ingredients to repeated contamination. Failure to perform appropriate hand hygiene has been recognized as a significant contributor to outbreaks of diseases. It has also been established that lack of adequate hand

washing by food handlers who prepare, process and handle food in the retail food system can transmit pathogens especially fecal pathogens to food products after a food worker uses the toilet. When consumed in food, these pathogens can cause illness and disease (FDA, 1997).

64 food vendors (distributed into three groups base on the kind of work the food handler is doing in the industry, i.e. 5 bakers, 8 loaders and 12 packagers.), a total of 376 bacteria and 59 fungi were isolated. The bacteria isolate from this study were *S. aureus* (21.01%), *E. coli* (23.14%), *Salmonella enterica* (13.03%), *Pseudomonas aeruginosa* (17.02%), *B. cereus* (11.70%), *Klebsiella spp* (10.90%) and *Serratia marcescens* (3.2%). The fungi isolates were *Aspergillus spp* (37.29%), *Microsporium canis* (15.25%), *Mucor spp* (11.86%), *Penicillium spp* (10.17%), and *Candida spp* (25.42%).

The Nigeria Centers for Disease Control and Prevention (NCDC) reported that approximately 20% of food-related infections are due to poor hygiene practices by food handlers (Michaels et al., 2004). Diarrhea diseases, mostly caused by food-borne microbial pathogens are leading causes of illness and death in developing countries; killing an estimated 1.9 million people annually at the global level (Adewunmi et al., 2014), Okare O.T. and Erhahon O.O (2015), although Nigeria has no official foodborne disease surveillance system. Sharmila (2011) reported that food vendors are carriers of food-borne pathogens like *Escherichia coli*, *Salmonella*, *Shigella*, *Campylobacter* and *Staphylococcus aureus* which they eventually transfer as food-borne hazards to the consumers. *Escherichia coli* and *Staphylococcus aureus* were recovered in a significant proportion of the food, water, hands and surface swabs tested in Harare (Gitahi et al., 2012).

Isolation of Microorganisms from Food Handler (Bread Sector) In Geidam Local Government Area, Yobe State, Nigeria

The overall aim of this work is to study the presumptive microorganisms associated with food vendors and the relationship between their occurrence and the hygiene practices in Al Heri bread industry in Geidam LGA Yobe state.

Al Heri bread industry is one of the most popular bread industries in Geidam LGA, Yobe State, which probably has the highest product sales per day in the community. This study was undertaken to check for possible microorganisms (pathogens) present in their workers hands to ensure that their product does not get contaminated and its won't cause illness when consumed by people living in Geidam

The questionnaire and observatory study adopted in this research showed poor personal hygiene and sanitary practices among food vendors in the industry. The findings of this study emphasized the importance of food vendors as potential vehicles for transmitting food-borne diseases and thus the need to adopt food safety measures geared towards maximum food safety is required.

Statement of Problem

Observation shows that most of the food handlers within the industry premises lack personal hygiene, which is one of the contributing factors of food borne illness and poor hand washing, is a significant contributory factor.

Another aspect of food service that frequently causes comment is the way food handlers within the industry premises prepares the food, takes the money for the purchase returns change to the customer and then prepares food for the next customer, this is also a means of transferring microorganisms since anything that gets on money gets on the hands.

Aims and Objective of the Study

The objective of the project is to isolate and determine microorganisms from the hands of food handlers in Al Heri bread industry.

In addition, to bring to the awareness of the food handlers the importance of personal hygiene.

Hypothesis

H1. Microorganisms were isolated from hands of handlers in Al Heri bread industry in Geidam LGA Yobe State.

H2. Microorganisms were not isolated from the hands of food handlers in Al Heri bread industry in Geidam LGA Yobe State.

Significance of Study

This study is very timely especially today that there is increased awareness on the importance of healthy living and personal hygiene. The study will be of immense benefit to the general public, institutions and organized food handlers and retailers because safe food practices is imperative given to the potential for widespread outbreaks of food borne illness.

Scope of The Study

This research work covers only the food handlers in Al Heri bread industry

Limitation of The Study

This work was limited to isolation of very few microorganisms from the hands of the food handlers within the industry, this is because microorganisms are very sensitive to the environment especially temperature. Lack of proper temperature due to lack of power supply for the growth of microorganisms was a limiting factor.

Materials and Method

Equipment

The following Equipment materials were used or this research.

- Electric thermostatic incubator
- Autoclave
- Microscope
- Refrigerator
- Electronic scale

Materials

The following materials were used for this research.

- Nutrient Agar
- MacConkey Agar
- Salmonella, shigella Agar (SSA)
- Mannitol Salt Agar
- Cetrimide Agar
- Kovac's reagent
- Crystal violet stain
- Acetone
- Safranin
- Hydrogen peroxide

Study Area

The study area for this research were only al heri bread industry Geidam Yobe sate, Nigeria known for their high population and dependence on vended foods. The selected workers sector used were, beakers; loaders and packagers

Sample/Swab Collection

A total of two hundred and sixteen (216) swabs were aseptically collected in duplicates from hands, plates, spoons and aprons of various food vendors (64 vendors) from the three selected

sector of the industry. Each sterile swab stick was dipped into normal saline and aseptically used to swab the surface of hands, plates, spoons and aprons of each food vendor. After collection, the swab sticks were placed in sterile bags and conveyed to the laboratory for analysis.

Preparation of Culture Media

All culture media used were prepared according to the manufacturer's instructions. They were sterilized by autoclaving at 121°C, 15psi and for 15 minutes while Salmonella-Shigella agar was prepared by boiling in a water bath at temperature of 100°C.

Isolation of Microorganisms

Bacterial Isolation

Each swab stick was aseptically rinsed into freshly prepared Nutrient Broth in test tubes (5ml per test tube and plugged); the test tubes were incubated at 37°C for 24 hours for growth which is detected through turbidity. After incubation, a loop full of each broth was streaked progressively to obtain discrete colonies on different culture media (Nutrient Agar, Columbia Blood Agar, MacConkey Agar, Mannitol Salt Agar, Salmonella-Shigella Agar, Cetrimide Agar). The plates were incubated at 37°C for 24 hours and then observed at the end of the incubation time for the kind of growth present on each agar.

Fungal Isolation

Each swab stick was aseptically rinsed into freshly prepared Sabouraud Dextrose Broth in test tubes (5ml per test tube and plugged), the test tubes were incubated at 25°C for 48 hours for growth. After incubation, a loop full of each test tube was streaked progressively to obtain discrete colonies on fortified Sabouraud Dextrose Agar

(chloramphenicol fortified to suppress bacterial growth). The plates were incubated at 25°C for 5 days and were observed daily for the kind of growth present on each plate.

Identification of the Isolates

Bacterial and fungal isolates were identified using various biochemical tests, microscopy, culture morphology and cross match of fungal isolates was done using Fungal Atlas for their easy identification. The isolation and identification follow similar practices and in global practices, Edeh N. A. (2012).

Morphology and biochemical tests carried out to identify the isolates

The following tests were carried out:

- Gram staining
- Triple Sugar Iron Agar
- Catalase Test
- Oxidase Test
- Coagulase Test
- Sulphide Indole Motility Test
- Citrate Test

Gram staining reaction

The procedure was carried out as follows:

A thin smear film of the organism (a 24-hour old bacterial culture) was prepared on a sterile clean glass slide, air-dried and heat-fixed by passing it horizontally over the Bunsen flame. The dried smear was stained with Crystal violet stain for 60 seconds after which it was rinsed with tap water. The resulting smear was then stained with Lugol's iodine for 60 seconds and was rinsed with tap water. The smear was decolorized with 95% ethanol until the slide appears free of the crystal violet stain. The slide was rinsed under

tap water, counter-stained with safranin for 1 minute and was finally rinsed with tap water. The prepared slide was allowed to dry and it was examined under the microscope using the x40 objective lens and x100 (oil immersion objective lens). The organisms that retained the crystal violet stain (purple in colour), indicated Gram positive organisms, while the organisms that appeared pinkish or reddish indicated Gram negative organisms.

Sulphide indole motility test

This test was carried out to detect the motility, sulphide and indole production of each isolate. The medium, sulphide indole-motility (SIM) medium is a semi-solid medium. The isolates were stab-inoculated aseptically and were incubated at 37°C for 24 hours. Motility is indicated by the spreading of the organism outside the line of stab, indole production is by the presence of a red-pink ring at the interphase after Kovac's reagent has been added; sulphide production is by the presence of a black colour in the medium.

Citrate test

The citrate test was carried out in order to determine the ability of the isolates to utilize citrate as their sole source of carbon and ammonia as the only source of nitrogen. Simmon citrate agar was used for this test; the agar was prepared in test tubes and was inoculated with a 24-hour old culture of each of the isolates aseptically. This was then inoculated at 37°C for 24 hours. A colour change from green to deep blue indicates positive citrate utilization while the absence of a colour change indicates negative citrate utilization.

Triple sugar iron test

This test was used to detect the fermentation of lactose (slope) and glucose (butt) due to the production of acid, the production of gas (CO₂) and the release of H₂S (hydrogen sulphide) which is a four in one test. The Triple Sugar Iron was inoculated with each isolate from the pure cultures on Nutrient agar using a straight wire to stab the butt and then streaking the slope in zig-zag pattern and it was incubated at 37°C for 24 hours. A yellow butt (acid production) and red-pink slope indicates the fermentation of glucose only; cracks and bubbles in the medium indicate gas production from glucose fermentation; a yellow slope and a yellow butt indicates the fermentation of lactose; a red-pink slope and butt indicates no fermentation of glucose or lactose; blackening along the stab line or throughout the medium indicates hydrogen sulphide production.

The reaction is:



Catalase test

Most aerobic microorganisms are capable of producing the enzyme catalase although of different extents. The principle of this is that when organisms containing catalase enzyme are mixed, Hydrogen peroxide (H₂O₂) and gaseous oxygen is released. A suspension of 18-24 hours old culture of the test organisms was placed on a clean glass microscope slide. A few drops of H₂O₂ were added using a syringe. The evolution of gas bubbles caused by the liberation of free oxygen indicated the presence catalase enzyme which shows that the reaction is positive; the absence of bubbles indicates a negative reaction.

Coagulase test

This test is used to identify *Staphylococcus aureus* which produces the enzyme coagulase. A

drop of distilled water is placed on each end of a slide or on two separate slide. The colony of the test organism was emulsified in each of the drops to make two thick suspensions. A loopful of freshly collected plasma was added to one of the suspensions and was gently mixed. Observe for clumping of the organisms within 10 seconds. If there is clumping within 10 seconds, it is *Staphylococcus aureus*; if there is no clumping within 10 seconds, it is coagulase negative.

Antibiotic susceptibility test

This test was carried out to determine the antibiotic susceptibility pattern of the different isolates Tiruneh MDM (2013). Nutrient agar plates were inoculated with isolates from stock cultures. The Kirby-Bauer disc-diffusion test which conforms to the recommended standard of the Clinical and Laboratory Standards Institute.

Turbidity of the inoculum of various isolates of enteric bacteria is compared with 0.5 McFarland standard and each of the isolates was inoculated onto the surface of Mueller Hinton Agar plates using a sterile swab in order to ensure even distribution of the inoculum, the plates were allowed to dry for not more than 15 minutes and the antibiotic discs with different concentration were placed on the surface of the agar plates. After 30 minutes of applying the discs, the plates were inverted and incubated for 24 hours at 30°C. The clear zone that developed around each disc were measured as the zone of inhibition from underneath each plate with the aid of a ruler in centimeter (cm) and converted to millimeter (mm). The antimicrobial discs used include the following: Ofloxacin (5 µg), Ciprofloxacin (5 µg), Augmentin (30 µg), Cefuroxime (30 µg), Gentamicin (10 µg), Nitrofurantoin (300 µg), Cefixime (5 µg), and Ceftazidime (30 µg).

Result

potential food-borne microorganisms isolated from the food vendors while tables 3 and 4 show their prevalence

Potential Microorganisms Isolated and Prevalence (%) Tables 1 and 2 shows the various

Table 1: Morphology and Biochemical Test Characteristics of Bacterial Isolates.

S/No	Colony Morphology	Gram Stain	Catalase	Coagulase	Motility	Indole	Urease	V-P	Methyl Red	Citrate	Oxidase	Starch test	Spore test	Glucose uti.	Lactose uti	Maltose uti.	Mannitol uti.	Most Probable Organism
1	Circular, and creamy	+ Cocci	+	+	-	-	V	+	+	+	-	-	-	+	+	+	+	<i>Staphylococcus aureus</i>
2	Oval, and Pinkish	- Rods	+	-	+	+	-	-	+	-	-	-	-	+	+	-	+	<i>Escherichia coli</i>
3	Black centered on SS Agar	- Rods	+	-	+	-	-	-	+	-	-	-	-	+	-	+	+	<i>Salmonella enterica</i>
4	Bluish-Greenish	- Rods	+	-	+	-	-	-	-	+	+	-	-	-	-	-	+	<i>Pseudomonas aeruginosa</i>
5	Creamy, Flat	+ Rods	+	-	+	-	-	+	-	V	-	+	+	+	-	+	-	<i>Bacillus cereus</i>
6	Pinkish-red, mucoid	- Rods	+	-	-	-	+	+	-	+	-	-	-	+	+	+	+	<i>Klebsiella spp</i>
7	Red	- Rods	+	-	+	-	-	+	-	+	-	-	-	+	-	+	+	<i>Serratia marcescens</i>

Key: + = Positive, V-P = Voges-Proskauer, V = varied, - = Negative, Uti. = Utilization.

Table 2: The Colony Morphologies and Microscopic Features of Fungal Isolates

Isolates	Colony Description	Microscopic Features	Suspected Organism
1a	Cottony and culture turned Brown to black with aging. Reverse: Pale yellow	Septate, hyaline hyphae. Conidiophores are long with spherical vesicles at the apex. Conidia are globose and have rough surface.	<i>Aspergillus niger</i>
1b	Cottony and powdery, turned yellow-green during Maturation. Reverse: Pale yellow	Septate, hyaline hyphae. Conidiophores are long with spherical/elongate vesicles at the apex.	<i>Aspergillus flavus</i>
2	Cottony and white Reverse : deep yellow	They have septate hyphae that produce numerous macroconidia. They are truncated, thick-walled and spindle shaped with snout.	<i>Microsporium canis</i>
3	Cottony/woolly and white, turned greyish-brown with aging Reverse: pale white	They have non-septate hyphae called the sporangiophores.	<i>Mucor spp</i>
4	Cottony and grey-green Reverse: yellowish-grey	The entire structure, the conidiophores and extending conidia resemble a “brush”.	<i>Penicillium spp</i>
5	Creamy/glabrous and white Reverse : white	Shows spherical to sub-spherical budding blastoconidia. Some were germ tube test positive detecting <i>Candida albicans</i>	<i>Candida spp</i>

Isolation of Microorganisms from Food Handler (Bread Sector) In Geidam Local Government Area, Yobe State, Nigeria

Table 3: Prevalence of Bacterial Isolates from the swab samples collected

Isolates	Frequency	Percentage prevalence (%)
<i>Staphylococcus aureus</i>	79	21.01
<i>Escherichia coli</i>	87	23.14
<i>Salmonella enterica</i>	49	13.03
<i>Pseudomonas aeruginosa</i>	64	17.02
<i>Bacillus cereus</i>	44	11.70
<i>Klebsiella spp</i>	41	10.90
<i>Serratia marcescens</i>	12	3.20
Total	376	100

Table 4: Prevalence of Fungal Isolates from the swab samples collected

Isolates	Frequency	Percentage prevalence (%)
<i>Aspergillus spp</i>	22	37.29
<i>Microsporium canis</i>	9	15.25
<i>Mucor spp</i>	7	11.86
<i>Penicillium spp</i>	6	10.18
<i>Candida spp</i>	15	25.42
Total	59	100

Isolation of Microorganisms from Food Handler (Bread Sector) In Geidam Local Government Area, Yobe State, Nigeria

Table 5: Percentage Number of Respondents to Variables used in the Study Questionnaire

S/N	Variables	Yes N = %	No N = %
1	Food vendor with surrounding environment free of potential contaminants	19 = 29.69	45 = 70.31
2	Food vendor with food handlers medical certificate	4 = 6.25	60 = 93.75
3	Food vendor wearing protective clothing apron	24 = 37.50	40 = 62.50
4	Food vendor with clean protective clothing apron	10 = 15.63	54 = 84.38
5	Food vendor with protective hair covering/cover	29 = 45.31	35 = 54.69
6	Food vendor with any training on food hygiene	11 = 17.19	53 = 82.81
7	Food vendor who have been invited by the Government or NGOs for training	9 = 14.06	55 = 85.94
8	Food vendor that have seen the Government agencies come to inspect their premises	13 = 20.31	51 = 79.69
9	Food vendor that serve pure/treated water for drinking	49 = 76.60	15 = 23.40
10	Food vendor who encounter pests and rodents in their vending facility	52 = 81.25	12 = 18.75
11	Food vendor that have access to sanitary facilities	11 = 17.19	53 = 82.81
12	Total number of vendors	64	

Discussion

From the results in Table 1 and 2, potential microorganisms were isolated from the food vendors which indicate that food vendors are carriers of microorganisms, and this agrees with Isara and Isah (2009) that food vendors play an important role in transmission and prevention of food borne disease. The bacteria isolated from this study and their percentage prevalence were

S. aureus (21.01%), *E. coli* (23.14%), *Salmonella enterica* (13.03%), *Pseudomonas aeruginosa* (17.02%), *B. cereus* (11.70%), *Klebsiella* spp (10.90%) and *Serratia marcescens* (3.2%). The fungi isolates were *Aspergillus* spp (37.29%), *Microsporium canis* (15.25%), *Mucor* spp (11.86%), *Penicillium* spp (10.17%), and *Candida* spp (25.42%). *Escherichia coli* and

Isolation of Microorganisms from Food Handler (Bread Sector) In Geidam Local Government Area, Yobe State, Nigeria

Aspergillus spp showed the highest prevalence rates while Serracia marcescens and Penicillium spp has the least percentage prevalence for both bacteria and fungi isolates respectively. Similar types of microbial contaminants were identified in previous studies in Benin City, Ogun State and Ondo State, Nigeria (Okareh and Erhahon, 2015; Bankole et al., 2009; Ibrahim et al., 2013). The percentage number of respondents to the hygiene practices survey questionnaire used during the course of this research was shown in Table 5, and from the survey it was observed that only 17.97% of the food vendors had access to sanitary facilities. As high as 81.25% of the vendors' encounter rodents in their vending facilities and only 20.31% of the food vendors have seen government agencies come to inspect their vending premises. As few as 14.06% of the food vendors have been invited by the government or NGOs for training and only 17.19% of the food vendors have had any training on food hygiene which is very poor as studies also conducted in Nigeria by Chukuezi (2010), Omemu and Aderoju (2008) reported that only 4.76% and 12% respectively of food vendors had been exposed to formal training. Furthermore, from this study it was observed that 54.69% and 62.5% of the food vendors had no protective hair cover and apron respectively which is similar to the findings by Chukuezi (2010), Muinde and Kuria (2005). Also, only 6.25% of the food vendors studied had medical certificate while only 29.69% of the food vendors had environments free of potential contaminants. During the course of this research, most of the food vendors (76.60%) claimed to serve pure/treated water to their customers explaining that customers no longer drink water served in mugs/jugs, the remaining 23.40% of the food vendors don't serve water to their customers because they were mostly hawkers. From this result, the general

hygiene practices/regulation among the food vendors were below average and generally must be regarded as poor.

Conclusion

This study has shown that most food vendors within the industry are carriers of wide variety of potentially microorganisms and could be a source of infection to their customers. The isolation of bacterial and fungal pathogens from food vendors reflects bad hygienic standards and necessitates their regular inspection by regulatory agencies. Despite the positive contributions of food vendors to the society, they also incorporate detrimental public health effects. This study therefore calls for caution in patronizing food vendors. The public health implication of the findings of this work is that it revealed that pathogenic isolates from food vendors can aggravate the ill health of the consumers if proper care and caution is not taken.

References

- Agbodaze, D. P. N. Nmai, F. Robert Son, D. Yeboah Manu, K., Owusu-darko & Addo, K. (2005). Microbiological quality of Iheabab consumed in the Accra metropolis Ghana Med. J. 39: 46-49
- Adewunmi et al., Nutritive assessment of milk from Fulani Herds in the savanna zone of Nigeria1; Current journal of applied science and technology; 19(2): 1 – 7, 2014
- EDEH ANASTHECIA N (AUGUST, 2012), ISOLATION AND IDENTIFICATION OF BACTERIA FROM FOOD VENDORS AND

Isolation of Microorganisms from Food Handler (Bread Sector) In Geidam Local Government Area, Yobe State, Nigeria

SOME VEGETABLE AVAILABLE
AT OGBETE MARKET ENUGU

University Cafeteria, Northwest
Ethiopia. *J Infect Dis Ther.*
2013;01(02):1–6.

Egbuim Timothy Chukwudiegwu Nnamdi
Azikiwe University, Umeh Sophina
Ogonna Nnamdi Azikiwe University,
microorganism isolated from food
vendor in Anambra state, 2020

Gitahi et al. Microbial Safety of Street Foods in
Industrial Area, Nairobi.
ResearchJournal of Microbiology;
2012. Vol. 7, Issue 6 PP 297 – 308.

Michaels et al., Prevention of food worker
transmission of foodborne pathogens:
Risk assessment and evaluation of
effective hygiene intervention
strategies. *Food Service Technology;*
4(1), pp 31 – 49, March, 2004

Musab et al., Isolation of enteric bacteria from
asymptomatic food handlers. *Indian
Journal of Microbiology Research*
(2020). Vol. 7, Issue 3 pp.247 – 257.

Okareh, O. T. and Erhahon, O. O. (2015).
Microbiological Assessment of Food
and Hand-Swabs Samples of School
Food Vendors in Benin City, Nigeria.
Food and Public Health Journal, 5(1):
23-28.

Sharmila R. (2011). Street Vended Food in
Developing World: Harzard
Analyses. *Indian J Microbiol.*
51(1):100-106

Tiruneh MDM. Bacterial Profile and
Antimicrobial Susceptibility Pattern
among Food Handlers at Gondar

***Isolation of Microorganisms from Food Handler (Bread Sector) In Geidam Local
Government Area, Yobe State, Nigeria***

The Role of the French Language in Democratic Governance in Nigeria

¹Olawoyin John Olajire, ²Adeyemi Adekemi Oluwatosin, ³Omotayo Gbenga Oluyemi, ⁴Adeyemo Rashidat Ayo, ⁵Adegbemi Esther Omolola, ⁶Olufunmi R. Debo-Ajayi

¹Department of Languages

²Department of Humanities and Social Science

³Department of Accountancy

⁴Juniour Establishment Unit

⁵Department of Languages

⁶SERVICOM Unit

Federal Polytechnic, Offa, Nigeria.

Email: ¹john.olawoyin@fedpoffaonline.edu.ng Phone No: +2348055220019

ABSTRACT

It is a fact that within the last six decades, the third world nations have experienced reconfiguration of their traditional systems of politics and governance, sociocultural formations and practices, and socioeconomic structures following their contact with the West. Unfortunately, one major aspect of the impact of this contact that is yet to produce positive effects is the role of political communication in stabilizing democratic governance. While issues that are not language-related such as an overambitious military leading to frequent coups d'états, military dictatorships that spanned for decades, loosely defined federalism, and weak political party systems in many nations—have been treated as constituting barriers to the establishment and sustenance of viable democratic governance in African and Third World countries, the role of political communication in developing a strong tradition of democratic practices has been overlooked. This work investigates the role of the French Language in stabilizing democratic governance by exploring and clarifying the inter-relationships between language, politics, and governance. The interplay of political communication and democratic processes in the multilingual Nigerian context is particularly explored to highlight the different roles of the interacting languages. It is argued that the dominance of an exogenous language over other numerous indigenous languages may portend grave implications for the young democratic governance in this third-world polity. Therefore, the search for linguistic equilibrium in the linguistic situation in the present Nigerian democracy requires more effort and commitment from the political class than the present academic debates on language policy and planning.

Keywords: Politics, Governance, sociocultural, socioeconomic and inter-relationships

Introduction

Shortly after being let loose from the chains of colonialism, Nigeria has been making efforts to practice and sustain democratic governance that is based on the principles of federalism. The political structure in Nigeria, which is supposed to reflect federal constitutionalism, has been criticized by many because of the over-concentration of power at the center to the disadvantage of the federating units. The initial experimentation with the parliamentary system of governance patterned after their colonial master, Britain, in the First Republic, failed. The country then turned to America for a solution and adopted the presidential system that has remained in practice but not without frequent military interventions. In fact, in the history of democratic practice in Nigeria, military rule accounted for twenty-nine out of its sixty-two years of nationhood.

While there has been much debate on the means to ensure the success of civil governance in the country, the role of political discourse has received very little attention. It is a fact that politics does not function independently of the instrument of communication. For instance, without effective and persuasive use of language, the primary goal of political campaigns, which is to gain and control power in a country and ensure good governance that is based on democratic principles, will not be realized. One of the processes of achieving power is the need to mobilize civil society to participate in the democratic process. Political communication and political education are thus pivotal to the attainment of effective social mobilization and political campaigns in a country that operates a system of governance that is based on Federalism.

The primary concern here is the exploration of how effectively political actors in and out of

government have been able to deploy language facilities available in the Nigerian multilingual speech community towards the success of democratic polity in Nigeria.

The data for the study include selected written political campaign texts, adverts, and media reports on political campaigns sourced from some Nigerian national newspapers. Selected rhetorical and persuasive strategies that are found in the campaign texts produced during recent elections in Nigeria are analyzed using the approaches of discourse analysis (e.g., Awonusi, 1996; Schiffrin, 1994).

Language remains the most potent vehicle for human communication. The ability to use language creatively as against the use of the same by other living creatures delineates human communities from other animal communities. It is very unique to humans. (Adebayo, 1999)

One of the definitions of language according to Greenberg, is of the view that: “Language is unique to man. No other species possesses a truly symbolic means of communication and no human society, however simple its material culture, lacks the basic human heritage of a well-developed language”. The position of Greenberg is that language is a universal property of human quality and that every human language has the same utilitarian functions irrespective of race and ethnic nationality.

Edward Sapire defines Language as is “a purely human and non-instinctive method of communicating ideas, emotions, and desires by means of a system of voluntarily produced symbols”. These symbols are, in the first instance, auditory and they are produced by the so-called “organs of speech.” There is no discernible instinctive basis in human speech as such, however much instinctive expressions and

the natural environment may serve as a stimulus for the development of certain elements of speech, however much instinctive tendencies and other, may give a predetermined range or mold to linguistic expression.

Longman Dictionary of Contemporary English defines language as “a system of communication by written or spoken words, which is used by the people of a particular country or area”.

B-Block and G.L. Trager state that: “a language is an arbitrary system of vocal symbols by means of which human beings as members of a social group co-operate, interact and communicate”. The increasing social awareness resulting from increasingly sophisticated and dynamic forms of human activities led equally to the sophistication of language from merely a rustic means of communication to a very complex tool of modern information and communication Anumihe (2009). Thus it can be seen that language developed and kept developing as a factor of the natural human desire to make communication and interaction with one another in any social context easier and more effective.

The above definitions suggest not only the concept of language but also the meaning, the features or characteristics and the uses of language.

French in Nigeria and the Geographical Location of the Country

Nigeria is an Anglophone country that is surrounded by francophone countries (the Republic of Niger in the North, the Republic of Chad in the North East, the Republic of Cameroon in the East, and the Benin Republic in the West). For effective interaction with the neighboring French-speaking countries and the entire world, Nigerian leaders need the

knowledge of the French language as they need to acquire the necessary skills and knowledge to remain relevant in the global village. Yet, the French language is given little or no recognition in the Nigerian democratic system of governance.

Though the French language was introduced into the education system of the country after the extinction of the Latin language. Asake (2006) and Ajiboye (2004) opined that the expatriates were brought into the country to come and teach the language in secondary schools throughout the country during the initial period. In recent times, the Nigerian government has started deemphasizing the teaching of the language. In schools, French teachers are no more employed and the already existing ones are not adequately motivated, according to Ayeomoni (2012), This attitude of the government has made both the parents and the students have an aversion to the language. Many parents now consider French language learning a waste of time. This was as a result of the attitude of our leaders toward learning the language

The geographical location of Nigeria as a country has made French language learning necessary in the country. Onyemelukwe (1995) observed that Nigeria needs the knowledge of French so as to have a healthy relationship with its francophone neighbors. Igonor (2011) opined that “... For Nigeria to enter a relation of mutual benefits with these nations, most especially, in combating terrorist acts of Boko Haram insurgency and banditry, it is imperative, at least to some extent, for her to communicate with these countries in their own official language - French”

Onyemelukwe and Adie Offiong (2004) buttressed the point by claiming that “Bilingualism is relevant to communication not only with our francophone neighbors but with other French-speaking countries of the world. In

short, it promotes global communication in all spheres of life - education, commerce, religion, and politics". Ogunkeye (2007) gave four reasons for the adoption of French in Nigeria:

- Nigeria is surrounded by francophone countries; therefore French as an official language will facilitate communication and interaction with the country's neighbors.

- The seat of ECOWAS is in Abuja, Nigeria; there are nine (9) Francophone and five (5) Anglophone countries in ECOWAS. French, therefore, is the natural choice being the language of the majority.

- In a world that is fast becoming a global village, learning French can only be an advantage. There will be access to foreign materials and other opportunities available in terms of communication, technology, and international politics. This point is also supported by Brahn et al (1988)

- There will also be job opportunities for individuals in organizations such as African Union, United Nations, UNESCO, and other multinational companies that require their employees to speak French, especially at various embassies.

Ogunbiyi (2012) also supports the opinion of the others by asserting that "Since Nigeria is surrounded by French-speaking countries, the importance of the language in Nigeria for social, political, economic and international relations cannot be overemphasized." In spite of the above-mentioned importance of the French language to Nigerian citizens, the language is yet to be taken seriously

Much has been said about the relevance of French language and the reason why our leaders should

adopt French as a pivotal tool in democratic governance. French is a modern language that is spoken, written and used like all the other world's modern languages. Despite its importance and easy access to learning, it is unfortunate that the wide use of French has often been overlooked by Nigerians leaders

French is a foreign language in Nigeria and has a stance of copious advantages as regards its pertinence in all spheres of life. The language has gained ascendancy among different international languages especially in Nigeria because of her geographical proximity with French speaking countries. Besides, French is the second most widely learned foreign languages in the world. We will in this paper discuss the emergence of French language in Nigeria and depicts its relevance which can be traced to the phases of economic, social, political, religious, educational, employment, and diplomatic benefits especially to Nigerian leaders. French is unusual in that it often exists alongside other languages in multilingual contexts; it shares with English the distinction of being taught as a foreign language in the educational systems of most countries around the world in which is not excepted from Nigeria . As a result of all these, Nigerian leaders are now kept abreast of the salient importance of the language, this is the reason they must be committed to learning the language irrespective of the tribe or political leanings. It has opened doors of opportunities to them nationally and internationally.

The aims of the French Language and Communication degree being awarded in universities is to allow individuals to develop an in-depth understanding of the French language and its role in the world as well as an in-depth understanding of communication in terms of how it functions at interpersonal, public, group and intercultural levels. The French language is one

of the dominant languages of international communication and with increasing globalization, it is important to have a refined understanding of the nature and structure of French and how one can use it to communicate with the speakers of the language. An understanding of the various dimensions of language and communication will give you the ability to communicate more effectively in this complex, globalised world.

Language does not develop in vacuum; it cannot be separated from culture. It is part of the culture of the people and the only available means by which the members of a society communicate. We may say that language is an embodiment, a component of culture and a central network through which the other components are expressed. Ajiboye (2004) buttressed the above view when he stressed further that language is a critical element of culture through which it reveals its fascinating power. All these inform the goals of learning a language as the ability to use it, understand its meaning and connotations, ideas and achievements. This could be the reason why Ogunbiyi (1998) insists that language is the key to the heart of the people, if we lose a key; we lose the people if we treasure the key and keep it safe it will unlock the door of untold riches which cannot be guessed out from the other sides of the door.

Efforts of Nigeria Government on the Introduction of French Language

As a result of the values of the French language in Nigeria, the federal government of Nigeria established The Nigerian French Language Village, Badgry Lagos in 1991 as an Inter-University Centre for French studies. The centre offers a variety of programmes and services with the mandate of providing language immersion programmes include: certificates, diplomas, NCE, and university degree programmes.

Furthermore, the importance of the language cannot be measured, as a result of this, the late General Sani Abacha in 1996 declared the new status of French as the nation's second official language. Therefore for Nigerians to interact effectively with francophone countries locally and internationally, they should not only be able to speak the language fluently but also be able to attend international seminars and conferences without much problem.

The declaration of French as the second official language of Nigeria during late General Sani Abacha's regime in 1996 paved more way for the recognition of French language education by some of our policy makers. Hence, in the National Policy on Education (NPE) (2004), the status of the French language was officially stated and documented as follows:

“For smooth interaction with our neighbours, it is desirable for every Nigerian to speak French.

Accordingly, French shall be the second official language in Nigeria and it shall be compulsory in Primary and Senior Secondary Schools, but a non-vocational elective at the Senior Secondary School.”

The good intention of the Nigerian government, as reflected in the declaration quoted above, is highly commendable. But it is yet a pity that, according to Akale et al (1998); after about twenty (20) years, the vision about making at least 70% of Nigerians internationally bilingual in English and French languages has not fully materialized. Despite the fact that the Nigerian government wants French to be offered as a core subject in both Primary and Secondary levels of our educational system, many public schools still remain adamant on the full implementation of the said policy (Falade, 2008).

Nigerian governments have on various occasions expressed their desire to adopt the French

language as Nigeria's second official language. At the end of the day, the adoption steps have been discovered to be politically inclined.

Recently, in some of our national dailies, there have been debates and reactions to the announcement by the present Minister of State for Education, Prof. Anthony Anwukah. Some respondents argued that learning a second official language is not necessary and is a pure waste of time.

It might interest Nigerians and Nigerian graduates to note that the announcement of the Minister during his meeting with the French Ambassador that "French was on its way to becoming Nigeria's second official language" is no news at all. Officially, French has been the second official language in this country for the past 19 years. It has also been made "compulsory" in the curriculum of primary and secondary schools across the country. French is also being taught at the tertiary level in the country.

Nigerians should not over-flog the notion that there are no benefits in making French a second official language; events have overtaken that. What is most important for us to know at the moment is the importance of bilingualism or multilingualism; that is having good knowledge of at least two international languages. While other neighbouring countries have at least two international languages as their official languages, others have three to four. Nigeria must join her counterparts in the trend of bilingualism, which without doubt, has many benefits.

We must understand that being bilingual has a positive effect on our intellectual growth and enhances our mental development. According to Nanduti (2009), "being bilingual opens the door to other cultures and helps an individual

understand and appreciate people from other countries." I can assure you that our political leaders will interact better and exchange better knowledge with their Francophone counterparts without interpreters if they have knowledge of both French and English languages. Nanduti also affirms that being bilingual increases job opportunities in many careers where knowing another language is a real asset.

Ludwing Wittgenstein clearly states that: "The limit of my language means the limits of my world." This simply means that we are limited to the world of whose language we can speak. Therefore, the more different international languages we learn, the wider our economic and political horizons. Edwards (2000). Being bilingual can equally make an individual have more executive control of whatever situation he or she finds herself by the simple ability to switch from one international language to the other.

During the course of this research, one of our respondents declared: "... relevance of French? It reminds me of the first time I attempted to get a visa. For days, I went to the embassy then at Onikan Abayomi but could not even see the colour of the gate due to the large crowd I met there. On the third day, I decided to use my knowledge of French to part the red sea of applicants already crowding the gate as early as 7.30am. And so, I straightened my dress, with my head held high and confidently approached the crowd speaking and chanting French. To my greatest surprise, the crowd parted ways for me to pass through; they obviously thought I was one of the embassy workers. I moved on until I got to the entrance where I equally introduced myself to the Frenchman in his language and the gates were thrown open for me to walk in majestically. Who says the language is not power?"

It is worthy of note that one may not be fluent, but can greet a dignitary and make a toast in the mother tongue. It's very helpful and makes you much more viable. Our leaders are strongly encouraged to take the study of foreign languages especially French as part of their training to stand out among their equals around the world as they can all benefit from the French language if taken more seriously.

To know the success or failure of a project or dream is the ability to take the first step toward achieving it. I, therefore, use this medium to call on Dr. Adamu Adamu, the Minister of State for Education, to put words into action and earn himself well-deserved credit in the educational sector by implementing the 1996 declaration of French as the second official language in Nigeria.

Essential Functions of French Language in Nigeria

Since French is a language, it performs all functions that human languages perform. Scholars and critics of different extractions (Owoeye, 2010; Essoh and Endong 2014) have examined the utilitarian functions of French language in Nigeria. In their different theoretical and empirical positions, they argue that French, as a language, performs communicative, interactive, diplomatic and informative functions. These functions have impacted positively on sustainable human development of the country. Some of the functions of French language are identified and discussed below:

French as a communication tool

The word 'communication' originated from the Latin expression 'communis' which means 'common'. Its derivation *communicare* means 'to share' 'impart' or 'partake' Inyang (1988). It is the transmission of information or ideas from one person to the other. Knezevich (1975: 66) defines communication as 'a process in which a communicator attempts to convey an image to

communicate'. Its essential entails the sharing of ideas, notions, feelings and experiences between the sender and the receiver of the message. Dalton E. (1974: 566) defines the concept as the process by which meanings are exchanged so as to produce understanding among human beings.

Without an iota of doubt, just like other foreign languages, French has been a useful instrument of communication in developing the 21st century Nigerian graduates. The beauty of a language is in its communication, Nigerian graduates are interested in the language for the purpose of communication. So many Nigerian graduates who specialized in different fields keenly wanted to develop themselves in the oral and written skills of the language. Therefore, it is a language of communication among the professionals and amateurs. It is often observed that graduates who are not specialists on the language are still in need of it. This is because it serves as a means to keep abreast with other foreign languages apart from the common English language. For learning to have more than transient utility, what is learnt must be kept available to day to day events and activities through communication. French language serves as a medium of communication in seminars, conferences, meetings and diplomatic gatherings. In fact, the language is becoming more popular in Nigerian Polytechnics due to its inclusion in some programmes' curriculum.

French Language as a Tool for Economic Development

The relevance of the French language to Nigerian leaders and people has been a topical issue in Nigeria since the sixties. Language, culture and economy are quite inseparable because of their intimate relationship. In the process of learning French as a foreign language, one learns French culture and tradition. Good knowledge of the French language may serve as catalyst for economic empowerment and development for

Nigerian graduates. The economic empowerment function of French does not solely depend on the contingency of Nigeria to neighboring countries such as the Republic of Benin and Togo that speak French as the official language. Aire (1993:4) argues further that:

“the importance of French does not depend only on the nearness of French speaking countries, France, the mother country of these neighbouring francophone countries has long since realized the necessity to disseminate her language in Nigeria as well realized its importance to her economy.”

Therefore, one of the principal functions of the language in developing the Nigerian society is to act as a base of commerce. Any graduate from Nigeria can easily venture into business with the neighbouring francophone countries. It is crystal clear that most graduates are now in France and in some French-speaking countries for the purpose of trade and commerce.

Without mincing any word, one can become a teacher, the so-called father of all professions. The learning of the language can give Nigerians the opportunity to be an instructor of the language in elementary, secondary, and tertiary institutions. In Nigeria today, we have a reasonable number of professors of French that are Nigerians. The language has really occupied an influential role in the formation of the national expectations and the integration of the nation and the neighbouring French-speaking nations.

Diplomatic Benefits of French Studies

Closely related to the role of the French language to develop the economy is that of political benefits of the language. French is a language of politics; it is as useful as English language. Before one can become an ambassador or the related professions, he or she must have the knowledge of the language. This is one of the

reasons that graduates must strive to have the knowledge and the culture of the language. Most political and international posts need French language, therefore; the knowledge of French will enhance the Nigerian graduates to fit in for the posts without denying them.

Equally, it is quite necessary to take note of the fact that French language is a language of conflict resolution and peacemaking. Language is necessary to promote absolute comprehension to settle the rising problems both nationally and internationally. Therefore, most Nigerian Polytechnic graduates are needed to be interested in the language in order to achieve political values.

Diplomatically, most Nigerian graduates think more than their environment, they believe that they need to press forward to keep their intimate relationships with the other countries of the world. Therefore, it is strongly believed that when they have the knowledge of French, this exposes the graduates to many opportunities that can order their lives better. French is one of the working languages of the European Union, along with English and German and the sole language used for the deliberations of the court of justice of European Union. It is the sole official language of the Universal Postal Union (UPU). It is one of the languages of many other international institutions: The Organization of Economic Cooperation and Development (OECD), THE United Nations Educational, Scientific and Cultural Organization (UNESCO), The United Nations Conference on Trade and Development (UNCTAD), The United Nations Economic and Social Council (ECOSOC), The Food and Agriculture Organization of the United Nations (FAO), The Office of the United Nations High Commissioner for Refugees (UNHCR), The North Atlantic Treaty Organization (NATO) etc. All these placed a priority in the faces of the Nigerian graduates which will give them the chances to work with these great diplomatic

organizations and in order to better their lives internationally.

Socio-cultural Benefits of French Studies

French language needs to be studied by 21st century Nigeria simply because of its socio-cultural benefits. Emordi (2007). It is possible for Nigerian leaders and society to be keenly interested in French culture and civilization. Knowing French culture and civilization could bring about unity and solidarity. When one knows about a country, one can easily relate with the country, one can develop the economic transactions with the French-speaking countries; culture is inseparable from a language. The knowledge of French cultural will enhance easy access to French speaking nations for commercial and monetary benefits. Socially, the knowledge of French will help to develop a great rapport with other people from French-speaking countries.

Nigerian polytechnic and university graduates can attend seminars, conferences and meetings in French speaking countries if they have the knowledge of the language and they will be able to understand the bone of discourse in the programme. Buetas M.C (1976:10) Opines that there is no serious-minded organization political, scientific, philosophical or even athletic which does not have the ambition to associate with other groups, sharing its idea outside its national boundaries. Therefore, the language promotes inter-personal relationship among the speakers. Furthermore, those who engage in sports activities need to know more about French. This will help them in their careers. The role of French in developing Nigerian graduates is inestimable. They can plan and travel to France or any francophone country, there they can do exploits as a result of their knowledge of the language.

Educational Benefits of French Studies

As language is the centre of human life, French language is one of the most important languages that express one's love in the midst of the French speakers. It is also vital to achieve many goals and careers. For instance, somebody who studies French and works hard can become a French teacher. In fact, the language is very common in our secondary school nowadays; due to this there are lots of job opportunities for as many who study the language and willing to teach.

Recently, the Rivers state government set up some programmes that will promote the study of French language and creative arts in its primary and secondary schools. While students of two secondary schools in the state are undergoing a two-week holiday training programme on French, prior to the French training programme, which is organized by the state ministry of Education in partnership with Alliance Française under the public private arrangement, the state government had earlier donated a piece of land for the development of French Resource Centre.

The former state commissioner of Education, Mrs Dame Alice Nemi explained that the French training programme is intended to expose them to the study of French for the purpose of inculcating in them the rudiments of French language in a conducive environment, equipped with adequate facilities. This enabling environment will develop their interest in studying the language in tertiary institution in the nearest future.

Multilingualism in the Modern World

The proficiency in multiple foreign languages is a basic prerequisite for successful communication in the world. John (2004). In today's globalized world, the importance of knowing foreign languages is a necessity and multilingualism is viewed as an investment in the future. With the continued expansion of the African Union and European Union, European language policies are moving towards the

teaching of 'at least two foreign languages from a very early age' and describe the knowledge of foreign languages as a 'basic skill' (Euridyce 2005).

In the increasingly mobile and multilingual Europe, knowledge of foreign languages plays an important and sometimes a decisive role in the employability of graduates. It is also important to state that in today's world of globalization; French plays a significant and important role, where intercultural contacts contribute to the development of intercultural dialogue. The knowledge of foreign languages has evidently the key role in the development of tourism which has a multiple role and is viewed as economic, social and cultural activity. Therefore, it is indisputable to state that it represents one of the most important activities of the modern, contemporary society around the world.

All European educational systems are attaching ever-increasing importance to the learning of foreign languages. There is a strong need to educate multilingual and multicultural individuals in a context where the linguistic consequences of globalization are more and more evident. The globalization process is forcing European educational systems to pay more attention to the learning of foreign languages. This should also be applicable to the Nigerian education system. This means that we should promote the importance of learning more than one foreign language in the early age.

The last decade has witnessed a rapid increase in interest in multilingualism. This increase is certainly linked to the commitment of the European Union to a multilingual Europe (Jessner, 2008). The language policy supported by the Council of Europe promotes teaching and learning of several foreign languages in the European educational context. In accordance

with the Common European Framework of Reference for Languages (CEFR, 2001) it was proposed that EU citizens should be proficient in three European languages, their mother tongue (L1) and two other community languages, to ensure multilingualism as an essential characteristic feature of European identity. This kind of policy can also be enshrined in the Nigeria context.

Language is a very valuable resource and those who understand only one go through life with a handicap. Multilingualism, studies have found, has both biological and cultural advantages. While we try to increase our quota in the world, we owe it to ourselves to take the teaching and learning of French language effectively and efficiently. Jibril (2015)

Nigerian students and graduates should wake up to this call to multilingualism - Nigerian companies (our banks, Dangote cement and so many others) are extending their tentacles to the francophone Africa and our University and Polytechnic graduates are crowding in on the few available vacancies here in Nigeria because of the language barrier preventing them from exploring the vast opportunities in Nigerian companies in francophone Africa. Nigerian graduates should be ready to be French compliant, if they want to remain relevant in this fast changing multilingual world. (Nwaogu 2015)

Promoting Intercultural Communication

It is evident that in all professions, beside the communicative language ability, it is extremely important to also develop the intercultural competence, or the ability of successful communication between members of different cultures. In the process of learning a new language it is important to be aware of its cultural aspect(s), because the knowledge of other

cultures helps a learner to learn a certain language and to assess cultural values of that language (Luka, 2007). In order to develop intercultural competence, students should not only learn a foreign language, but such a process should also include intercultural training and intercultural exchange of ideas. It is evident that the knowledge and the skills acquired in this learning process will highly contribute to the development of such an individual in general.

Graduates of our Polytechnics also have to acquire theoretical and practical cultural knowledge, which can be gained through intercultural communication and the development of intercultural competence (Sain 2011). If we transfer this into the area of tourism and hospitality, and try to distinguish what is important to know about the language that hotel and restaurant employees use, we will soon realize that it is not only the knowledge of the grammar and vocabulary that they need to apply but they need to be aware of the importance of socio-cultural aspect as well (Petrovska, 2010). Although their grammatical and their lexical competence of a foreign language may be outstanding, it still can cause cultural misunderstanding Onyemelukwe & Adie-Offiong (2004) or a final failure in communication with native speakers. Petrovska (2010) points out that this failure may be a result of lack of knowledge of cultural differences between the two (or more) societies, or the influence of their mother tongue and direct transfer of meaning in the other language.

Therefore, the programme of French studies and other related course in Nigeria Polytechnics and Colleges of Education needs to be adjusted in order to raise students' awareness of the importance of multilingualism as earlier as possible

Conclusion

This study has exposed relatively the relevance of French language to Nigerian society (leaders, policy makers, professionals, students and informed public) with particular emphasis on our political leaders and policy makers. Attempts has also been made to establish the popularity of French language in all professions in Nigeria as a multilingual and multicultural state where over five hundred languages exist together with English language which is the official language of the country.

For any democratized nation like ours, to attain greatness, the issue of second official language should not be handled with levity. French is supposed to be taught and made compulsory right from the nursery and primary school so that it will not be a great burden or task for the graduates to learn. Though, it has been found to be very useful and its utilization is across the globe. Learning the language does not only give one added advantage but copious advantages.

Equally, due to the tremendous role being played by the French language to develop the 21st century Nigerian political leaders and policy makers, we need to re-engineer the teaching and learning of the language at primary, post primary and as a general course in all higher institutions of learning in Nigeria in order to prepare various Nigeria graduates and professionals for the challenges of learning the language.

The status of French as the de facto second official language in Nigeria and the useful value of the language to all professions should not be over-emphasized. Knowledge of French language should be critically looked into as it has significant effect on the career development of students and Polytechnic graduates. All Nigerians

should be ready to be French compliant, if they want to remain relevant in this fast changing world.

Recommendations

All our leaders, policy makers, graduates of Polytechnics, Colleges Education and Universities should be re-educated to acquire certificates at French language centres (such as Nigerian French Village, Badagry and Alliance Française) to increase French literacy in order to add value to their chosen career as we have in computer today.

French language should be given more priority attention in the three tiers of education in fulfillment of the recent National Policy on Education. French language should be made compulsory in all secondary schools in this country from JSS1-SS3 and at first year of all tertiary institutions as a general course.

The attitudes of students in the Polytechnics and Universities to French language should be positively enhanced in order to improve on their knowledge of the language. Therefore, departments offering French at the moment, the Polytechnic Academic Planning and Quality Assurance Unit, all concerned professionals should embark on sensitization programme that would create an awareness of the relevance of French language as a veritable tool of development for our 21st century graduates.

References

- Adebayo, A. (1999). *Modern European and Nigeria Languages Contact*, Ibadan: Group Publisher.
- Ajiboye, T. (2004). *Fore-runners of French in Nigeria*, Ilorin: Info-links Publishers.

Asake, O.J. (2006). *Introduction to French language* Ife: Lawrence press.

Ayeomoni M.O. (2012). Socio-Political-Pedagogical Problems of Language Teaching in Nigeria. *English Language Teaching* 5 (5) 45-50 (www.ccnnet.org/elt)

Brann et al, (1988); *French as an Integral Language. French as a Plescolect in Nigeria*. In first conference of French studies in Nigeria, Buk, Kami.

Bani T. (1998). *The vision and mission of special education in Nigeria*. In K. Isyaku, M. A, G. Akale et al (Eds), *Vision and mission of education in Nigeria. The challenges of the 21st Century* (60-69) NCCE, Kaduna

Edwards, N. (2000). *Language for business: effective needs assessment, syllabus design and materials preparation in a practical FSP case study*. French for Specific Purposes.

Emordi, F. (2007) *Bonjour le Nigeria comment ça va? The French language in Nigeria so far (1859-2007)* an inaugural lecture delivered in the 28th series of inaugural lectures of Ambrose Ali University, Ekpoma on 29th March 2007.

Essien, O. (2003). *National development, language and language policy in Nigeria*, In O. Essien and M. Okon (Eds), *Topical Issues in Sociolinguistics: The Nigerian Perspective* (21-41), Emhai Port Harcourt.

- Falade, J. O. (2008). *French Graduates and French Teaching in the Nigerian Educational System*, Ibadan: Group Publisher.
- John E. (2004). *Bilingualism in Nigeria: An introduction, Calabar Studies in Languages* (CASIL) (1-11)(11)1, Calabar.
- Igonor J. (2011). *Quality Assurance in the Training of Teachers of French as a Second Language in the Nigerian Colleges of Education. The Nigerian Teacher Today*. Abuja: NCCE.
- Jibril, K. O et als IN “*Asia Pacific Journal of Multidisciplinary Research*”, Vol. 3, No. 3, August 2015.
- Nwaogu , B.U et als.(2015). *L'Introduction au Français Professionnel*, Owerri :Shepherd Consult.
- Ogunbiyi O. (2012). *Implementation of the Senior Secondary School French Curriculum in Lagos State: Problems and Prospects. British Journal of Arts and Social Sciences* 5 (1). Inc (<http://journal.co.uk/BJASS.aspx>).
- Ogunkeye O. (2007). *Bilingualism and the Teaching of English and French in Nigeria. Journal of Social and Cultural Studies*. 10 (2) December 2007(<http://contextjournal.wordpress.com>)
- Onyemelukwe, I. (2004). *The French Language and Literacy Creativity in Nigeria*. Zaria:Labelle Educational Publisher.
- Onyemelukwe, I. (1995). *Teaching French Effectively under Difficult Circumstances in Secondary Schools:The Case of Kaduna State*, Research in Education. 1 (1)
- Onyemelukwe I. And Adie-Offiong V. (2004). *Deceptive Cognates in a French class in Nigeria. Education et Societes Plurilinguistiques*. 17 (18).
- http://www.eurydice.org/ressources/Eurydice/pdf/0_integral/049EN.pdf (5 April, 2012).
- <http://www.world-tourism.org/highlights.KeyDataonTeachingLanguagesatSchoolinEurope>.
- <Http://www.hawaii.edu/satocenter/langnet/definitions/aave.htm> (accessed 08-08-15)

A Survey of Urinary Schistosomiasis in Ikngwakap Mushere Chiefdom Bokkos Local Government Area of Plateau State, Middle Belt, Nigeria

Dangot Godfrey Gufom

Department of Science Plateau State Polytechnic Main Campus

dgufom@yahoo.com

Abstract

Schistosomiasis is classified among the thirteen (13) diseases, as a life threatening infection among the human population by World Health Organization. The survey was carried out in Ikngwakap-Mushere Chiefdom Bokkos Local Government Area of Plateau State Middle Belt Nigeria among 200 volunteers. Microscopic examination of the urine samples were carried using standard parasitology configuration technique for the analysis. A total of 200 urine samples were examined showing prevalence of Schistosoma haematobium as 22 (11%) in the District; comprising (11.67%) males and (10) females infected. There was an insignificant difference in the distribution of the disease between males and females. 0.05% infection was among age group. 10-20 years; followed by 7.5% in 21-30 years of group, while those within the aged group of 0-1, 31-40 and above years were (0.5%) respectively. Statistical analysis shows that infection rate is different significantly. 0.05% among the various groups are prevalence in the village indicate that Kopdil, Kwales and GSS Mushere was 10% Dashung, Dimar, Kopyang and Tongder 7.5% each while no infection was recorded in Poraum and Mission compound. The prevalence in occupations shows that the highest among farmers 8 (6.7%) while 0.5% was recorded among pupils and applicants. Despite the low percentage infection recorded in both males and females, it constitutes a major public health problem in the locality thus, State Government should provide safe portable water, latrine and functional health facilities to rural communities as a means of prevention.

Keywords: Survey, Urine, Schistosomiasis, Ikngwakap-Mushere Chiefdom.

A Survey of Urinary Schistosomiasis in Ikngwakap Mushere Chiefdom Bokkos Local Government Area of Plateau State, Middle Belt, Nigeria

Introduction

Schistosomiasis also known as Bilharziasis is a water borne disease caused by parasitic of the genus schistosoma, a digenitrematodes that reside in the blood vessels of man. (World Health Organization 2007, Arora & Arora 2008, 2012, Sibomana 2009). It was first discovered in Cairo Egypt in 1851, by Theoder Bilharzia, German pathologists in the blood mesenteric vein of a young man autopsy (Arora & Arora, 2008, 2012, Sibomana 2009).

There are five main species that infect human out of which four (4) causes intestinal *schistosome* these include *schstosome*, *mansonii*, *schistosoma japonicum*, *schistose mamekogi*, *schistosema intercalated* and *schistosema haematobium* that cause urinary schistosomiasis (WHO 2007, Arora and Arora 2012, Uwaezuoke et al., 2015, Goselle et al., 2010).

Schistosomiasis infection is prevalent in the tropical and sub-tropical areas, especially in poor communities without access to safe drinking water, poor sanitation facilities, poverty, ranking second to malaria and posing a threat public health and social economic threat in sub-Sahara Africa (SSA). Sibomana 2009, Abiola et al., 2015, Goselle et al., 2010).

This disease is listed among the thirteen (13) diseases classified by WHO as (Neglected Tropical Disease) (NTD). They are named so because they persist in the poorest and marginalized people who are often subsistence farmers especially living on no money and sulk poverty, with no education, simply because they are mainly in rural Areas where families depend on crude agriculture, they impair productivity. (Siboman 2009).

The disease is endemic in 79 tropical developing countries of the world. It is estimated that about 600 million people suffer from *schistosomiasis*, also more than 200 million people residing in rural

predominately agricultural areas infected and between 500 to 600 million are exposed to the infection because of poverty ignorance, poor hygiene practices, inadequate or total lack of public health facilities and non-availability of sanitary facilities (Assafa et al., 2004).

Urinary schistosomiasis is a chronic disease and cause pain to the victims with prolonged untreated infection; the ureters may become obstructed and the wall thickened leading to abnormal bladder malfunction with painful and frequent urination, urinary infection and eventually kidney damaged. (Cheesbrongh, 2004).

Bulimus Snail's species transmitted *schistosoma haematobium* which is the chief causes of urinary schistosomiasis in Africa and in the Arab world (Lucas & Gilles, 2013). It is a burden in Sub-Sahara Africa and can cause glomerulonephritis pulmonary hypertension and squamous cells carcinoma of the bladder. Anaemia and under nutrition. Schistosomiasis and anaemia in children has also been contributed to poor growth and reduced school performance. The burden of the disease causes an estimated 8-60 million disabilities adjusted to life year (daily) every year (Aason et al., 2011).

Feldmeris et al., (1998) reported an estimated 50% to 80% of girls with *schistosoma haematobium* causing genital lesion and women parasitized by those species. It is believed that genital schistosomiasis can influence infertility and cause complications in pregnancy. In this context, two problems are expected to arise, ectopic pregnancy and pathological complications of normal pregnancy leading to life-threatening: peritoneal bleeding and death have been reported from Brazil, infection of placenta may cause still birth, abortion, premature onset of labor. WHO (2007), reported 66 million children alone infected with urinary schistosomiasis in 54 countries.

A Survey of Urinary Schistosomiasis in Ikwgwap Mushere Chiefdom Bokkos Local Government Area of Plateau State, Middle Belt, Nigeria

Hotezet al., (2009) reported that two-third schistosomiasis cases are due to infection caused severe urinary tract diseases. Haematobium produces bladder wall pathologies in approximately 18 million people in SSA, and 10 million in hydronephrosis. Maxwell 2008, in Hotez et al., (2009) also observed that renal failure accounts for large percentage of the estimated 150,000 deaths from urinary tractschistosomiasis in SSA, and there is also a significant association between major bladder wall pathology and squamous cell carcinoma. A significant percentage of men and women with urinary schistosomiasis acquire genital ulcers and other lesions: urogenital schistosomiasis is a significant cause of poor reproductive health including sexual dysfunction and infertility. Genital *schistosomiasis* also promotes the horizontal transmission of HIV/AIDS in SSA (Hentze et al., 2009). Ansong et al., (2011) reported *schistosomiasis haematobium* as high 60% infection in communities in a Ghana, Nkongazon et al., (2013) revealed an alarming of 69.17% prevalence of *schistosomiasis haematobium* in Berom Kotto Focal South West Cameroon: Telted et al., (2013) cited in Abiola et al., (2015) also reported the prevalence in Niakhai District of Segenal (57.6%) Eastern Cape Tozon province of South Africa (73.5%), Arborvites, Cote Devour (53.8%) Mozambique (44.7%), Daekene in Niger Republic (47.7%) the presence of *Schistosomiasis haematobium* in Nigeria has been known since 1881 from the account of German Traveler NACHTIGAL who passed through the Eastern region of Borno State, Cowpers, cited in Atlas of the global distribution in Nigeria by Pulani (Puelamherdmen) arriving from upper Nile valley (GEA ETCNRSIDMS WHO, 1987). Isaac, (2009) stated that Nigeria is one of the most severely affected countries in Africa. It is estimated that 101.28 million people are at risk of infection while 25.83 million are infected with *Schistosomiasis haematobium*. Previous work on *Schistosoma haematobium* in Nigeria cut across some States has revealed that present of the disease. A preliminary

parasitology machological was conducted in rural communities in some Local Government Area of Plateau State, Middle Belt indicated that prevalence of urinary schistosomiasis and identified active transmission foci. Out of 2888 persons examined in six (6) LGAs 1381 (47.9%) were excreting eggs of *schistosoma haematoium* in their urine; Pankshin (62.4%), Shendam, Quan'pan and Langtang South (45.4%), (40.20. Lantang North (58.9%) and Wase (50%). Akufongwe et al.,(1996), Pukuma et al., (2007), reported the prevalence of (48.9%) infection in a rural community of Waduka Lamorde L.G.A Adamawa with males (54%) and females (46.9%) (Okon et al., 2006 Agum & Banke 2006), reported 1 year old in Abini community Baise L. G. A. Cross River State. Okoli et al., (2006) reported (24.33%) in pupils in Kam/Abinese District of Guma L.G.A Benue State. The aim of the study is to survey urinary schistosomiasis in Ikngwakp Mushere chiefdom Bokkos Local Government Area of Plateau State, Middle Belt Nigeria.

Materials and Methods

Study Area

The study was carried in Ikngwakap headquarters of Mushere chiefdom, Bokkos Local Government Area of Plateau State. Ikngwakap is located about 83km from Jos the capital of Plateau State. It is a rural settlement where social amenities such as pipe borne, or borehole water are lacking. The villagers depend on various streams for their various water related activities which may be domestic and agriculture. There are also no toilet facilities; hence urination and defecation are done in nearby bush.

Study Population

The study population comprises of adults, young children both male and females between the age of 6-51 years and above in the study area. A total of 200 people were employed for these study.

A Survey of Urinary Schistosomiasis in Ikngwakap Mushere Chiefdom Bokkos Local Government Area of Plateau State, Middle Belt, Nigeria

Ethical Clearance

Prior to the study survey ethical clearance was sought and received from appropriate authorities, that is from the district head, pastors and the stakeholders in the villages. They were briefed on the purpose of the research before samples collection. The subjects were asked for their age, sex, and occupation in an interview questionnaires.

Sample Collection

Each subject for the study was given one labeled sterilized specimen bottle for the collection of urine. The labeled bottles were distributed randomly to the selected people in the study areas with instruction to deposit terminal between the hours of 11am-2:00pm in the sterilizer bottles. The urine collected were tested immediately for hematuria using (combi9) strip reagent. Two-three drops of commercial beach solution were added to each of the urine sample as preservation and were transported to microbiology laboratory of Plateau State main campus Heipang for analysis (Okon et al 2007, Ngele & Okeye, 2016).

Laboratory Analysis

The urine samples were mixed thoroughly before transferring it at 10mls into centrifuge tubes and centrifuged at 5,000rpm for 5 minutes (Ngele & Okeye, 2016). The supernatant was discarded and the deposit or sediment was transferred to a clean grease free slide (Ngele & Okeye, 2016). It was then covered with coverslip and examined microscopically, with 10x objectives identification of ova or eggs of *schistosoma haematobium* in the specimen.

Data Analysis

Chi-square was used to determine whether any relations exist between en-parasites ova, cyst and contamination of different.

Results

A total of 200 urine samples were collected and examined for *schistosoma haematobium* out which 22 were positive giving a total prevalence of 11%. The distribution shows that fourteen (14) males were positive for *schistosoma haematobium* (1.16%) and eight (8) females positive (10%) (Table 1). It shows that there was significant difference $p > 0.05$, in the infection rate among gender.

Table 2: shows the relationship between age group and prevalence of *schistosoma haematobium* in the study area. The highest prevalence of (10%) was recorded age group of 11-20 years followed by (7.5%) in 21-30 years of age, where as those within the age group of 0-11, 31-40, 41-50, 51 and above years were (05%) respectively. Statistical analysis shows that infection rate different significantly $p > 0.05$, among the various group in the area.

Table 3: Shows the distribution of *schistosoma haematobium* in the villages with Kopdil, G.S.S Mushhere and Kwales (10%) having the highest prevalence infection rate followed by Dangshang (7.5%), Kopyang, Dimar and Tongder (05%) each. Statistical analysis shows significant different $p > 0.05$ in rate of infection in the villages.

It was observed that in farming occupation had the highest prevalence of (19.05%) followed by (98.3%) among students, and will servant (6.67) with least (05%) infection in pupils and applicant. There was a significant $p > 0.05$ in the infection among the various occupation (Table 4).

Table 1: Distribution of urinary schistosomias is according to gender in the study area.

Sex	Number Examined	Number Infected	Prevalence (%)	χ^2	pvalue
Males	120	14	14(11.67%)	0.136	0.712
Females	80	8	8(10.0%)		
Total	200	22	22(11%)		

Table 2: Distribution of Urinary Schistosomias is according to age in the study Area.

Age Group (Years)	Number Examined	Number Infected	Prevalence (%)	χ^2	pvalue
1-10	40	2	2 (05%)	1.395	0.925
11-20	40	4	4 (10%)		
21-30	40	3	3 (7.5%)		
31-40	40	2	2 (0.5%)		
41-50	20	1	1(05%)		
51 & above	20	1	1(05%)		
Total	200	13	13 (6.5%)		

Table 3: Distribution of Urinary schistosomias is according to the villages in the study

Villages	Number Examined	Number Infected	Prevalence (%)	χ^2	pvalue
Kopyang	20	2	2 (05%)	8.303	0.404
Kopdil	20	4	4 (10%)		
Dangshang	20	3	3 (7.5%)		
Dimar	20	2	2 (05%)		
Tongder	2	1	1 (05%)		
Poram	20	0	0 (00%)		
Mission compound	20	0	0 (00%)		
Kwales	20	2	2 (20%)		
G. S. S. Mushere	40	4	4 (6.5%)		
Total	200	13	13 (6.5%)		

A Survey of Urinary Schistosomiasis in Iknwakap Mushere Chiefdom Bokkos Local Government Area of Plateau State, Middle Belt, Nigeria

Table 4: Distribution of urinary schistosomias is according to occupation

Occupation	Number Examined	Number Infected	Prevalence (%)	χ^2	pvalue
Farmer	42	8	8 (19.05%)	6.966	0.138
Civil servant	30	2	2 (6.67%)		
Students	48	4	4 (8.3%)		
Pupils	60	3	3 (5.0%)		
Applicants	1	1	1 (5.0%)		
Total	200	18	8 (9.0%)		

Discussion

The result of this study has demonstrated the existence of urinary schistosomias is in Ikngwakap District of Mushere-Chiefdom, Bokkos Local Government Area, Plateau State, Middle Belt Nigeria.

The survey on the prevalence of urinary *Schistosomias is* in Ikngwakap was carried out between December 2017 and March 2018. Among the 20 persons examined in the study revealed overall prevalence in the study area.

The overall prevalence of 11.67% *Schistosomias is haematobium* recorded in the study area confirmed confirm presence of the disease. The prevalence appears relatively low in the area; however, this may constitute public health hazard as it could increase unless curtailed early. The prevalence reported in this study is higher than those reported by other researchers (Uwaezuokeet al., 2007, Ukpai & Ezekiel, 2002).

Result obtained shows variation in the distribution of urinary schistosomias is infection in relation to sex, age location and occupation. The 11.67% overall prevalence rate of urinary schistosomias is observed

in the research is in conformity to previous finding in Nigeria Akufon et al., (1996), revealed the overall prevalence of 47.93% in six (60 LGAs of Plateau State, they also reported the prevalence of urinary in these six LGAs as follow: Pankshin 62.4%, Shendam 42.2%, Lantang North 50% and Wase 50%. Okpala, et al 2004), reported 0.05% among some private primary/secondary schools in Apata Jos, Plateau State Nigeria; Uwaezouke et al., (2007) 8.1%, with 32 (8.9%) in males and 27 (7.2%) in females, 9.2% among the age group between 11-2 years infection in Imo State. Agum & Banke (2006) noted prevalence of urinary schistosomias is from five (5) selected primary schools in Guma L.G.A of Benue State had the overall prevalence of (24.33%), males and females recorded (27.03%) and (21.71%) respectively. Pukuma & Musa (2007) observed to have the overall prevalence of 48.0% of those examined were infected. The males were observed to have a prevalence rate of (52.0%) than females (46.0%), it was observed that resident within the age group of 10-20 years (52.0%) were the most infected while the least (37.5%) was recorded in resident aged 41 years (52.0%) and above. Infection in relation to occupations, fishermen (65.2%), farmers (50.75%), students (48.3%) were the most infected people and civil servants (33.3%). Prevalence in Wadukuin Lamadre L.G.A of Adamawa State. Okoli (2006)

A Survey of Urinary Schistosomiasis in Ikngwakap Mushere Chiefdom Bokkos Local Government Area of Plateau State, Middle Belt, Nigeria

reported (11.3%) prevalence in some communities of Ahagi/Egbena L.G.A of Imo State. Okon et al., (2007) also reported prevalence of urinary schistosomiasis 40 (39.2%) in males, females 30 (30.6%) in Abini (2009) recorded (18.3% in ABU Saramu Zaria, Kaduna State. Ngele et al., (2016) noted the prevalence of urinary schistosomiasis as (44.84%) in Agu L.G.A of Enugu State Nigeria. The prevalence in respect to their age 189 (60.97%) children between 12-14 years were most infected with schistosomiasis 46 (14.84%) while 3-7 years had the least prevalence (9.86%) of urinary schistosomiasis. Community Baise L.G.A of Cross Rivers State, Nigeria. Isaac (2009) recorded.

A similar finding of urinary schistosomiasis infection has been reported in Ghana rural setting in 2011. The overall prevalence of 41.1% was rerecorded the highest prevalence was in the age group of 10-14 years (71.0%) with lowest among age group of 30-54 years (Asong et al., 2011).

These similarities in this overall prevalence in various studies in Nigeria and Ghana indicate similar water related practices in the various localities, state and countries by the people. More so, majority of the people deepened on stream, pond and rivers source of water supply, prevalence of urinary schistosomiasis which is probably due to indiscriminate urination and defecation in the near bush by the people possibly also contributed to the prevalence rate reported in this study.

In the study males had the highest prevalence rate of infection than females which might be due to the fact males are more exposed to infection during the research, because activities such as swimming, farming, and playing in streams, rivers, ponds unlike the females whose activities with water are mainly fetching of water and washing, more for females are always shy or scared of swimming. This finding agrees with those of Dakul (1999), Uwaezuoke et al., (2007), Pukuma & Musa (2007). Although,

statistical analysis showed the infection did not vary significant. Subjects within age group of 11-20 years were more infected. The contributed to their engaging in swimming, or playing in rivers, streams or ponds. There was slight difference in infection rate among the various villages studied. The distribution of infection in relation to occupation showed that farmers were most infected (19.5%), followed by students (8.3%) whereas lowest infection was most among pupils and applicants. This also agreed with the result obtained in Adamawa State by Pukuma & Musa (2007).

Conclusion

This study has shown that urinary schistosomiasis is endemic in Ikngwakap-Mushere Chiefdom Area though of low prevalence. This observation is of public health significance and could be a threat to socio-economic important activities in the area.

If not quickly checked, there is urgent need therefore for the Local Government, State Government as well as Federal Government to established control programmes in the area.

Recommendation

Schistosomiasis, as with many communicable disease is as a result of inequality and poverty people get infected because they do not have access to safe, portable water and maintain transmission because of absence of proper excerptor and rune disposals system.

1. The Federal, State and Local Government should provide safe water latrine and health facilities to rural communities.
2. Public enlightenment on the method of transmission and danger of the disease by Federal, state ministry of health and health department of L.G.A.
3. Health Education campaigns in rural communities, environmental sanitation,

A Survey of Urinary Schistosomiasis in Ikngwakap Mushere Chiefdom Bokkos Local Government Area of Plateau State, Middle Belt, Nigeria

personal hygiene should be introduced and laws be enacted and enforced on all the citizens to curb the transmission and spread of the disease.

4. Improving the social-economic conditions of citizen in communities will no doubt enhance the control of Schistosomiasis, harm or danger and mortality caused by worms through provision of wells, boreholes by well spirited individuals and non-governmental organization
5. Free screening of citizen in the communities, administration of anti-Schistosomiasis medicine could play an important role in reducing the infection in the countries.

References

- Agum G.N & Banke R. O. K (2006) Prevalence of Human Schistosomiasis among primary Scholar primary School. Pupils of Kaanlaba district Gururu Local Government Area; Benue State. Abstract Nigeria Journal of Parasitology pp.28.
- Arora, D. R. and Arora, B. (2010). *Medical Parasitology* Third Edition CBS Publishers and Distributors New Delhi, Banglor India.
- Assafa, D., Kibru, E., Nagesh, S., Gebreselaslie, Deribe, F. & Ali, J. (2004). Medical Parasitology Lectures Notes For Degree and Diploma for Health Science Students. Ethiopia Public Health Training initiative, the carter center, the Ethiopia Ministry of Health and the Ethiopia Ministry of Education.
- Asong D. Acader; S.C-Crook Ksto B. T Beck C, Gyam Pamoh, T.I Amusans I.H, Boakye I Sylverken J. Oforian A., Hele D. Akato Y.O.A & Larsen R.S (2011). Role of *A Survey of Urinary Schistosomiasis in Ikwgwap Mushere Chieftdom Bokkos Local Government Area of Plateau State, Middle Belt, Nigeria*
- Diagnostic Testing in Schistosomiasis control program in Rural Ghana. Journal of Bacteriology and parasitology. <http://dx-org.110417.e12155-957>.
- Cheesbrough, M. (1987). Medical Laboratory Manuel for tropical Countries second Edition Volume 1 ECBS Cambridge p 323-341.
- Cheesbrough, M. (1999). District Laboratory Practice in Tropical Countries, Parasitological Tests pp238-239.
- Dakul, Dd. A. (1995). Seminar Paper (PhD) unpublished Department of Zoology University of Jos. Plateau State, Nigeria.
- Edward, F. (2010). Parasite Cleanse resource Centre <file://Rabjib290.29clean>
- Felder, H., Daccal. C.R., Martin, J. M., Soares, V. and Martin, R. (1998). Genital manifestation of SchistosomiasisMansoni in Women: Important but Neglected. Memorial Institute Oswaldo Cruz, Rio de Janeiro 93 (1): 127-133.
- GEGETCNRS/OMSWHO (1987). Atlas of the Global Distribution of Schistosomiasis 17- Nigeria.
- Goselle, N. O., Anegbe, O., Imandeh, G. N., Dakul, D. R., Onwuliri, A. C. F., Abba, O. J., Udeh, O. E and Abele, A. M. (2010). SchistosomiasisMansoni. Infection amongst School Children in Jos Nigeria. Science World Journal 5 (1) 42-45.
- Hotez, J. P & Kamath, A. (2009). Neglected Tropical Disease in Sub-Saharan African: Review of their prevalence, Distribution and Disease Burden www.plosntds.org 3 (8)

<http://www.stanford.edu/class/humanbio/ozparasite2004/scisto/web?>

- Isaac, o. A (2009). Prevalence of Snail vectors of Schistosomiasis and their Infection Rates in two Localities within Ahmadu Bello University 9A. B. U) campus Zaria, Kaduna State Nigeria *Journal of Cell and Animal Biology* 13 (4) 052-061.
- Lucas, O. A. & Gills, M. H. (2003). Short Textbook of Public Health Medicine for tropical 4th edition Holder Arnold part of Hachette Liver U.K pn 141-151.
- Ngele, K.K & Okoye, n. T. (2016). Prevalence of Schistosomiasis Infection among Primary School Pupils in Awgu L.G.A, Enugu State, Nigeria *Journal of Parasitology* 37 (1) 11-15,
- Nkengazong, I., Njokou, F. & Asonganyi, t. (2013). Two years impact of single Praziquantel Treatment on Urinary schistosomiasis, in Barambi Kotto focus. South West Cameroon *Journal of Parasitology Vector Biological* 5. 8-9.
- Okoli, A. (2006). Prevalence and Distribution of Urinary Schistosomiasis in nine (9) Communities of Obji/Egbema Local Government Area of Imo State, Nigeria *Journal of American Science* 2 (4) 46-49.
- Okon, O.E., Udonttu, M. E., Oku, E. E., Nta, A, I., Etim, S. E., Abraham, J. T. & Akpan, P. A. (2007). Prevalence of Urinary Schistosomiasis in Abina Community, Biase Local Government Area of cross river State Nigeria. *Nigerian Journal of Parasitology* 28 (1) 28-31.
- Okpala, H.O., Agwu, E., Agba, M. I., Chimezie, O. R., Nwoba, G. O. & Ohihin, A. A. (2004). A Survey of the prevalence of Schistosomiasis among Pupils in Apata and Larato Area Jos. Plateau State Nigeria. *Ojhas Published Quarterly Mangoloies south India* 3.
- Pukum, M.S. & Musa, S. P. (2007). Prevalence of Urinary Schistosomiasis among resident of Waduka Lamorde Local Government Area of Adamawa State, Nigeria. *Nigerian Journal of Parasitology Text Limited Flow Limited Ibadan Nigeria* 28 (2) 65-68.
- Sibomana, I. (2009). Association of Schistosomiasis prevalence with socio-demographic status Measures in Sub-Sahara Africa. University of Pittsburgh.
- Uwaezuoke, J.C., Anosike, J.C., Nwoke, B. E. B. & Dozie, I. N. S. (2007). Urinary Schistosomiasis in Ihitte Uboma Local Government Area Imo State. *Nigerian Journal of Parasitology Text Flow Limited Ibadan* 28 (2) 90-94.
- Ukpai, O. M. & Ezekiel, A. C. (2002). The Prevalence of Urinary Schistosomiasis among Primary School Children in Agu L.G.A Anambra State Nigeria. *The Nigerian Journal of parasitology* 32: 139-144.
- World Health Organization. (2004). The UNICEF-UNDP World Bank WHO special programme for Research on control Schistosomiasis.
- World Health Organization. (2007). Geneva, an update report of WHO Division of tropical Disease.

A Survey of Urinary Schistosomiasis in Ikngwakap Mushere Chieftdom Bokkos Local Government Area of Plateau State, Middle Belt, Nigeria

World Health Organization, (2014). WHO Schistosomiasis fact sheet available from <http://www.who.int/mediacentre/factsheets/fs115/en>. (Accessed 1004.14)

Gendered Preferences at an Early Age as Affecting Choice of Fields of Study in South- South Universities in Nigeria

Nwokoro, Catherine Isioma^{*1} & Nwokeocha, Martins Ifeanyi

^{*1}Wellspring University, Benin City,
Edo State.

Mobile no: 09132768927

^{*}Corresponding E-mail: isyamra2013@gmail.com

²Heritage Polytechnic, Eket, Akwa Ibom State.

Mobile no: 08038592101

E-mail: giftedmartins41@gmail.com

Abstract

The study investigated if gendered preferences made at early age among students can influence their choice of fields of study in the Universities in the South- South region of Nigeria. The Universities studied were the private, state and federal institutions of higher education. The objectives set for the study were to: ascertain if the students of Western Delta University (WDU), University of Benin (UNIBEN) and Rivers State University understand gendered preferences made at an early age entails, identify whether students from Western Delta University (WDU), University of Benin (UNIBEN) and Rivers State University choice of study were influenced by gendered preferences made at an early age and determine whether students from Western Delta University (WDU), University of Benin (UNIBEN) and Rivers State University choice of study were influenced by other factors in the South- south region of Nigeria. The theories used for the study were Gender role, Gender Schema and Social constructionism theories with a population of 132,700 from the University of Benin, Benin City, Edo State (Federal – owned University), Western Delta University, Oghara, Delta State (Private – owned University) and Rivers State University, Rivers State (State – owned University). A sample size of 384 was determined by Krejcie and Margan sample size determination. In conclusion, the study discovered that, students in private Universities are more prone to getting gendered on their choice of field of study than their counterparts in the public Universities in South- south, Nigeria. As a result, the study recommends that, parents and other persons in charge of the nurturing of children should endeavor to avoid influencing their children through gendered actions.

Keywords: Gendered Preference, Gender, University, South- south Nigeria and Students

Introduction

Gendered preferences have been a source of concern for feminists and scholars in the academic environment. The resultant influence that gendering as a concept has on reality in terms of the inhabitants of a particular environment can be very much noticeable. Gender as a term simply means the social construction of behavior, norms and actions that defines men and women in the society which becomes reality overtime (Okeke, 2005; Curran & Sue, 2010).

Getting gendered in any society involves a reshape of norms, behaviours and roles of an individual to suit the society's wants whether in a male or female child and even an adult (Nwokoro & Ekwunife, 2020). This boils down to finding out the knowledge gap that revolves around deciphering if a student's preference for a particular field of study is tied to the gendering role plays assigned to a given academic context within a particular society like the South- south region in Nigeria.

It is important to note that, this line of study is very relevant to Africa and Nigeria in particular as it has raised arguments in diverse places. According to researchers in the field of gender studies, Africa is a very volatile continent filled with diverse cultural influences, gender- specific treatment effect, gender stereotypes and other motivational factors that most times guides an individual in whatever course of life to operate from (Lopes & Vogel, 2020). Like the pursuit of academic knowledge, the kind of course of study taken in schools is determined by certain factors in the wider society. But if gender is part of this influence on what university students in South- south region of Nigeria choose as their choice of field of study, it is yet unknown, hence this study.

Statement of the Problem

It is been the trend that students in Nigeria face pressures from parents, family members, peers, work environment, stereotypes of masculine and feminine ideology and availability of employment opportunities associated with particular disciplines are on the high and

noticeable virtually anywhere one looks. But do these people influence these young minds on choice of study in South- south, Nigerian Universities? These raises concerns as it has come to the point that, students in Tertiary institutions often times make their choice of study before gaining admission in to the University. During the periods of reading and sitting for WAEC, UTME and Post- UTME examinations which are prerequisites to gaining admissions in to the University, there are factors like peer pressure, financial considerations, family influence or the parents- choose - for- me syndrome, religious background and the ideology that some course of study that are Mathematics-related are meant for the boy child and not the girl child among other factors leads to the question on whether gender preferences has a way of influencing a child's choice of study or if it is the child that makes such choice by his/ herself. This research gap is what this study is out to fill.

Objectives of the Study

The main aim of this study was to investigate whether gendered preferences at an early age affects students' choices of study in the Universities in South- south region of Nigeria. Specific objectives that guided this study were:

1. To ascertain if the students of Western Delta University (WDU), University of Benin (UNIBEN) and Rivers State University (RSU) understand what entails gendered preferences made at an early age.
2. To identify whether students from Western Delta University (WDU), University of Benin (UNIBEN) and Rivers State University (RSU) choice of study were influenced by gendered preferences made at an early age.
3. To determine whether students from Western Delta University (WDU), University of Benin (UNIBEN) and Rivers State University (RSU) choice of study were influenced by other factors in the South- south region of Nigeria.

Research questions

This work was guided by the following questions:

1. Does students of Western Delta University (WDU), University of Benin (UNIBEN) and Rivers State University (RSU) understand what entails gendered preferences made at an early age?
2. Were students of Western Delta University (WDU), University of Benin (UNIBEN) and Rivers State University (RSU) choice of study influenced by gendered preferences made at an early age?
3. What other factors in the South- South region of Nigeria influenced students from Western Delta University (WDU), University of Benin (UNIBEN) and Rivers State University (RSU) choice of study?

Scope of the Study

This study focused on three Universities in the South- South region of Nigeria. The selected Universities are: University of Benin, Benin City, Edo State (Federal – owned University), Western Delta University, Oghara, Delta State (Private – owned University) and Rivers State University (State – owned University). The reason for this is to ensure that the Universities chosen for the study cuts across the three types of University system operating in South- south region of Nigeria in order to give room for diverse opinions from students in these institutions (Private, State and Federal). The essence was to find out from them if gendered preferences promoted their choice of study in their various disciplines in their Universities.

Justification of the Study

This study will be relevant to scholars in media studies, psychology, Education and Ministries of information, Culture and Policy makers in South-south region of Nigeria and beyond as it is a very important area of concern regarding early

upbringing, gender and its possible influence on a child or a potential student.

Gender is an interesting area that has been an arguable field for decades in Nigeria and beyond by scholars and academics. As a result, these researchers deem it fit to study what necessitates a students' choice of study in the University especially being the fact that Nigeria is a multicultural country (Jimoh, 2017; Chinyere, 2005) with diverse views, ethnicities and religions all geared towards shaping a child's view to living, education been part of it. It is the hope of this study to help solve this gap in knowledge.

The research area hopes to be a relevant guide on children, parents, guardians and especially young children who have the hope of furthering their education beyond the elementary stages in to the tertiary unit of learning like the University.

Theoretical Framework

The three theories that were employed for this study were: Gender role, Gender Schema and Social constructionism theories.

Gender Role Theory

Gender role are socio- culturally defined prescriptions and beliefs about the behavior and emotions of men and women (Anselmi & Law, 1998). As a result, it is perceived by many authors and theorists that, perceived gender roles form the bases for the development of gender identity (Buss, 1995; Shield, 1975).

The emergence of Gender role theory goes back to the work of Money, John and co- researchers (1955) and Goldie (2014). These scholars provided the principles that guide the understanding of gender as a socially constructed norm with regards to sex categorization of individuals in society which emphasizes the notion of males and females as a distinct gender identity whose actions and inactions are subsumed (Odia- Osazee & Nwokoro, 2021).

Gender role theory explains the differences in role playing between men and women in the

Gendered Preferences at an Early Age as Affecting Choice of Fields of Study in South- South Universities in Nigeria

society and the way individuals' attributes unfold in a particular group behavior and relationship possibly at the level of influencing students in a University setting. Simply put, the gender role theory provides a theoretical basis in explaining how men and women are perceived differently as leaders, students, workers, family relationships among others since, individuals have role expectations on which they are known and identified with (Blackstone, 2003; Gauntlet, 2008 & Enwefah, 2018).

This theory discusses the gender roles centred on conceptions of masculinity and femininity. Instances are abound on this. Men and women in a non- traditional gendered occupations includes a male midwife, women sworn in as combatants in the Army, a woman who is a construction worker and a male kindergarten teacher. Gender roles influence a wide range of human behavior, including the outfit or the job one is employed in to.

Gender role is not the same thing as gender identity. The former originates from the internalized identities that forms the core of a human being while roles are assigned by the expectations drawn from the external environment by the members of the society (Wikipedia, 2022).

Gender Schema Theory

This theory was developed in 1981 by Sandra Bem, a social psychologist in the United States whose major role was to study the US population particularly children (Starr & Zubriggen, 2017). The Gender Schema Theory (GST) was postulated to study how a child processes information with regards to gender. A gender schema serves essentially as a cognitive filter of a sort that guides individuals on how to decipher and choose masculine and feminine categories in any circumstance they get involved with (Davis & Wilson, 2016). A schema is the structure or an association that guides and organizes the perception of an individual or a child in any society. Sandra (2016) cited in Christine & Eileen (2016) adds that, a child grows up within a heterogeneous networks of sex- related themes in

other to assimilate any information based on evolving gender schema.

Been gender schematic simply refers to been able as an individual to sort information, process it and choose the categories to place the information received in to gender categories that suits the individual (Sandra 1981 cited in Starr & Zubriggen, 2017). To the founder of the theory, children specifically make schemas which guide them on what is masculine or feminine. This theory is closely related to the social learning theory by Albert Banduras with regards to a child's learning and development process. The slight difference between the two theories is that, the GST is concerned with how a child chooses the gender form (masculine or feminine) to stick through the aid of schematic categories while the social learning theory states that a child learns through observation from the society.

The GST theory is relevant to this study as it guides to the understanding of the concepts used in this study with regards to what influences a child's choice of study in the University based on gender schema.

Social Constructionism Theory

This theory stands on the notion that, people within a particular society develop meanings to any event based on the meanings drawn from the attached reality to such events (Wikipedia, 2022). According to Nickerson (2021), the social constructionism theory is based on how individuals in a society develop their knowledge and understanding of the world. The proponents of this theory further stated that, understanding the world is based on so many social constructions.

The founders of this theory, Peter L. Berger and Thomas Luckman in 1966, made it clear that, as human we construct realities from those influences which we get from the social environment in which we find ourselves, with an emphatic look on social interactions which is responsible for the understanding of social reality.

This theory is relevant to this study as it is able to state that, gender preference on a choice of study in a University can be influenced by the social construct that an individual is exposed to. Critically, it is stated that, no phenomenon is entirely and objectively true.

Literature Review

Sources of Literature

This study reviewed related literatures from EBooks, textbooks, blogs amongst others in order to properly aid understanding of the key concepts of this study.

Conceptual Definitions

Gender

The term gender has to do with the social construction of behaviours and actions. Before the study of gender, the issue of gender simply meant the sex: male or female. The term took its new value from the 1970s when academic feminist started 'complaining' about the universal use of sex as an independent variable in determining one's behaviour and thinking. The word gender according to John & Ken (2005, p. 309), is the social aspects of differences and hierarchies between male and female. This is so because gender is evident throughout the world, shaping how we think about ourselves, guiding our interactions with others as well as influencing our work and family life (Nwokoro & Ekwunife, 2020).

Saul (2014), states that although biological differences are fixed, gender differences are the oppressive results of social interventions that dictate how men and women should behave in a given society. However since gender is mutable or changeable, it then means that it can be altered by a political or social reform (Curran & Sue, 2010). Such changes can either favour a particular sex or the other particularly in areas of education with regards to Nigeria.

Contextually speaking, the world of education is a choice made by the individual either early in age or while growing up. This can be influenced by a

special person of interest to the child in question. Getting gendered may be very early or later in the life of a child or a young adult.

Gender Preferences

Gender preferences is described as the sexual discrimination as practiced by parents in favouring one child to the disadvantage of the others based on sex (www.encyclopedia.com/2019). Preferences can be varied, individualized as well as influenced to guide a young child on what form of gender category to choose from. The society one grows in can be a major influence on the social development and educational advancement of the child, a youth or an individual as the case may be (Marcionis & Ken, 2005). But if gender influences the preferences made on the choice of study of a child towards gaining a degree in the University, is yet unknown, hence this study.

Sociologists and gender studies scholars are of the opinion that, no person grows outside the influence created by those around him or her which pre-determines a particular or an expected behavior (Marcionis & Ken, 2005).

Gender preference is a matter of concern for countries in Western countries particularly as it relates to child and parenting where specifically parents choose to love a particular child over the other (Lee & Gerald, 2013). Gender preferences results from macro- societally 'family- survival mechanism' in which kin, particularly children use members of their families for their own personal interests (Lee & Gerald, 2013).

Conceptually speaking, gender preferences can best be described as the difference between the value placed on sons and daughters. The way a child is trained by the parents – whether mother or father goes a long way in influencing the outcome of the gender patterns exhibited by the child (www.simplypsychology.org/2021) hence the need for these researchers to find out if gendered preferences at an early age of a child influences the choice of study in the Universities in the South- south region of Nigeria.

Gendered Preferences at an Early Age as Affecting Choice of Fields of Study in South- South Universities in Nigeria

Children and Early Gender Preferences

According to Social Learning theory is of the opinion that, children learn through models in the society (Banduras, 1977 cited in Saul, 2016). To this end, it is not out of place to find children copying from their parents, peer groups, media, teachers, environment and friends. In this regard therefore, children are bound to ‘copy’ from a person who they look up to. In addition, the theories used in this study also aids in emphasizing the place of influence of social constructs on the living patterns of an individual. Studies on www.encyclopedia.com/ 2020 have proven that, there are gender preferences for sons than daughters in the continents of Africa with particular reference to Nigeria (Ndu & Uzochukwu, 2011). It is also interesting to note that, children get to understand their sex as different from the age of 2years and exposed to gender cues from those around them at a very early age (www.encyclopedia.com/ 2020). A child’s idea of gender roles can impact on their lives socially and educationally. In this regard therefore, it will not be out of context to assume that, gender preferences could influence a particular sex of children on the choice of study.

Empirical Review

The study by Ndu & Uzochukwu (2011) entitled- ‘Child and Gender preferences in an Urban and rural community in Enugu State, investigated if there is the preference of son to having a daughter by women in urban and rural communities in Enugu State. The objective of the study was: to ascertain the child gender preferences in an urban and rural community in Enugu State. A

multistage sampling method was employed to select 245 urban and 243 rural women for households in Enugu State, Eastern Nigeria. A structured questionnaire was used to ascertain child gender preferences in an urban and rural area.

The results from the findings showed that, there is a son preference in both urban and rural areas where 74.7% and 71.6% of women would prefer to have a male child if they could have only one child. In conclusion, son preference exists in the rural and urban community in Enugu State. The study recommended that, family education especially on achieving gender equality of both sexes.

Methodology

Research Design and Population of Study

This study made use of survey research design. This was to give room for the diverse opinions of students from the three Universities to be represented. The population of the study totals; Western Delta University (WDU) = 1,200, University of Benin (UNIBEN)= 77,000and Rivers State University= 54,500 (Source: Edeh, 2020)

Sampling techniques and sample size

The sampling technique used for this study was the convenience and stratified sampling techniques. Since the population of students from these three Universities in the South- south are high in number for a study of this nature, the researchers employed the use of a sample frame as shown on the table 1 below:

Table 1- Sample frame of the population of students in the three Universities

Name and Location of Universities	Population of Students
Western Delta University, Oghara, Delta State	1,200
University of Benin, Benin City, Edo State	77,000
Rivers State University, Rivers State	54,500
Total	132,700

Source: Adams, 2021

From the sample frame which totals 132,700 as the number of the students in the three

Universities used for the study, the sample size according to Krejcie and Margan (1970) cited in

Gendered Preferences at an Early Age as Affecting Choice of Fields of Study in South- South Universities in Nigeria

www.kenpro.org/2012, is 384 with 0.5% sampling error. The students are homogenous since they are from Universities in the South-south, hence the allotment of the sample size to the three Universities. The sample size was proportionally distributed among the students in the three Universities used for this study.

Instrument for Data Collection

The instrument for data collection is the structured questionnaire where the students in each department in the three Universities were administered copies of the questionnaire.

Validity of the Research Instrument

1. Do you understand what entails gendered preferences made at an early age?

Table 2- The number of students who understand what gendered preference is

Options	Frequency	Percentage (%)
Yes	377	98
No	5	1
I don't know	2	1
Total	384	100

Source: Field study, 2022

Out of the 384 respondents, 377 (98%) stated that they know what gendered preferences made at an early age is, 5 (1%) stated they are not aware of the practice while just 2 (1%) do not know what gendered preferences is.

2. Were your choice of study influenced by gendered preferences made at an early age?

Table 3- Students whose choice of study were influenced at an early age

Options	Frequency	Percentage (%)
Yes	303	79
No	28	7
Partly	53	14
Total	384	100

Source: Field study, 2022

The table 3 above indicates that, 303 (79%) affirmed that some of these students were influenced by gender preferences on the choices of fields of study in the University compared to

The pre-test and post- test was carried out to ascertain the validity of the study with the aid of two research assistants that helped to distribute the questions to a few students to note if the set of questions are in line with the research questions.

Method of Data Analysis

The data was analyzed using frequency distribution tables in other to give meaning and interpretative value to the data that was collected.

Data Presentation and Analysis

In other to analyze data, the researchers discussed the data gathered based on the research questions raised for the study.

28 (7%) number of students that stated that, they were not influenced by gender preferences. Only 53 (14%) number of the students were partly influenced.

3. Which University students were majorly influenced by gendered preferences made at an early age?

Gendered Preferences at an Early Age as Affecting Choice of Fields of Study in South- South Universities in Nigeria

Table 4- The University with the most influenced students from gendered preference

Options	Frequency	Percentage (%)
UNIBEN	67	17
RSU	54	14
WDU	263	68
Total	384	100

Source: Field study, 2022

Table 4 above indicates that, the students from Western Delta (WDU) were mostly influenced by gendered preferences made at an early age which invariably informed their choice of study. This is

shown by the 263 (68%) above. This data gathered from the other two Universities: UNIBEN and Rivers State University were 67 (17%) and 54 (14%) respectively.

4. What other factors in the South- South region of Nigeria influenced these students on their choice of study?

Table 5- Other factors that influence gendered preference among students in South- south, Nigeria

Options	Frequency	Percentage (%)
Peer pressure	102	27
Societal/ environmental influence	73	19
Examination forces	171	45
Sex categorization of the child	38	9
Total	384	100

Source: Field study, 2022

Table 5 indicates that the respondents' field of choice of study were majorly influenced by examination forces which were 171 (45%) closely followed by peer influence who totaled 102 (27%). The societal/ environmental forces and the sex categorization of the child were 73 (19%) and 38 (9%) respectively.

Discussion of findings

The findings showed that, majority of respondents understand what gender preferences entails and how it influences them in their choice of studies. This findings corroborates with the Social Learning theory by Banduras, 1977 cited in Saul, 2016. According to Banduras, we get influenced from the factors in the environment and people we take as role models with only a few that stated that, they do not have awareness about gendered preferences made at an early age.

In addition, the number of students that stated that gender preferences influenced their choice of study were higher than those that opined

otherwise. Some of the students from these three Universities also stated they were partly influenced by gendered preferences made at an early age. This is in collaboration with the findings of Ndu & Uzochukwu (2011). The study also found out that, Western Delta University students were the most influenced on the choice of study which is a private University while the two public institutions were least influenced. This is in agreement with the work of Sandra 1981 cited in Starr & Zubriggen, (2017) who developed the Gender Schema theory that focuses on how a child processes information with regards to gender in other to determine what is a masculine or feminine character or in this case, a course of study to study at the University since to Blackstone, (2003) and Osazee & Nwokoro, (2021), in this part of the world, females are subjected to certain jobs or studies than their males counterparts.

Finally, the study discovered that, other factors that can influence gendered preferences made at an early age about choice of study were: peer

Gendered Preferences at an Early Age as Affecting Choice of Fields of Study in South- South Universities in Nigeria

pressure, societal / environmental pressure, sex categorization of the child and examination forces among the students of the three Universities in the South- south, Nigeria.

Conclusion

Gendered preferences influence many students' choice of course of study. Societal/environmental factors and sex categorization play key roles in determining the careers or disciplines students go for.

Recommendations

1. Parents, especially rich ones, should nurture their children in an atmosphere that allows them make their own choices with regard to their fields of study.
2. Emphasis on career prospects should be made from nursery and primary schools to enable pupils make informed career choices very early in life.

References

Christine, S & Eileen, L. Z. (2016). Sandra Bem's Gender schema theory after 34years: A review of its reach and impact> DOI: 10.10007/s11199-016-0591-4. Accessed from www.researchgate.net>publication.

Curran, J. T. & Sue, T. (2010). *Media and feminism: media and society* (5th ed.), United Kingdom, Bloomsbury publishing, pp. 63-78

Edeh, S. C (2020). [Most populated universities in Nigeria in 2020](http://www.bschorlarly.com): Top 10. Accessed from www.bschorlarly.com

<https://www.encyclopedia.com/2020>>Gendered-preferences-for-children

<https://www.wikipedia.or/wiki/2021>>gender-roles-in-childhood

Jimoh, J. (2017). Gender sensitivity in coverage of conflict situations, In Umaru Pate and Lai Oso (ed.), In *Multiculturalism*,

[diversity and reporting conflict in Nigeria, Ibadan, Evans Brothers Limited.](http://www.fanefanejournal.com)

Lee, S. Y. & Gerald, M (2013). General theory for gender preference. Accessed from <https://.ussp.org/sites/default/files/event/html>.

Marcionis, J. & Ken, P. (2005). *Sociology: An introduction* (3rd ed), United Kingdom, Pearson education

Ndu, A. C & Uzochukwu, B. S. C (2011). Child and gender preferences in an urban and rural community in Enugu State, Eastern Nigeria. Accessed from <https://www.ajol.info/index.php/jcm/article/view>, vol. 16, No. 1, pp. 24-29.

Nickerson, C (2021). Social constructionism theory definition and examples. Accessed from www.simplypsychology.org

Nwokoro, C. I. & Ekwunife, O. R (2020). Gender-sensitive advertising as an effective tool for repositioning women into public offices in Nigeria. Accessed from www.ajpojournals.org, vol. 2(1), pp.1-16

Odia- Osazee, O. U & Nwokoro, C. I (2021). A situational analysis of gender inequality in journalism practice in Nigeria. Accessed from www.ajhss.org, vol. 9, pp. 36-53

Okeke, D. I (2005). Gender communication, In Nnayelugo Okoro (ed.) in *Contemporary readings in media and communication studies*, Enugu, Rhycee Kerex publishers.

Saul, M. (2016). Albert Bandura's social learning theory. Accessed from www.simplypsychology.org/bandura.html

www.genderschema.com>gender-schema-theory-and-its-implications-for-gender-developmenet:Raising-schematic-children-in-a-gender-schematic-society<Sandra-Lipsitz-

[Bem\(2016\).](#) Accessed from www.wikipedia.com/2022
[https://about.jstor.org/terms.](https://about.jstor.org/terms)
[www.simplypsychology.org/2021>child-upbringing/html.](http://www.simplypsychology.org/2021>child-upbringing/html)
www.demographicresearch.org/html>reason-for-gender-preferences<2022
[www.kenpro.org/2012/Margan/1970/html.](http://www.kenpro.org/2012/Margan/1970/html) Krejcie-&
www.encyclopedia.com>social-sciences-preferences-on-gender<2019

Seroprevalence of Brucella Infection in Humans, Bovine and ovine in Wards of Tal District, Pankshin LGA, Plateau State Nigeria

¹Dayok, O; ¹Kum, F.O & ²Bismoyi Dilkit,I

^{*1}Department of Science, School of Science and Technology, Plateau State Polytechnic, Barkin-Ladi

²Bacterial Vaccine Production Division, National Veterinary Research Institute, Vom

^{*}Corresponding Author: dayokolukemi5080@gmail.com

Abstract

A serological study was conducted to determine the percentage seroprevalence of brucellosis in humans, bovine and ovine among different farms of two wards in Tal district, Pankshin Local Government area of Plateau state. Blood samples were collected from 43 humans, 173 bovine and 192 ovine, given a total 408 samples. Samples were screened for brucellosis using the Rose Bengal Plate Test (RBPT). Results showed the percentage seroprevalence values of 0% in humans, 4.6% in bovine and 6.8% in ovine. However, percentage seroprevalence in bovine and ovine brucellosis was higher in Tal B ward than Tal A ward and higher in females than males respectively. In consideration of age significance on brucellosis, seroprevalence of bovine was higher (4.7%) among the age group 6-12 months. In ovine, results showed a higher percentage seroprevalence in age group 6-36 months (7.4%) as compared to 6.1% in age group > 36 months. Similarly, no statistical significant association between species, sex, age and occurrence of B. brucellosis at $P > 0.05$. The absence of brucellosis in humans in both wards of Tal may not indicate an apparently brucellosis free status of the residents of the area due to the presence of bovine and ovine brucellosis in the study area which could pose a significant public health risk to the same residents. A wider and a periodic study on herds of bovine, ovine and cross species transmission to humans is recommended. This will aid policy making in combating cross transmission of brucellosis.

Key Words: Seroprevalence, brucellosis, humans, bovine and ovine.

Introduction

Brucellosis is recognized as an important potential zoonosis in developing countries (Ducrottoy *et al.*, 2014). The World Health Organization has declared brucellosis to be a significant re-emerging zoonosis. World Health Organization (WHO, 2004).

Nigeria's food animals' population is estimated at 15.2 million cattle, 23 million sheep and 28 million goats. A great proportion of families in the State keep sheep and goats, which provides sources of income to them. It is also a common practice to find those who keep cattle especially the Fulani pastoralists as well as other farmers keeping sheep and goat alongside. This practice is common among the rural population of the middle belt and northern parts of Nigeria. Sheep and goats are also reared along with cattle in most private or government owned farms which are semi-intensive in nature. The major husbandry practice in the State is the extensive seasonal confinement system. The animals are allowed to fend for themselves during the dry season but are taken out for grazing or tethered during the day in the rainy season and are brought to the house in the evenings. The keeping of sheep with cattle provides an opportunity for the spread of brucella infection from cattle to small ruminants (Ocholi *et al.*, 2005).

In Nigeria, several authors have reported brucellosis in Nigeria livestock (Ishola *et al.*, 2001, Cadmus *et al.*, 2006), with evidence of the spread of the disease in all parts of the country. The role of brucellosis in limiting livestock production and its economic impact on the livestock industry in Nigeria is widely recognized (Ajogi, 2002). Brucellosis is endemic in Nigeria and causes severe economic losses to livestock farmers. It is serious risk to human health and has been documented in different part of the country, especially in ranches, livestock breeding centre and dairy farms in Nigeria (Ocholi *et al.*, 2005).

The risk factors for brucella infection include consumption of raw milk and unpasteurized dairy products and direct contact with animals and their products (Vassalo *et al.*, 2009).

Brucellosis in human is transmitted by poor hygiene, close contact with animals and consumption of unpasteurized dairy products and undercooked meat products. For example, consumption of traditional delicacies such as infected raw liver can cause human infection.

Acquiring infection through direct contact is possible to occupational groups such as veterinarians, farmers, butcher men, milkers, laboratory workers and inseminators. The routes of infection are through contamination of broken skin, inhalation of aerosols containing organism and contamination of the conjunctiva or other membranes (Regassa *et al.*, 2009).

The present study is aimed at determining the prevalence rate for brucella infection in human, sheep and cattle in Tal district, Pankshin Local Government Area, Plateau State.

Method

Study Area

The research was conducted at Wards of Tal District. Pankshin Local Government Area of Plateau state, Nigeria which is geographically located in the South-Eastern part of Pankshin Local Government Area of Plateau State.

They are neighbors with the Dokpai and Angas people to the North, Piapung and Koenem to the south, Tal to the east and Chip, Belning and Mupun to the west. It has a land size of about 104 square miles.

Sample size

A total of 408 blood samples were collected (43 from Humans, 173 from Bovine and 192 from Ovine) from different herds and selected households from Tal A and B wards of Tal district.

Sampling Techniques

A simple random sampling technique as described by Yates *et al.*, 2008) was used, Bovine and Ovine herds were randomly selected from each ward alongside selected households from Tal A and B wards of Tal district to give the required sample size in this study.

Seroprevalence of Brucella Infection in Humans, Bovine and ovine in Wards of Tal District, Pankshin LGA, Plateau State Nigeria

Method of Sample Collection

With the help of a phlebotomist and a veterinarian, approximately 5ml of blood were obtained from humans through the venous method; collection were done at the ante-cubital vein with sterile hypodermic needle and syringe and 5ml of blood were also obtained from Bovine and Ovine through jugular vein with sterile hypodermic needle and syringe, after which the blood samples were allowed to clot, centrifuged and serum transferred into sterile plain tube and stored at -20°C until required.

Serological Test

The samples were serologically screened using standard Rose Bengal Plate Test as described by (OIE, 2012) at the *Brucella* Laboratory of the National Veterinary Research Institute Vom.

Rose Bengal Plate Test

This test was performed following the standard procedure described by OIE, (2012), by mixing 30ml of Sera and 30µl of the Rose Bengal Plate, Test antigen from *Onderstepoort* Biological Product (OBP) South African on white ceramic tile.

The Sera and the antigen were mixed with an applicator stick and rocked gently for four minutes and observed for *agglutination*. Samples that show distinct *agglutination* were recorded as positive and those without *agglutination* were considered negative. The controls for Rose Bengal Plate test were set up concurrently with the test samples, one positive control and one negative control were set up to validate the result using known positive and negative control sera samples.

Results

Table 1: A total of 173 Bovine were sampled. Tal B ward recorded the highest percentage seroprevalence rate of 5(8.8) of 57 Bovine from the ward and Tal A ward recorded 3(2.6)

of the 116 Bovine from the ward. The percentage seroprevalence infection rates were not statistically associated at $p>0.05$

Table 2: A total of 192 Ovine were sampled. Tal B ward also recorded the highest percentage seroprevalence rate of 9(9.2) of 96 Ovine from the ward and Tal A ward recorded 4 (4.2) of the 96 Ovine from the ward.

However, the percentage seroprevalence infection rates were not statistically associated at $P>0.05$.

Table 3: A total of 173 Bovine were sampled (90 females, 83 males). Findings showed a higher percentage seroprevalence rate of 5(5.6) in female while the males recorded 3(3.6).

However, the percentage seroprevalence infection rates were not statistically associated at $P>0.05$

Table 4: A total of 192 Ovine were sampled (125 females, 67 males). The females also recorded the highest percentage seroprevalence rate of 10(8) of the 125 females sampled while the males recorded 3(4.5) of the 67 males tested.

However, the percentage seroprevalence infection rates were not statistically associated at $p>0.05$.

Table 5: A total of 173 Bovine were sampled (68 of age group 6-36 months, 105 of age group > 36 months). Result showed age group > 36 Months recorded the highest percentage seroprevalence rate of 5(4.7) while age group 6-36 reported a lower 3(4.4).

However, the percentage seroprevalence infection rates were not statistically associated at $p>0.05$.

Table 6: A total of 192 Ovine were sampled (94 of age group 6-36 months, 98 of age group > 36 months). Result showed age group 6-36 months recorded the highest percentage seroprevalence rate of 7(7.4) while age group >36 reported a lower 6(6.1).

However, the percentage seroprevalence infection rates were not statistically associated at $p>0.05$

Table 1: Seroprevalence of Brucellosis in bovine herds in wards A and B of Tal District

Ward	Bovine sampled	Number Positive (%)
A	116	3(2.6)
B	57	5(8.8)
Total	173	8(4.6)

$X^2 = 2.0612$ P Value = 0.1512 OR = 0.2761 P>0.05

Table 2: Seroprevalence of Brucellosis in Ovine herds in ward A and B of Tal District

Ward	Ovine sampled	Number Positive (%)
A	96	4(4.2)
B	96	9(9.4)
Total	192	13(6.8)

$X^2 = 1.32$ P Value = 0.2500 OR = 0.4203 P>0.05

Table 3: Association between Sex and Seroprevalence of Bovine Brucellosis distribution in Tal District

Ward	Bovine sampled	Number Positive (%)
Male	83	3(3.6)
Female	90	5(5.6)
Total	173	8(4.6)

$X^2 = 0.006004$ P Value = 0.8119 OR = 0.6375 P>0.05

Table 4: Association between sex and Seroprevalence of Ovine brucellosis distribution in Tal District

Ward	Ovine sampled	Number Positive (%)
Male	67	3(4.5)
Female	125	10(8)
Total	192	13(6.8)

$X^2 = 0.3901$ P Value = 0.5454 OR = 0.5391 P>0.05

Table 5: Association between age and Seroprevalence of Bovine and Ovine Brucellosis distribution in Tal District

Age Group (Months)	Bovine sampled	Number Positive (%)
6-36	68	3(4.4)
>36	105	5(4.8)
Total	173	8(4.6)

$X^2 = 0.1254$ P Value => 0.99999999 OR = 0.8393 P>0.05

Table 6: Association between age and Seroprevalence of Bovine and Ovine Brucellosis distribution in Tal District

Age Group (Months)	Ovine sampled	Number Positive (%)
6-36	94	7(7.4)
>36	98	6(6.1)
Total	192	13(6.8)

$X^2 = 0.006055$ P Value = 0.9369 OR = 1.234 P>0.05

Discussion

The result of this research work showed the presence of brucellosis in cattle and sheep herds and non on human in Tal district of Pankshin Local Government as this is the first

time the disease is being diagnosed and documented.

The seroprevalence of bovine brucellosis as reported in Yobe (34.0%) and Adamawa (36.6%) respectively (Adamu *et al*, 2016).

Seroprevalence of Brucella Infection in Humans, Bovine and ovine in Wards of Tal District, Pankshin LGA, Plateau State Nigeria

Similarly, in Southern Nigeria, (Cadmus *et al*, 2010) reported a seroprevalence of 6% in 2004, 6.17% in 2005, which was higher than the seroprevalence of bovine brucellosis reported in this study.

Cadmus *et al* 2013 reported higher seroprevalence of 8.6% in three cattle production system in South West Nigeria.

However the seroprevalence of 4.6% for bovine brucellosis in this study are higher than overall 3.8% reported by Wungak *et al.*, 2011 on serological survey of antibodies against brucellosis in cattle in Jos South Local Government Area and Jajere *et al.*, 2016 in seroprevalence study of brucellosis among cattle slaughtered in three municipal abattoirs of Gombe state.

The bovine seroprevalence of 4.6% in this study is also similar to those reported in other African countries such as Ethiopia 4.9% (Mekonnen *et al*, 2010) Eritrea 4.2% (Omer *et al.*, 2000).

In this study, the seropositivity of bovine brucellosis was reported higher in Tal B ward than Tal A ward. However, there was no statistically significant association between breeds and occurrence of brucellosis in cattle ($P>0.05$) (Table 1).

In addition, even though the proportion of bovine brucellosis was higher in females than in males, the difference was not statistically significant ($p>0.05$) Table 2).

This disparity in the seroprevalence of bovine brucellosis in different parts of the country is in congruent with the report of Mai *et al.*, 2012 where the authors reported that the prevalence of bovine brucellosis varied between animals in the same agro-pastoral zone.

This difference in the seroprevalence of the disease could be attributed to the difference in breeds, sensitivity of test kits, seasonal variation, farming system, and sample size.

A higher rate 14.5% was reported by Bertu *et al.*, 2010 in sheep in plateau State which is higher than the 6.8% of sheep reported in this study. The 6.8% in sheep in this study is also

similar to the 6.0% as reported by Tijani *et al.*, 2009 in Borno and Yobe States.

Gusi *et al.*, 2010 in another study, reported a seroprevalence rate of 5.5% for sheep which is lower than the 6.8% in this study. This may suggest a likely increase in the rate of infection in the sheep herds since most of the animals were acquired from local markets without recourse to their brucellosis status. In a related study on small ruminants in Bauchi and environs, Shehu *et al.*, 1999 recorded a 6.6% prevalence of sheep which is similar to sheep in this study but a higher 10.8% on bovine brucellosis.

In this study, the seropositivity of ovine brucellosis was also higher in Tal B ward than Tal A ward.

In Eastern Sudan, Gumaa *et al*, 2014 reported seroprevalence of 2.15%, after sampling 2500 serum samples collected from sheep which is lower than the report from this study.

The difference in prevalence could be due to the difference in breeds, geographical location sample size, serological techniques and inter-laboratory variation. Variation in sex of bovine and ovine sampled in this study could be for economic reasons because the farmers tend to keep more female for higher production of animal and animal products than female in practices. However, there was also no statistically significant association between breeds and occurrence of brucellosis in sheep ($P>0.05$) Table 1. In addition, even though the proportion of ovine brucellosis was also higher in females than in males, the difference was also not statistically significant ($P>0.05$) Table 2

The 0% as reported in humans in this study is similar to the report of Ducrottoy *et al.*, 2014. Who reported that several serological investigations for animal-originated human brucellosis in Nigeria.

The risk of bovine and ovine brucellosis is not only restricted to the animal husbandry alone but also represent significant zoonotic implications characterized by debilitating and severe complications in humans (Gwida *et al.*, 2016).

In Nigeria, serological studies have shown that bovine brucellosis is a common problem in

many grazing zones in Nigeria (Adamu *et al.*, 2016).

From reports, it was observed that there was variation in the prevalence of bovine brucellosis in many countries, the surveillance strategies adopted for the control and prevention of the disease is generally very poor.

Purchase of infected animals as replacement, interaction with wildlife, free movement of animals by nomads, change in climatic conditions, and the system of animal production others include regulatory issues and demographic factors were also considered as likely factors that increase the spread of bovine brucellosis. More factors include sharing of bulls between farmers, the practice of free range grazing and movement as a result of trade have greatly increased the risk of exposure to brucellosis in cattle (Adamu *et al.*, 2016).

Conclusion

This study revealed that the percentage seroprevalence rates brucellosis is endemic with the seroprevalence percentage rates of 0% in human, 4.6% in bovine and 6.8% in ovine in the studied area.

Findings also showed higher percentage seroprevalence in Tal B ward that Tal A ward, the infection rates was higher in the females than males.

The zoonotic implication so increase prevalence are the likelihood of increase spread to susceptible animals and humans. The fact that bovine and ovine tested serologically positive to brucellosis in this study area, more proactive precautionary measures should be put in place since brucellosis is a zoonotic disease of both public health and economic importance hence contamination of common grazing lands by infected by apparently clean looking herds could serve as a source of *Brucella* infection to other herds.

Recommendation

1. Personal hygiene and good sanitary measures must be practice to reduce/avoid the disease through contact with infected material such as

unpasteurized milk, meat and other animal products.

2. The herding of bovine with ovine which usually increase the risk of transmission of this disease should be discouraged.
3. Regular culling of infected animals should be enforced.
4. Restocking or replacement of animals from local markets and neighboring farm or borders with consideration of their brucellosis status is recommended.
5. An effective control/preventive measures should be carried out by government in the studied area of bovine and ovine brucellosis using *B. abortus* 519 vaccines to prevent further spread of disease to other areas.

References

- Adamu S., Atsanda, N., Tijhani A., Usur, A., Sule A & Gulani, I. (2016). Epidemiological study of bovine brucellosis in three senatorial zones of Bauchi state, Nigeria. *Veterinary World*, 9(1): 48:5
- Ajogi, I., Osinubi, M.O.V., Makun, H., Luga, I. & Andrew A. (2002). Seroprevalence of brucellosis is an institution farm Zaria. Proceeding of the 39th Nigeria Veterinary Medical Association Conference, Sokoto, Nigeria.
- Bertu, W.J., Ajogi, I., Bale, J.O., Kwaga, J.K. & Ocholi, R.A. (2010). Seroepidemiology of brucellosis in small ruminants in Plateau state, Nigeria. *Africa Journal of Microbiological Research* 4:1935-1938.
- Cadmus, S., Adesokan, H., Adedokun, B. & Stack, J. (2010). Seroprevalence of bovine brucellosis in trade cattle slaughtered in Ibadan, Nigeria, Nigeria, from 2004-2006. *Journal of South Africa Veterinary Association*, 81 (1): 50-53

- Cadmus, S.I.B., Ijagbone, J.F., Oputa, H.E., Adenosak, H.L. & Stack, J.A. (2006). Serological survey of brucellosis in livestock animals and workers in Ibadan, Nigeria. *Africa Journal of Biomedical Research* 9: 163-168.
- Cadmus, S. I., Alabi, P. I., Adesokan, H. K., Dale, E.J & Stack, J.A. (2013). Serological investigation of bovine brucellosis in three cattle production Systems in Yewa Division, South-Western Nigeria. *J. South Africa Veterinary Association*. 84(1): E1-E6.
- Ducrottoy, M.J. Bertu, W.J., Ocholi, R.A., Gusi, A.M., Bryssinckx, W. & Welburn, S. (2014). Brucellosis as an Emerging Threat in Developing Economies: Lessons from Nigeria. *PlosNegl Trop Dis* 8(7) e 3008. Doi: 10.1371/journal.pntd.0003008.
- Gumaa, M., Osman, H., Omer, M., El Sanousi, E., Godfroid, J. & Ahamed, A. (2014). Seroprevalence of brucellosis in sheep and isolation of *Brucella abortus* biovar 6 in Kassala State, Eastern Sudan. *Review science technology office Internation des Epizootics* , 33:957-965.
- Gusi, A.M., Bertu, W.J., Mwankwon, E.S., Hassan M. & Ocholi, R.A. (2010). Prevalence of *Brucella* antibodies in animals and butchers at Jos Abattoir, Nigeria, *Vom Journal of Veterinary Science* 7: 30-34
- Gwida, M., El-Ashker, M., Melzer, F., El-Diasty, M., El-Beskaws, M. & Neubaver, H. (2016). Use of serology and real time PCR to control outbreak of bovine brucellosis at a dairy cattle farm in the Nile Delta region, Egypt. *Irish Veterinary Journal*, 69(1):1
- Ishola, O.O. & Ogundipe, G.A.T. (2001). Seroprevalence of brucellosis in Trade Cattle Slaughtered in three municipal abattoirs of Gombe state, Northeastern Nigeria, *Veterinary World*, 9(10): 1082-1086.
- Jajere, S.M., Atsanda, N.N., Bitrus, A.A., Hamisu, T.M. & Ayo, A.O. (2016). Seroprevalence of brucellosis among cattle slaughtered in there municipal abattoirs of Gombe State, Northeastern Nigeria, *Veterinary World*, 9(10): 1082-1086.
- Mai, H.M., Irons, P.C., Kabir, J. & Thompson, P.N. (2012). A large seroprevalence survey of Brucellosis in cattle herds under diverse production systems in northern Nigeria. *Biomedical Veterinary Research*, 8(1):1.
- Mekonnen, H., Kalayou, S. & Kyule, M. (2010). Serological Survey of bovine brucellosis in barka and arado breeds (*Bos indicus*) of western Tigray, Ethiopia. *Preview Veterinary Medicine* 94(1): 28-35.
- Ocholi, R.A., Kwaga, J.K., Ajogi, I. & Bale J.O. (2005). Abortion due to *Brucella abortus* in sheep in Nigeria. *Review Science Technology office Internation Des Epizooties* 24:973 979.
- Office International Des Epizooties OIE (2012). Bovine Brucellosis In: Manual of Diagnostic Tests and Vaccines for Terrestrial Animals. World Organization for Animal Health. Paris, France, 2.4.3: 44-78. http://www.oie.int/fileadmin/home/eng/health_standards/tahm/2.04.16_bovine_brucella.
- Omer M., Skjerve E., Zerai W. & Gudmund H. (2000). Risk factors for *Brucella* spp. infection In dairy cattle farms in Asmara, State of Eritrea. 46(4):257-65
- Regassa, G., Mekonnen, D., Yamuah, L., Tilahun, H., Guta, T., Gebreyohannes, A., Aseffa, A., Theresa, Abdoel, H. & Smits, A.L. (2009). Pastoral communities in Ethiopia, *International Journal of Tropical Medicine*, 4(2):59-64.

Seroprevalence of Brucella Infection in Humans, Bovine and ovine in Wards of Tal District, Pankshin LGA, Plateau State Nigeria

- Shehu, L. Yusuf, H., Kudi, A.C. & Kalla, D.U. (1999). Sero prevalence of Brucellosis in ruminants in Bauchi and Environs. *Nigeria Veterinary Journal*, 20 (1): 67-74
- Tijani, A.O., Musa, H.I., Onsoumanou, O. & Akintola, O. (2009). *Sahel Journal of Veterinary Science* .8(1): 55-60.
- Vassalo, C.M., Economou, V., Vassalou, E. & Papidaulor, C. (2009). Brucellosis in humans: why is it so elusive? *Review of Medical Microbiology* 0:63-7
- WHO (2004). Emerging Zoonoses Available at: http://www.who.int/zoonoses/emerging_zoonoses/en/
- Wungak, Y.S, Aworh, M.K.F., Maurice, N.A., Balami, A.G., Danmarwa, A. & Danthe, H.D. (2011). Serological survey of antibodies against vom *Journal of Veterinary Science*; 8:39-42.
- Yates, D.S., David, S.M., & Daren S.S., (2008). The practice of statistics, 3rd ed. ISBN-13: 978-0716773092

Assessment of Bacteria and Fungi Responsible for the Spoilage of Tomato Sold in Gada-Biu Market, Jos, Plateau State

Dayok O, Kum F.O & Danjuma, Gwamzhi

Department of Science, School of Science and Technology, Plateau State Polytechnic, Barkin-Ladi

Corresponding Author: dayokolukemi5080@gmail.com

Abstract

This study assessed bacteria and fungi associated with spoilage of tomato fruit (Lycopersium esculentum). Tomatoes contain a large amount of water, which makes them more susceptible to spoilage by bacteria and fungi. This study was therefore carried out to isolate, characterize and identify bacteria and fungi associated with the spoilage of tomato fruit. A total of 20 tomatoes were obtained from 5 different retail stands in Gada-biu market in Jos. Bacteria isolated and identified were Bacillus subtilis, Klebsiella aerogenes, Aeromonas hydrophila, Pseudomonas aeruginosa, and Staphylococcus aureus. The most prevalent bacterial isolate was Bacillus subtilis with 41.93%. The fungal isolates were Aspergillus niger, Aspergillus flavus, Penicillium notatum, Fusarium oxysporum, and Saccharomyces cerevisiae. Aspergillus niger was the most prevalent with 37.12%, while Saccharomyces cerevisiae was the least prevalent with 4.55%. The presence of toxin-producing fungi such as Aspergillus niger and Fusarium oxysporum, which are capable of causing food poisoning as well as some bacteria isolates, raises concern over public health risks that may be associated with the consumption of wholesome tomatoes. Proper handling and adequate storage facilities must therefore be employed to prolong the shelf life of tomato fruits.

Keywords: *bacteria, fungi, spoilage, tomato fruit.*

Introduction

Lycopersicon esculentum, or tomato, is an annual plant with a weak woody stem covered in glistening reddish yellow glandular hairs. The tomato plant is widely cultivated in many parts of the world. The tomato fruit has a smooth skin. It is green when immature but becomes bright red or yellow as it ripens. The fruit varies greatly in size and shape (Agrios, 2005).

Tomato fruit is a common vegetable eaten raw as a salad or for garnishing various cooked foods in Nigeria as well as in many parts of the world. The fruit contains a high concentration of carbohydrates, fats, organic acid, water, minerals, vitamins, and pigments. It is estimated that ripe tomato fruits contain approximately 94% water, 4.3% carbohydrate, 1% protein, 1.0% fat, 0.6 fibre and vitamins. The nutrients support the growth of microorganisms, such as bacteria and fungi, which produce enzymes that degrade the nutrients (Sharma, 2016).

Tomato fruits contain a lot of water, which makes them more susceptible to spoilage by microorganisms. Also, the high water content makes storage and transportation of this vegetable difficult. These microorganisms reduce not only the nutritional value but also the market value of tomato fruits (Obunukwu et al., 2018).

In recent years, the incidence of diseases in tomato fruits has been a cause for global concern and intensive research has been undertaken to comprehend the measures which can be taken to effect some radical control (Beuchat, 2011). The parameters during quality control include various factors such as time of harvesting, temperature and moisture during storage, selection of agricultural products prior to processing, decontamination conditions, addition of chemicals, and final product storage (Bello et al., 2016). The work is aimed at assessing bacteria and fungi associated with the spoilage of tomato fruits sold in Gada-biu market, Jos, Plateau State.

Study Area

Four (4) samples each of spoilt tomatoes were purchased from five (5) different retail stands (20 samples in total), from Gada-biu market in Jos, Plateau State. The tomatoes were then transported separately in sterile polythene bags and brought to the laboratory.

Isolation of Microorganisms

Nutrient and Potato Dextrose Agar were prepared according to the manufacturer's instructions and then were used for the isolation of bacteria and fungi respectively.

The diseased portion of the tomato fruit was cut under aseptic conditions into small bits and placed in a sterile dish with the aid of a knife, which was then flamed over a Bunsen burner. A serial dilution of up to 10^{-4} of the homogenate was made in sterile test-tubes, 1ml of the serially diluted tomato sample was pipetted into 9ml of sterile distilled water in a test-tube. The test tube was shaken vigorously to homogenize. A 1ml portion of the third and fourth factors were aseptically transferred and plated in duplicate sets using sterile nutrient agar for bacterial isolates and potato dextrose agar for fungal isolates. The total microbial count was carried out on the spoilt tomato fruit samples using pour plate method. The plates were subsequently incubated at 37°C for 24 hours for bacteria and 72hours for fungi. Discrete colonies that developed after incubation were counted and enumerated as colony forming units (CFU/g) after multiplying with the dilution factor (Mbajiuka & Emmanuel, 2014). Colonies from the primary plates were aseptically picked with sterile wire loop and transferred onto a freshly prepared sterile nutrient agar and potatoes dextrose agar, with a streaking technique such that discrete colonies appear at the ends of streaked lines after incubation. The sub-cultured plates were incubated as described by Mbajiuka and Emmanuel (2014).

Characterization and Identification of Fungal Isolate

Identification and characterization of the fungal isolates was based on macroscopic and microscopic examination. It was done by comparing the result of their morphological characteristics with existing stock cultures and references were also made to fungi atlas. Identification of fungi was based on growth, patterns, color of mycelia and microscopic examination of vegetative and reproductive structures (Obunukwu et al., 2018).

Characterization and Identification of Bacterial Isolates

The characterization and identification of bacterial isolates was based on gram's staining and some selected biochemical tests which include; Catalase test, Oxidase test, Methylred

(MR) test, Citrate test, Coagulase test, Motility test and Indole test as described by Cheesbrough (2007).

Results and Discussion

Results

Table 1: Microbial Load Of Spoilt Fresh Tomatoes Stored At Ambient Temperature (Cfu/G)

SAMPLES	TOTALBACTERIAL COUNT	TOTALFUNGAL COUNT
S1	7.5X10 ²	12x10 ²
S2	10.8x10 ²	8.3x10 ²
S3	8.7x10 ²	12.0x10 ²
S4	11.3x10 ²	8.4x10 ²
S5	11.6x10 ²	8.6x10 ²

Key

1-S 5, Sample 1-Sample 5.

Table 2: Morphological and Biochemical Characterization of Bacteria Isolates

Sample	Shape	Elevation	Surface	Opacity	Color	Texture	Gram-staining	Catalase Test	Oxidase Test	Methyl-Red	Citrate Test	Coagulase Test	Motility Test	Indole Test	Probable
S1	Rd	Um	Sth	Trans	White	Mucoi d	-rod	+	-	-	+	-	-	-	<i>Klebsiella aerogenes</i>
	Ir	Um	Rgh	Opq	White	Dry	+rod	+	-	-	-	-	+	-	<i>Bacillus subtilis</i>
	Rd	Ra	Sth	Opq	D/gn	Mucoi d	+rod	+	+	+	+	+	+	+	<i>Aeromonas hydrophila</i>
S2	Rd	Ra	Sth	Opq	D/gn	Mucoi d	-rod	+	+	+	+	+	+	+	<i>Aeromonas hydrophila</i>
	Rd	Um	Sth	Trans	White	Mucoi d	-rod	+	-	-	+	-	-	-	<i>Bacillus subtilis</i>
	Ir	Um	Rgh	Opq	White	Dry Mucoi d	+rod	+	+	-	-	-	+	-	
S3	Rd	Ra	Sth	Opq	D/gn	Dry Mucoi d	-rod	+	+	+	+	+	+	+	<i>Aeromonas hydrophila</i>
	Ir	Um	Rgh	Opq	White	Mucoi d	+rod	+	+	-	-	-	+	-	<i>Bacillus subtilis</i>
	Oval	Um	Sth	Trans	Green	Dry Mucoi d	-rod	+	+	-	+	-	+	-	<i>Pseudomonas aeruginosa</i>
	Rd	Um	Sth	Opq	White	Mucoi d	+cocci	+	-	+	-	+	-	-	<i>Staphylococcus aureus</i>
S4	Rd	Ra	Sth	Opq	D/gn	Mucoi d	-rod	+	+	+	+	+	+	+	<i>Aeromonas hydrophila</i>
	Ir	Um	Rgh	Opq	White	Dry Mucoi d	+rod	+	+	-	-	-	+	-	<i>Bacillus subtilis</i>
S5	Ir	Um	Rgh	Opq	White	Mucoi d	+rod	+	+	-	-	-	+	-	<i>Bacillus subtilis</i>
	Oval	Um	Sth	Trans	Green	Dry Mucoi d	-rod	+	+	-	+	-	+	-	<i>Pseudomonas aeruginosa</i>
	Rd	Ra	Sth	Opq	D/gn	Mucoi d	-rod	+	+	+	+	+	+	+	<i>Aeromonas hydrophila</i>

Key: Rd – Round, Ir-Irregular, Um-Umbonate, Ra-Raised, Sth-Smooth, Rgh-Rough, Opq-Opaque, Trans-Translucent, D/gn-Dark-green

Assessment of Bacteria and Fungi Responsible for The Spoilage of Tomato Sold in Gada-Biu Market, Jos, Plateau State

Table 3: Bacterial Isolates from Tomatoes Sample

SAMPLES	BACTERIAL ISOLATES
SAMPLE 1	<i>Klebsiella aerogenes</i> , <i>Bacillus subtilis</i> , <i>Aeromonas hydrophila</i>
SAMPLE 2	<i>Aeromonas hydrophila</i> , <i>Klebsiella aerogenes</i> , <i>Bacillus subtilis</i>
SAMPLE 3	<i>Aeromonas hydrophila</i> , <i>Bacillus subtilis</i> , <i>Pseudomonas aeruginosa</i> , <i>Staphylococcus</i>
SAMPLE 4	<i>Aeromonas hydrophila</i> , <i>Bacillus subtilis</i>
SAMPLE 5	<i>Bacillus subtilis</i> , <i>Pseudomonas aeruginosa</i> , <i>Aeromonas hydrophila</i>

Table 4: Macroscopic and Microscopic Identification of Fungal Isolates

Samples	Macroscopic Examination	Microscopic Examination	Probable Organism
Sample 1	Blackish colony, with blackish spores, rapidly spreading, cream color on reverse.	Septate branching hyphae, with conidiophores that are non septate.	<i>Aspergillus niger</i>
	Rapid colonies with a dull green and white margin, colorless to white on reverse	Conidiophore is simple and smooth with a septate hyphae. Conidia is borne in loose columns.	<i>Penicillium notatum</i>
Sample 2	Blackish colony, with blackish spores, rapidly spreading, cream color on reverse.	Septate branching hyphae, with conidiophores that are non-septate.	<i>Aspergillus niger</i>
	A clear green color with a smoother velvety appearance, cream color on reverse	Conidiophores are present with a short columnar conidial heads. Mycelium is slightly visible.	<i>Aspergillus flavus</i>
Sample 3	Rapid colonies with a dull green and white margin, colorless to white on reverse.	Conidiophore is simple and smooth with a septate hyphae. Conidia is borne in loose columns.	<i>Penicillium notatum</i>
	Blackish colony, with blackish spores, rapidly spreading, cream color on reverse	Septate branching hyphae, with conidiophore that are non-septate.	<i>Aspergillus niger</i>
Sample 4	Initially white and cottony but later develop pink center with a lighter periphery.	Septate hyphae with canoe-shaped macroconidia,	<i>Fusarium oxysporum</i>
	Rapid colonies with a dull green and white margin, colorless to white on reverse.	Conidiophore is simple and smooth with a septate hyphae. Conidia is borne in loose columns.	<i>Penicillium notatum</i>

Assessment of Bacteria and Fungi Responsible for The Spoilage of Tomato Sold in Gada-Biu Market, Jos, Plateau State

Sample 5	A clear green color with a smoother velvety appearance, cream color on reverse.	Conidiophores are present with a short columnar conidial heads. Mycelium is slightly visible.	<i>Aspergillus flavus</i>
	Blackish colony, with blackish spores, rapidly spreading, cream color on reverse.	Septate branching hyphae, with conidiophores that are non-septate.	<i>Aspergillus niger</i>
	Colonies of <i>Saccharomyces spp.</i> Grow rapidly. They are flat, smooth, moist glistening or dull and cream to tannish cream in color.	Multilateral budding is typical Pseudohyphae, if present are rudimentary. Hyphae are present, <i>Saccharomyces spp.</i> Produces ascospores.	<i>Saccharomyces Cerevisiae</i>

Table 5: Fungal Isolates from Tomatoes Samples

Samples	Fungal Isolates
Sample 1	<i>Aspergillus niger, Penicillium notatum</i>
Sample 2	<i>Aspergillus niger, Aspergillus flavus</i>
Sample 3	<i>Penicillium notatum, Aspergillus niger</i>
Sample 4	<i>Fusarium oxysporum, Penicillium notatum</i>
Sample 5	<i>Aspergillus flavus, Aspergillus niger, Saccharomyces cerevisiae</i>

Table 6: Frequency of Occurrence of Bacteria Isolates Associated with Tomatoes Samples from Gada-Biu Market

Bacteria Isolates	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Frequency	Percentage
<i>Klebsiella aerogenes</i>	10	20	-	-	-	30	24.19
<i>Bacillus subtilis</i>	25	3	4	8	12	52	41.93
<i>Aeromonas hydrophila</i>	5	5	4	10	6	30	24.19
<i>Pseudomonas aeruginosa</i>	-	-	5	-	2	7	5.64
<i>Staphylococcus aureus</i>	-	-	5	-	-	5	4.03
Total	40	28	18	18	20	124	100

Table 7: Frequency of Occurrence of Fungi Isolates Associated with Tomatoes Samples from Gada-Biu Market

Fungi Isolates	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Frequency	Percentage
<i>Aspergillus flavus</i>	2	20	-	-	11	33	25
<i>Aspergillus niger</i>	15	10	15	-	9	49	37.12
<i>Penicillium notatum</i>	8	-	7	9	-	24	18.18
<i>Fusarium oxysporum</i>	-	-	-	20	-	20	15.15
<i>Saccharomyces cerevisiae</i>	-	-	-	-	6	6	4.55
Total	25	30	22	29	26	132	100

Discussion

The results on the assessment of bacteria and fungi responsible for the spoilage of tomatoes are described as follows. The microbial load of spoilt fresh tomatoes stored at ambient temperature is shown in Table 1. The result shows that tomato fruit samples from sample 5 show the highest bacteria count of 11.6×10^2 and sample 1 shows the lowest bacteria count of 7.5×10^2 cfu/ml, while the samples from sample 1 recorded the highest fungi count of 12.5×10^2 cfu/ml and sample 2 recorded the lowest fungi count of 8.3×10^2 cfu/ml. The result agreed with the work of Akinmusire (2011), who reported and concluded that fungus may be the major organism responsible for the spoilage of tomato fruits due to poor sanitation, overcrowding, poor storage, and unhygienic practises by the fruit handlers.

Table 2 shows the morphological and biochemical characterization of bacteria isolates.

The bacteria isolates identified from fresh spoilt tomatoes were: *Bacillus subtilis*, *Klebsiella aerogenes*, *Pseudomonas aeruginosa*, *Aeromonas hydrophila*, and *Staphylococcus aureus*. These isolated organisms agree with the work of Wogu and Ofuase (2014). The presence of these organisms in spoilt tomatoes is an indication that tomato fruits were exposed to faecal contaminated water or organic manure.

Table 3 shows the bacterial isolate of each sample.

The results on the macroscopic and microscopic identification of fungi isolates are shown in Table 4. The fungi isolated were *Aspergillus niger*, *Penicillium notatum*, *Aspergillus flavus*, *Fusarium oxysporum*, and *Saccharomyces cerevisiae*. Table 5 shows the fungal isolates of each tomato sample.

The frequency of occurrence of bacteria isolates associated with tomato samples is present in Table 6, which indicates that from all the tomato fruit samples obtained, 124 bacteria were isolated, of which *Bacillus subtilis* was the most prevalent with 41.93%, followed by *Klebsiella aerogenes* (24.19%), *Aeromonas hydrophila* (24.19%), *Pseudomonas aeruginosa* (5.64%) and *Staphylococcus aureus* (4.03%). The isolation of *Bacillus subtilis* from the fruit samples suggests evidence of opportunistic contamination from human activities.

In Table 7, shows the frequency of occurrence of fungi isolates associated with tomato samples; in the characterization of fungi, a total of 132 organisms were isolated, of which *Aspergillus niger* had the highest of 37.12%, *Aspergillus flavus* (25%), *Penicillium notatum* (18.18%), *Fusarium oxysporum* (15.15%), and *Saccharomyces cerevisiae* (4.55%). *Aspergillus niger* had the highest percentage occurrence of 37.12% in the spoilt tomato fruits examined, while *Saccharomyces cerevisiae* had the lowest percentage occurrence of 4.55% in the fruit examined.

The result is similar to the work of Akinmusire (2011) but with variation in the frequency of occurrence. They reported that *Aspergillus niger* had the highest rate of occurrence of 47.27% in the tomato fruits, while in this present study, *Aspergillus niger* had the highest rate of occurrence of 37.12%. This may be due to the variation in the market, poor practises or unhygienic practises by the fruit handlers. Wogu and Ofuase (2014) isolated *Aspergillus niger* (47.27%), *Aspergillus flavus* (30.1%), *Penicillium notatum* (15.3%), *Fusarium oxysporum* (12.73%) and *Saccharomyces cerevisiae* (3.64%), from spoilt tomato fruits, which is also similar to the organisms isolated from these present study, whereas, there is variation in the frequency of occurrence. These isolated fungi could probably be due to fungal spores usually found in the environment, their spores can be carried on air, and thus can infect exposed tomato fruits, as well as farm tools. The implication of microbial contamination and growth on tomato produce causes spoilage, decreased sensory appeal and decreased shelf life, leading to loss and wastage of product that have significant economic consequences. The prevalence frequency of occurrence of fungi was higher than that of bacteria as shown in table 6 and 7, which demands the appropriate control measures against infection should be employed. Adequate microbiological knowledge and handling practices of these produce would help minimise wastes due to deterioration.

It is therefore, important that both the farmers who harvest the fruits into bags for transportation, the marketers, and consumers take necessary precautions in prevention contamination and eating contaminated fruits. This will however, enhance reduction in the risk of microbial toxins that are deleterious to human health which are produced from these microorganism that have been isolated.

Conclusion and recommendation

Conclusion

This study showed that bacteria and fungi are associated with spoilage of tomato in Gada-biu market. . The result showed that tomato fruit samples from sample 5 had the highest bacteria count of 11.6×10^2 and sample 1 showed the lowest bacteria count of 7.5×10^2 cfu/ml, while the samples from sample 1 recorded the highest

fungi count of 12.5×10^2 cfu/ml and sample 2 recorded the lowest fungi count of 8.3×10^2 cfu/ml.

It was also revealed that mechanical injuries such as bruises or cuts that occur during harvesting, post-harvesting and packaging could provide infections sites for spoilage pathogens. These infections sites can therefore be greatly reduced and brought to a minimal by proper storage and handling of the vegetable. The major organisms associated with the spoilage of tomato fruits may be due to poor sanitation, poor packaging and storage, and unhygienic practises by the fruit handlers.

Recommendation

1. Tomatoes must be thoroughly washed with clean water and properly cooked before consumption.
2. Proper cleaning and sanitation of ware houses and disinfection of packaging containers.
3. Proper handling of the vegetable during harvest should be done to prevent bruises and scars or other mechanical injuries.
4. The environment in which the tomatoes are sold should also be kept clean since most of the bacteria isolated are associated with dirty environment.
5. Tomatoes farmers as well as other vegetable farmers should be advised to avoid the use of contaminated waste water for irrigation during cultivation as well as, using organic manure that contains animal or human fertilizer which are potential habitants for *Klebsiella aerogenes* and *Pseudomonas aeruginosa*.

References

Academics and Journal of Bioscience, 2(7), 459-466.

Agrios, G. (2005). Plant pathology, 5th Edition, Elsevier Academic press, Amsterdam, 26-27, 398-401.

Akinmusire, O. O. (2011). Fungal species associated with the spoilage of some Edible fruits in Maiduguri, Northern Eastern Nigeria. *Advances in Environmental Biology*. 5(1); 157-161.

Bello, O. B., Olawuyi, O. J., Azeez, A. H. Adebisi, O. So., & Owoade, T. A. (2016). Microorganisms causing post-harvest tomato fruit decay in Nigeria. *Scientia Agriculture*, 13(2), 93-96.

Beuchat, L. R. (2011). Pathogenic organisms associated with fresh produce. *Journal of Food protection*. 59,204-216.

Cheesbrough, M. (2007). Biochemical Tests to identify bacteria. In S. Davies, S. Hardly, E. Bridson & M. Tofiq (Eds), *District Laboratory Practice in Topical Countries* (2nd ed., pp, 62-70). New York: Cambridge University Press.

Mbajiuka, S. C., & Emmanuel, E. (2014). Isolation of Microorganisms associated with deterioration of tomato and paw-paw. *International Journal of Current Microbiology and Applied Sciences*, 3 (5), 501-512.

Obunukwu, G. N., Dike, K. S., & Nkwasi, G. E. (2018). Isolation and Identification of Microbial Deteriogens of Fresh Tomatoes and Ambient Temperature. *Microbial Research Journal International*. 26 (1), 1-8.

Sharma, R. (2016). Pathogenicity of *Aspergillus niger* in plants. *Cibtech Journal of Microbiology*; 1(1); 47-51.

Wogu, M. D., & Ofuase, O. (2014). Microorganisms responsible for the spoilage of tomato fruits, sold in markets in Benin City, Southern Nigeria. School of